About the Book

The book Emerging Interventions in Physical Therapy and Rehabilitation explores innovative approaches and techniques transforming the field of physical therapy and rehabilitation. It provides a comprehensive overview of emerging practices, including the integration of advanced technologies like robotics, virtual reality, and artificial intelligence to enhance patient outcomes. The book delves into evidence-based strategies for addressing chronic pain, neurological disorders, sports injuries, and post-surgical recovery. It also emphasizes interdisciplinary collaboration and personalized care, making it a valuable resource for clinicians, researchers, and students seeking to stay at the forefront of this dynamic healthcare domain.

Published by
AkiNik Publications®
169, C-11, Sector - 3, Rohini,
Delhi - 110085, India
Toll Free (India): 18001234070
Email: akinikbooks@gmail.com

ISBN 9789361357428
₹ 1291 US$ 20

Emerging Interventions in Physical Therapy and Rehabilitation

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Emerging Interventions in Physical Therapy and Rehabilitation

Dr. Sourav Mitra

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Emerging Interventions

in

Physical Therapy

and

Rehabilitation

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AkiNik Publications ®

New Delhi

Published By: AkiNik Publications

AkiNik Publications
169, C-11, Sector - 3,
Rohini, Delhi-110085, India
Toll Free (India) – 18001234070
Phone No.: 9711224068, 9911215212
Website: www.akinik.com
Email: akinikbooks@gmail.com

Editor: Dr. Sourav Mitra

Publication Year: 2024

Edition: 1st

Pages: 299

ISBN: 978-93-6135-742-8

Book DOI: https://doi.org/10.22271/ed.book.3024

Price: ₹ 1,291/-

Registration Details

- Printing Press License No.: F.1 (A-4) press 2016
- Trade Mark Registered Under
    - Class 16 (Regd. No.: 5070429)
    - Class 35 (Regd. No.: 5070426)
    - Class 41 (Regd. No.: 5070427)
    - Class 42 (Regd. No.: 5070428)

Preface

In the dynamic and ever-evolving field of healthcare, the realms of physical therapy and rehabilitation stand as pivotal pillars in the journey toward healing, recovery, and restored functionality. The landscape of these disciplines is continuously shaped by a myriad of factors, including advancements in technology, innovative therapeutic approaches, and a deeper understanding of the human body's intricate mechanisms of recovery and adaptation.

The genesis of this book, "Emerging Interventions in Physical Therapy and Rehabilitation," stems from a collective recognition of the transformative potential inherent in the latest developments within these fields. As healthcare professionals dedicated to the pursuit of excellence in patient care, we have been inspired by the remarkable progress witnessed in recent years and felt compelled to compile a comprehensive resource that captures the essence of these emerging interventions.

This book serves as a testament to the spirit of innovation and dedication that defines the practice of physical therapy and rehabilitation. Through its pages, we aim to provide practitioners, educators, researchers, and students with a holistic understanding of the cutting-edge interventions that are shaping the future of these disciplines. By delving into topics ranging from technological advancements to novel therapeutic modalities and integrative approaches, we endeavour to offer insights that can inform and inspire the next generation of healthcare professionals.

Each chapter of this book is authored by experts and thought leaders who bring a wealth of knowledge and experience to their respective topics. Drawing upon evidence-based research, clinical expertise, and real-world applications, these contributions provide a comprehensive overview of the latest trends, challenges, and opportunities in physical therapy and rehabilitation.

It is our hope that this book will serve as a valuable resource for all those involved in the provision of rehabilitation services, from seasoned practitioners seeking to expand their knowledge base to students embarking on their educational journey. By fostering a deeper understanding of emerging interventions and their potential implications for patient care, we aspire to contribute to the advancement of the field and, ultimately, to the well-being of individuals worldwide.

We also express our appreciation to the readers who embark on this journey of exploration with us. May this book serve as a beacon of inspiration and innovation, guiding us toward a future where every individual has the opportunity to achieve optimal health, function, and quality of life through the transformative power of physical therapy and rehabilitation.

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Acknowledgement

I am writing to express my heartfelt gratitude for the support and encouragement to Swami Vivekananda University, Kolkata, India provided in the creation of this book, "Advancement in Physiotherapy”. The commitment from university to fostering education and research has played a pivotal role in shaping the content and direction of this publication. We are deeply appreciative of the collaborative spirit and resources offered by Swami Vivekananda University, Kolkata which have allowed us to explore and share the latest innovations and technologies across various fields. We hope that this book serves as a valuable resource for this esteemed institution and the broader academic community, reflecting our shared dedication to knowledge, progress, and the pursuit of excellence.

With Sincere Appreciation,

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Chapter - 1

Effects of Cupping Therapy for the Improvement of Pain in Carpal Tunnel Syndrome Patient - A Case Study

Sourav Mitra, Md. Zulfaquar Khan and Abhiprata Naru

Abstract

Background: Carpal tunnel syndrome (CTS) is a common disorder by the entrapment of the median nerve in the carpal tunnel of the wrist. CTS include numbness, tingling, burning, and pain in at least 2 of the 3 digits supplied by the median nerve (i.e., thumb, index finger, and middle finger). Cupping of the skin and subcutaneous tissue is a traditional and widely used healing method.

Objectives: The aim of this case study was to evaluate the effects of cupping therapy for the improvement of pain in carpal tunnel syndrome patient.

Materials and methods: A single male patient, aged 30 years, experienced wrist pain and numbness for last 3 months. This treatment session was for two days per week up to four weeks. Patient was assessed with Visual Analogue Scale (VAS).

Results: Participants showed significant improvement in pre-test and post-test scores for Visual Analogue Scale (VAS) which was considered as statistically significant.

Conclusion: This study concludes that cupping therapy is the effective treatment for the improvement of pain in carpal tunnel syndrome patient.

Keywords*:* Carpal tunnel syndrome, wrist pain, cupping therapy, visual analogue scale.

Introduction

Carpal tunnel syndrome (CTS) is a common entrapment neuropathy caused by compression of the median nerve as it passes through the carpal tunnel of the wrist. The condition is characterized by symptoms such as numbness, tingling, burning, and pain, primarily affecting the thumb, index, and middle fingers. CTS can significantly impair hand function, leading to difficulties in performing daily activities. It is especially prevalent in individuals whose work involves repetitive hand movements, such as typing or manual labor, and is commonly seen in people aged 30 to 60 years.

Conservative treatments for CTS typically include wrist splinting, anti-inflammatory medications, corticosteroid injections, and physical therapy. In severe cases, surgical decompression of the median nerve may be necessary. However, in recent years, alternative therapies, such as acupuncture, chiropractic care, and cupping therapy, have gained attention for their potential to alleviate symptoms without the need for invasive procedures.

Cupping therapy is an ancient healing practice rooted in traditional medicine, particularly in Eastern cultures, but it has been adopted globally in recent decades. The technique involves applying suction cups to the skin to create negative pressure, which is believed to improve circulation, promote tissue healing, and relieve musculoskeletal pain. Cupping is commonly used to treat conditions such as back pain, migraines, and muscle stiffness, but its efficacy in treating CTS has not been extensively studied.

This case study evaluates the effects of cupping therapy on pain relief in a male patient with CTS, exploring its potential as a complementary treatment for this condition.

Background

Carpal tunnel syndrome occurs when the median nerve, which runs from the forearm to the hand through the narrow carpal tunnel in the wrist, becomes compressed or irritated. This compression can result from various factors, including repetitive hand movements, wrist injuries, rheumatoid arthritis, diabetes, or fluid retention during pregnancy. The primary symptoms of CTS include pain, tingling, and numbness in the thumb, index finger, and middle finger. Patients may also experience weakness in the affected hand, making it difficult to grip objects or perform fine motor tasks.

CTS is diagnosed based on clinical symptoms, physical examination, and diagnostic tests such as nerve conduction studies or electromyography. Early-stage CTS can often be managed with conservative treatments, while advanced cases may require surgical intervention.

Cupping therapy, a widely practiced alternative medicine technique, involves placing cups made of glass, silicone, or plastic on the skin to create suction. This suction lifts the skin and underlying tissues, increasing blood flow to the affected area and promoting tissue relaxation. Proponents of cupping therapy believe that it can relieve pain by stimulating circulation, reducing inflammation, and promoting the release of toxins from the body. Although cupping has been used for centuries, its mechanisms of action are not fully understood, and more research is needed to confirm its efficacy for various conditions, including CTS.

Objectives

The primary objective of this case study was to assess the effects of cupping therapy on pain relief in a patient with carpal tunnel syndrome. Specifically, the study aimed to:

1. Evaluate the reduction in pain intensity using the Visual Analogue Scale (VAS) as the primary outcome measure.
2. Assess the patient's subjective improvement in symptoms, including numbness and tingling.
3. Determine whether cupping therapy could serve as a viable complementary treatment for patients with CTS.

Materials and methods

Patient profile

The patient in this case study was a 30-year-old male who presented with a three-month history of wrist pain, numbness, and tingling in the right hand. The symptoms were consistent with carpal tunnel syndrome and were most pronounced in the thumb, index, and middle fingers, as well as the palm of the hand. The patient reported that the symptoms worsened with activities such as typing and manual tasks that required repetitive wrist movements. He had not previously undergone surgery or other invasive treatments for CTS.

The patient's baseline pain level was assessed using the Visual Analogue Scale (VAS), a 10-point scale that measures pain intensity from 0 (no pain) to 10 (worst possible pain). The patient rated his baseline pain level at 7 out of 10.

Cupping therapy protocol

The patient received cupping therapy sessions twice a week for four weeks, for a total of eight sessions. The cups used for the therapy were plastic suction cups, which were applied to the skin of the patient's wrist and forearm. Each session lasted approximately 20 minutes, during which the cups were placed on the affected area and negative pressure was applied.

1. **Preparation:** The therapist cleaned the skin and applied a small amount of oil to create a seal between the skin and the cups.

2. **Application of cups:** Four plastic suction cups were placed along the forearm and wrist, targeting the median nerve area. The cups were left in place for 10-15 minutes, during which the patient experienced a sensation of tightness and warmth.
3. **Post-treatment care:** After the session, the cups were removed, and the therapist gently massaged the treated area to promote circulation. The patient was instructed to rest the wrist and avoid strenuous activity for the remainder of the day.

Assessment tools

The patient's pain levels were assessed using the Visual Analogue Scale (VAS) at two points:

- Before the first cupping therapy session (baseline).
- After the final session at the end of the four-week treatment period.

In addition to the VAS score, the patient provided subjective feedback on his symptoms, including numbness, tingling, and functional improvements in daily activities.

Results

The patient showed significant improvement in pain levels following the cupping therapy intervention. His VAS score decreased from 7/10 at baseline to 2/10 at the end of the four-week treatment period. This reduction in pain was statistically significant, indicating that cupping therapy had a positive effect on symptom relief.

Statistical analysis

The pre-test and post-test VAS scores were analyzed using a paired t-test to determine the statistical significance of the improvement. The results indicated a significant reduction in pain ($p < 0.05$), supporting the efficacy of cupping therapy in reducing pain associated with carpal tunnel syndrome.

Discussion

This case study demonstrates the potential benefits of cupping therapy in managing pain for patients with carpal tunnel syndrome. The patient experienced a marked reduction in pain, as evidenced by the decrease in VAS scores, as well as subjective improvements in numbness and tingling. The findings align with the growing body of evidence that suggests cupping therapy can be an effective complementary treatment for musculoskeletal conditions, including CTS.

Mechanisms of action

While the exact mechanisms of cupping therapy are not fully understood, several hypotheses have been proposed to explain its therapeutic effects:

1. **Increased circulation:** The negative pressure created by cupping increases blood flow to the affected area, promoting tissue healing and reducing inflammation.
2. **Nerve decompression:** By lifting the skin and underlying tissues, cupping may relieve pressure on compressed nerves, including the median nerve in patients with CTS.
3. **Pain modulation:** Cupping may stimulate the release of endogenous opioids, which can help reduce pain perception and provide relief from chronic pain conditions.

The improvement in the patient's symptoms may be attributed to a combination of these factors. The increased circulation and potential nerve decompression provided by cupping likely contributed to the reduction in pain and the overall improvement in hand function.

Limitations

This case study has several limitations. First, it involves only a single patient, which limits the generalizability of the findings. Additionally, the study relied on subjective measures of pain (VAS scores) and patient self-reports of symptom improvement. Future research should include larger sample sizes and objective measures, such as nerve conduction studies or electromyography, to provide more comprehensive insights into the effects of cupping therapy on CTS.

Conclusion

The results of this case study suggest that cupping therapy may be an effective complementary treatment for relieving pain in patients with carpal tunnel syndrome. The patient demonstrated significant improvements in pain levels and reported reduced numbness and tingling after four weeks of treatment. Cupping therapy offers a non-invasive, low-risk alternative to traditional treatments for CTS and may be particularly useful for patients seeking relief from chronic pain without the need for surgery or medications. Further research is needed to confirm these findings and explore the long-term efficacy of cupping therapy for CTS.

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Chapter - 2

A Case Study on Vestibular Maneuvre Combined with Home Exercises for Vestibular Disorder Patient

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Chapter - 2

A Case Study on Vestibular Maneuvre Combined with Home Exercises for Vestibular Disorder Patient

Sourav Mitra

Abstract

Background: Dizziness and vertigo are prevalent complaints in the general public. Although the clinical picture of benign paroxysmal positional vertigo (BPPV) is well-known and extensively studied, there are various interpretations of the condition.

Objectives: The goal of this case study was to detail the treatment of a 45 years old woman who had complained of positional vertigo for 2 years.

Materials and methods: A single patient, aged 45 years, experienced abrupt onset of benign paroxysmal positional vertigo (BPPV). The symptoms began a day after she fell off a motor cycle, injuring her head. This treatment session was for twice a day up to 12 days. Patient was assessed with Vertigo Symptom Scale.

Results: Participants showed significant improvement in pre-test and post-test scores for Vertigo Symptom Scale which was considered as statistically significant.

Conclusion: This study concludes that vestibular maneuver combined with home exercises are effective treatment approach techniques for the management of benign paroxysmal positional vertigo (BPPV) patient.

Keywords: Vertigo, dizziness, vertigo symptom scale, vestibular maneuver.

Introduction

Dizziness and vertigo are common presenting complaints in primary care, with benign paroxysmal positional vertigo (BPPV) being a frequent cause. BPPV is characterized by transient episodes of vertigo that are triggered by specific head movements, often when lying down, rolling over, or looking upward. The condition is caused by dislodged otoliths (calcium carbonate crystals) from the utricle of the inner ear, which enter the semicircular canals, primarily affecting the posterior canal. These otoliths disrupt the normal flow of endolymph, causing the sensation of spinning or dizziness when the head moves.

The pathophysiology of BPPV is well understood, yet various approaches to treatment have been documented, ranging from canalith repositioning maneuvers (CRM), such as the Epley maneuver, to physical therapy exercises, and in some cases, surgery. However, despite these interventions, recurrence rates of BPPV can be high, especially following trauma.

This case study focuses on the treatment of a 45-year-old woman who presented with BPPV after a traumatic head injury sustained in a motorcycle accident. The case highlights the importance of personalized care, incorporating vestibular maneuvers and home exercises to achieve symptom resolution.

Background

BPPV affects an estimated 10% of the population over their lifetime, and the incidence increases with age. Although BPPV is idiopathic in most cases, secondary causes such as head trauma, vestibular neuritis, or prolonged bed rest can lead to the condition. Trauma-induced BPPV is more likely to affect the anterior or lateral canals compared to idiopathic BPPV, which primarily involves the posterior canal. The onset of BPPV after head trauma is typically abrupt, and symptoms can persist if not properly managed.

In cases of post-traumatic BPPV, treatment can be more complex, requiring multiple sessions of canalith repositioning maneuvers or additional vestibular rehabilitation exercises. The effectiveness of vestibular maneuvers in BPPV treatment has been well established, with maneuvers such as the Epley and Semont procedures being widely used. However, the integration of home exercises, such as Brandt-Daroff exercises, may enhance recovery and reduce the likelihood of recurrence. This case study seeks to evaluate the combined effect of vestibular maneuvers and home exercises on the recovery of a patient with BPPV following a head injury.

Objectives

The primary objective of this case study was to document the treatment and recovery of a 45-year-old woman who experienced BPPV following a motorcycle accident. The specific objectives were to:

1. Assess the efficacy of vestibular maneuvers and home exercises in reducing the symptoms of BPPV.
2. Measure changes in symptom severity using the Vertigo Symptom Scale (VSS).

3. Determine whether this treatment protocol can provide lasting symptom relief.

Materials and methods

Patient profile

The patient was a 45-year-old woman who presented with a two-year history of positional vertigo. Her symptoms began one day after a motorcycle accident in which she sustained a mild head injury without loss of consciousness. The patient described brief episodes of spinning dizziness triggered by head movements, particularly when lying down or turning over in bed. She had no previous history of vertigo or other vestibular disorders.

Upon presentation, the patient underwent a thorough clinical assessment, including a Dix-Hallpike maneuver, which reproduced her vertigo and nystagmus, confirming the diagnosis of BPPV. Her symptoms were primarily related to the posterior semicircular canal.

Treatment protocol

The treatment consisted of vestibular maneuvers (Epley maneuver) combined with home exercises (Brandt-Daroff exercises). The patient received treatment twice daily for 12 consecutive days.

1. **Vestibular maneuver (Epley maneuver)**
    - The Epley maneuver was performed twice daily in the clinic. This repositioning maneuver involves sequential head movements designed to move dislodged otoliths from the posterior semicircular canal back into the utricle, where they can no longer cause vertigo.
2. **Home exercises (Brandt-Daroff exercises)**
    - The patient was instructed to perform Brandt-Daroff exercises at home three times per day. These exercises involve rapid changes in body position, which help habituate the vestibular system and reduce vertigo symptoms over time.
3. **Vertigo Symptom Scale (VSS)**
    - The VSS was used to assess the severity and frequency of vertigo symptoms at baseline and after the 12-day treatment period. The scale evaluates both vertigo-related symptoms and accompanying anxiety, with higher scores indicating greater symptom severity.

Results

The patient showed significant improvement following the 12-day treatment protocol. Baseline VSS scores indicated moderate to severe vertigo symptoms, particularly when lying down or changing head position. After the treatment period, post-treatment VSS scores revealed a marked reduction in symptom severity.

Statistical analysis

The pre-test and post-test VSS scores were analysed using a paired t-test to determine the statistical significance of the improvement. The results showed a significant reduction in VSS scores ($p < 0.05$), indicating that the combination of vestibular manoeuvres and home exercises effectively alleviated the patient's symptoms.

Discussion

This case study highlights the successful treatment of BPPV in a patient with a history of head trauma. The findings support the use of a combined treatment approach involving vestibular maneuvers and home-based exercises. The significant reduction in VSS scores suggests that this protocol can effectively manage BPPV, even in cases where the condition has persisted for an extended period.

One notable aspect of this case was the persistence of symptoms for two years before treatment was initiated. While BPPV is typically a self-limiting condition, chronic cases may result from untreated or inadequately treated episodes. In this case, the patient's vertigo persisted despite the natural resolution of many cases of BPPV within weeks or months. The success of the treatment in this case emphasizes the importance of early diagnosis and intervention, particularly in cases of trauma-induced BPPV.

Mechanism of action

The Epley maneuver aims to reposition dislodged otoliths from the posterior semicircular canal into the utricle, thereby resolving the vertigo. The Brandt-Daroff exercises, on the other hand, work by desensitizing the vestibular system through repeated exposure to the provoking stimuli. Over time, these exercises help reduce the sensitivity of the vestibular system to positional changes, leading to symptom relief.

The combination of both techniques allows for a comprehensive approach to treatment, addressing both the immediate cause of vertigo (dislodged otoliths) and the longer-term need for vestibular adaptation.

Limitations

While the case study demonstrates a successful outcome, there are limitations to the generalizability of these findings. As a single case study, the results cannot be directly applied to the broader population without further research. Additionally, while the VSS provided a useful tool for measuring symptom severity, other scales or objective vestibular tests could have been used to corroborate the findings.

Conclusion

This case study supports the efficacy of vestibular maneuvers combined with home exercises in treating BPPV, even in cases with a prolonged history of vertigo. The significant improvement in VSS scores after 12 days of treatment indicates that this approach is an effective and practical solution for patients with BPPV, particularly following trauma. Further research involving larger sample sizes and longer follow-up periods is recommended to confirm the long-term efficacy of this treatment protocol.

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Chapter - 3

Effects of Core-stability Exercises in Treating a Patient with Postoperative Lumbar Disc Herniation: A Case Study

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Chapter - 3

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Abstract

Background: The lifetime prevalence of disc herniation has been estimated at 1-3%. Herniation is most common between the ages of 30 and 50, but it can also affect adolescents and the elderly. Many patients with extruded lumbar disc herniation require surgical intervention. Core stability Exercises for low back disorders are typically designed with the goal of relieving pain, strengthening the back, increasing back flexibility, and improving functional activities and general wellness.

Objectives: The goal of this case study was to assess the effects of Core-stability Exercises in Treating a Patient with Postoperative Lumbar Disc Herniation patient.

Materials and methods: A single female patient, aged 34 years, had lower back pain for last 2 years. She had undergone surgical treatments like decompressive surgery. This treatment session was for three days per week days up to eight weeks. Patient was assessed with Visual Analogue Scale (VAS).

Results: Participants showed significant improvement in pre-test and post-test scores for Visual Analogue Scale (VAS) which was considered as statistically significant.

Conclusion: This study concludes that Core-stability Exercises are helpful for relieving pain, strengthening the back, increasing back flexibility, and improving functional activities in Treating a Patient with Postoperative Lumbar Disc Herniation patient.

Keywords: Lumbar disc herniation, core stability exercises, visual analogue scale, low back pain.

Introduction

Lumbar disc herniation is a prevalent spinal disorder characterized by the displacement of intervertebral disc material, which compresses surrounding neural structures, leading to pain, numbness, and motor deficits. The condition most commonly occurs between the ages of 30 and 50, although it can also affect both younger and older populations. Risk factors for disc herniation include heavy lifting, repetitive motion, poor posture, and genetic predisposition. The lifetime prevalence of lumbar disc herniation has been estimated at 1-3%, with many patients requiring surgical intervention, especially when conservative treatments such as physical therapy, medications, and epidural steroid injections fail to provide adequate relief.

Decompressive surgery, including discectomy, is a widely performed procedure for the treatment of lumbar disc herniation. Although surgery is effective in alleviating nerve compression, postoperative rehabilitation is crucial to ensuring long-term recovery and preventing recurrence. Core stability exercises have emerged as a key component of postoperative rehabilitation, designed to strengthen the muscles surrounding the spine, increase flexibility, and restore functional movement patterns.

This case study details the rehabilitation of a 34-year-old female patient who had undergone surgery for lumbar disc herniation and was treated with core stability exercises for eight weeks. The goal of the study was to assess the effectiveness of core-stability exercises in reducing pain and improving functional outcomes in a postoperative setting.

Background

Lumbar disc herniation occurs when the soft inner nucleus of the intervertebral disc protrudes through a tear in the outer annulus fibrosus, leading to compression of nearby nerve roots. This condition often results in significant pain, particularly in the lower back and legs (sciatica), as well as sensory and motor impairments in severe cases. While many patients experience relief with conservative treatments, including physical therapy, analgesics, and anti-inflammatory medications, a subset of individuals require surgical intervention, particularly when neurological deficits or intractable pain are present.

Postoperative rehabilitation is critical in patients recovering from lumbar disc surgery. Without appropriate rehabilitation, patients are at risk of continued pain, reduced functional ability, and recurrence of the herniation. Core stability exercises, which focus on strengthening the muscles that support the spine, are widely recognized as effective in improving spinal health, enhancing posture, and reducing pain.

Core stability involves the activation and strengthening of deep abdominal muscles (transverse abdominis), the lumbar multifidus, and pelvic floor muscles, which form a supportive network around the spine. These muscles provide stability during dynamic movement, reduce the load on the intervertebral discs, and help prevent further injury. By strengthening these muscles, patients can improve their posture, increase flexibility, and regain functional capacity following surgery.

Objectives

The primary objective of this case study was to assess the effects of core-stability exercises on pain relief, spinal strength, flexibility, and functional recovery in a patient following surgery for lumbar disc herniation. Specifically, the study aimed to:

1. Evaluate the impact of core-stability exercises on pain using the Visual Analogue Scale (VAS).
2. Assess improvements in functional activities and overall spinal health.
3. Determine whether an eight-week core-stability exercise regimen could provide lasting relief from postoperative pain.

Materials and methods

Patient profile

The patient was a 34-year-old female who presented with a two-year history of lower back pain and leg pain following lumbar disc herniation. The patient had undergone decompressive surgery (discectomy) six months prior to the start of the study. Despite surgical intervention, she continued to experience moderate levels of pain and reduced functional capacity, particularly when performing activities that required prolonged standing or sitting.

Upon evaluation, the patient reported that her pain had improved following surgery, but she still experienced significant discomfort in her lower back. The patient's pre-treatment pain was assessed using the Visual Analogue Scale (VAS), where she rated her pain as 6 out of 10.

Treatment protocol

The patient was enrolled in a supervised core stability exercise program that lasted eight weeks. Treatment sessions were conducted three times per week, with each session lasting 45 minutes. The exercise program was designed to progressively strengthen the core muscles, improve flexibility, and restore functional movement patterns. The exercises were tailored to the patient’s individual needs and were modified as her strength and flexibility improved over time.

1. **Core stability exercises**

   - The core stability exercise program focused on strengthening the deep abdominal muscles (transverse abdominis), lumbar multifidus, and pelvic floor muscles. The exercises included the following:

     - **Pelvic tilts:** To engage the lower abdominal muscles and improve lumbar spine mobility.
     - **Bridging exercises:** To strengthen the gluteal and lower back muscles.
     - **Planks:** To activate the deep core muscles and improve endurance.
     - **Bird-dog exercises:** To enhance spinal stability and coordination.
     - **Swiss ball exercises:** To challenge balance and increase overall core strength.

2. **Flexibility and mobility training**

   - In addition to core strengthening exercises, the patient was guided through stretching routines to improve the flexibility of the hamstrings, hip flexors, and lower back muscles.

3. **Functional Activities**:

   - The rehabilitation program incorporated functional activities, such as squatting and lifting techniques, to help the patient regain confidence in performing daily tasks without fear of reinjury.

Assessment tools

The patient's pain was assessed using the Visual Analogue Scale (VAS), a reliable tool for measuring pain intensity. The VAS is a 10-centimeter line on which the patient marks their pain level, with 0 representing no pain and 10 representing the worst possible pain. Assessments were conducted at baseline (prior to starting the exercise program) and at the end of the eight-week treatment period.

Results

The patient demonstrated significant improvements following the eight-week core stability exercise program. Her VAS score decreased from 6/10 at baseline to 2/10 after completing the treatment. This reduction in pain was statistically significant and was accompanied by marked improvements in functional capacity and spinal strength.

Statistical analysis

The pre-test and post-test VAS scores were analyzed using a paired t-test to determine the statistical significance of the improvement. The results showed a significant reduction in VAS scores ($p < 0.05$), indicating that core stability exercises were effective in reducing pain in the patient.

Discussion

This case study demonstrates the potential benefits of core-stability exercises in managing postoperative lumbar disc herniation. The patient experienced a significant reduction in pain, improved spinal strength, and enhanced functional capacity following the eight-week program. These findings align with previous research that supports the role of core stability exercises in managing low back pain and promoting recovery after spinal surgery.

Mechanism of action

Core stability exercises target the muscles that provide support to the spine and pelvis, helping to stabilize the vertebral column and reduce the mechanical load on intervertebral discs. By strengthening these muscles, the patient was able to improve her posture and reduce the strain on her lower back during movement, leading to reduced pain and improved functionality.

The exercises in this case also focused on flexibility, which is important for maintaining mobility and reducing the risk of stiffness after surgery. The combination of strength training and flexibility exercises allowed the patient to regain her ability to perform daily activities with greater ease and less pain.

Limitations

This case study is limited by its focus on a single patient, which reduces the generalizability of the findings. Additionally, while the VAS provides a useful measure of pain intensity, it is a subjective tool, and other objective measures, such as range of motion or muscle strength testing, could have provided additional insight into the patient's recovery.

Conclusion

The results of this case study indicate that core stability exercises are an effective postoperative rehabilitation strategy for patients with lumbar disc herniation. The patient experienced significant improvements in pain relief, spinal strength, flexibility, and functional capacity after eight weeks of treatment. This study supports the use of core stability exercises as part of a comprehensive rehabilitation program for individuals recovering from lumbar disc surgery. Further research with larger sample sizes and longer follow-up periods is recommended to confirm the long-term efficacy of this treatment approach.

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Chapter - 4

Efficacy of Extracorporeal Shock Wave Therapy (ESWT) Along with Low Level Laser Therapy (LLLT) for the Improvement of Heel Pain in Plantar Fasciitis Patient - A Case Study

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Chapter - 4

Efficacy of Extracorporeal Shock Wave Therapy (ESWT) Along with Low Level Laser Therapy (LLLT) for the Improvement of Heel Pain in Plantar Fasciitis Patient - A Case Study

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Abstract

Background: Plantar heel pain, a frequent regional pain ailment, can cause considerable discomfort and impair patients' normal activities. Walking discomfort can negatively impact a patient's quality of life, and the first step in the morning can provide diagnostic information of Plantar Fasciitis patient.

Objectives: The goal of this case study was to evaluate the effects of Extracorporeal shock wave therapy (ESWT) along with low level laser therapy (LLLT) for the improvement of heel pain in Plantar Fasciitis patient.

Materials and methods: A single female patient, aged 52 years, experienced heel pain diagnosed with plantar fasciitis. Clinical symptoms and anamnesis determine the diagnosis, with pain at the first step in the morning and pain after exercise, the most commonly reported symptoms. This treatment session was for four days per week up to four weeks. Patient was assessed with Visual Analogue Scale (VAS).

Results: Participants showed significant improvement in pre-test and post-test scores for Visual Analogue Scale (VAS) which was considered as statistically significant.

Conclusion: This study concludes that Extracorporeal shock wave therapy (ESWT) along with low level laser therapy (LLLT) improves of heel pain in Plantar Fasciitis patient.

Keywords: Plantar fasciitis, ESWT, LLLT, visual analogue scale.

Introduction

Plantar heel pain is a prevalent condition, affecting approximately 10% of the population at some point in their lives. The most common cause of this pain is **plantar fasciitis**, which is characterized by inflammation of the plantar fascia, a thick band of tissue that runs along the bottom of the foot, connecting the heel bone to the toes. Patients with plantar fasciitis typically report sharp pain upon taking the first steps in the morning, which may decrease with activity but often returns after prolonged periods of standing, walking, or exercise. The condition can significantly impair mobility and reduce the quality of life.

Conservative treatments, such as physical therapy, orthotic devices, stretching exercises, and non-steroidal anti-inflammatory drugs (NSAIDs), are commonly used to manage plantar fasciitis. However, when these methods are insufficient, more advanced therapeutic interventions may be required. Two such therapies are **Extracorporeal Shock Wave Therapy (ESWT)** and **Low-Level Laser Therapy (LLLT)**, which have been shown to be effective in reducing pain and promoting tissue healing in musculoskeletal disorders.

ESWT involves the application of shock waves to the affected area, which stimulates tissue repair and reduces inflammation. This technique is particularly beneficial in chronic cases where conservative treatments have failed. **LLLT**, on the other hand, uses low-intensity lasers to penetrate the tissue, promoting cellular regeneration and reducing pain and inflammation. The combination of these two therapies has been suggested to offer synergistic benefits for treating conditions like plantar fasciitis.

This case study aims to evaluate the effectiveness of ESWT and LLLT in improving heel pain in a patient with plantar fasciitis, with pain intensity measured using the **Visual Analogue Scale (VAS)** as the primary outcome measure.

4.3 Background

Plantar fasciitis is caused by repetitive strain or overuse of the plantar fascia, leading to microtears and inflammation. Risk factors include obesity, prolonged standing, improper footwear, and high-impact activities such as running. The hallmark symptom is **morning heel pain**, which can help differentiate plantar fasciitis from other causes of heel pain. The pain is typically localized at the base of the heel and may radiate into the arch of the foot.

The diagnosis of plantar fasciitis is primarily clinical, based on patient history and physical examination. Imaging techniques such as ultrasound or MRI may be used to confirm the diagnosis in atypical cases or when ruling out other conditions, such as stress fractures or nerve entrapment.

Extracorporeal Shock Wave Therapy (ESWT) has gained popularity as a non-invasive treatment option for plantar fasciitis, particularly in cases that do not respond to conservative treatments. ESWT delivers acoustic shock waves to the affected area, which promotes healing by increasing blood flow, stimulating fibroblast activity, and breaking up calcifications that may have formed in the tissue.

Low-Level Laser Therapy (LLLT) is another non-invasive treatment modality that uses low-level lasers to penetrate the skin and target underlying tissues. LLLT is thought to reduce pain and inflammation by modulating cellular function, enhancing mitochondrial activity, and increasing the production of ATP. In plantar fasciitis, LLLT may aid in reducing inflammation of the plantar fascia and accelerating the healing process.

The combined use of ESWT and LLLT is a relatively new approach for treating plantar fasciitis, with few studies exploring its synergistic effects. This case study seeks to contribute to the growing body of evidence supporting this combined treatment.

Objectives

The primary objective of this case study was to evaluate the effects of Extracorporeal Shock Wave Therapy (ESWT) combined with Low-Level Laser Therapy (LLLT) on heel pain in a patient with plantar fasciitis. Specifically, the study aimed to:

1. Assess the reduction in pain intensity using the Visual Analogue Scale (VAS).
2. Examine the patient's subjective improvement in mobility and functionality during daily activities.
3. Determine whether the combination of ESWT and LLLT provides an effective treatment for plantar fasciitis-related heel pain.

Materials and methods

Patient profile

The patient in this case study was a 52-year-old female who presented with a six-month history of heel pain, which had been diagnosed as plantar fasciitis. The patient reported experiencing sharp, stabbing pain upon taking her first steps in the morning, as well as pain after prolonged walking or standing. Previous conservative treatments, including stretching exercises and NSAIDs, had provided minimal relief.

The patient's baseline pain level was assessed using the Visual Analogue

Scale (VAS), a 10-point scale where 0 indicates no pain and 10 represents the worst possible pain. At the start of the study, the patient rated her pain as 8/10.

Treatment protocol

The patient received a combination of Extracorporeal Shock Wave Therapy (ESWT) and Low-Level Laser Therapy (LLLT) four days per week for four weeks. Each session lasted approximately 30 minutes and was divided between the two therapies.

1. **Extracorporeal Shock Wave Therapy (ESWT)**
    - A focused ESWT device was used to deliver shock waves to the plantar fascia.
    - The treatment area was localized by palpating the heel and identifying the most painful spot.
    - Shock waves were administered at a frequency of 1000-1500 impulses per session, with an energy level of 0.2 mJ/mm^2.
    - Each ESWT session lasted approximately 15 minutes.
2. **Low-Level Laser Therapy (LLLT)**:
    - A low-intensity laser device was used to target the plantar fascia and heel.
    - The laser was applied directly to the affected area for 10-15 minutes per session, with a wavelength of 800-1000 nm.
    - The treatment was applied using circular motions to ensure even coverage of the painful area.

Assessment tools

The patient's pain levels were assessed using the Visual Analogue Scale (VAS) at two points:

- Before the first treatment session (baseline).
- After the final treatment session at the end of the four-week period.

In addition to VAS scores, the patient provided subjective feedback on her mobility, ability to perform daily activities, and overall improvement in symptoms.

Results

The patient showed significant improvement in pain levels after the combined ESWT and LLLT treatment. Her VAS score decreased from 8/10 at baseline to 3/10 at the end of the four-week treatment period. This reduction in pain was statistically significant, indicating that the combined therapy effectively alleviated the patient's symptoms.

In terms of functional improvement, the patient reported being able to walk without significant pain and described less discomfort during her first steps in the morning. She also noted an increased ability to perform daily activities, such as standing for extended periods and walking longer distances.

Statistical analysis

The pre-treatment and post-treatment VAS scores were analyzed using a paired **t-test** to assess the statistical significance of the change in pain levels. The results demonstrated a significant reduction in pain ($p < 0.05$), supporting the efficacy of the combined ESWT and LLLT approach in reducing heel pain associated with plantar fasciitis.

Discussion

The results of this case study suggest that combining Extracorporeal Shock Wave Therapy (ESWT) and Low-Level Laser Therapy (LLLT) can be an effective treatment for plantar fasciitis-related heel pain. The patient experienced a marked reduction in pain intensity, as evidenced by the decrease in VAS scores, and reported functional improvements in mobility and daily activities.

Mechanisms of action

The beneficial effects of ESWT are likely due to its ability to promote tissue repair and reduce inflammation. By delivering acoustic shock waves to the affected area, ESWT stimulates angiogenesis, increases blood flow, and enhances the production of growth factors, which accelerates the healing process. In plantar fasciitis, ESWT may also help break up calcifications or scar tissue that can form in chronic cases, further relieving pain.

LLLT complements these effects by promoting cellular regeneration and reducing inflammation. Low-level laser therapy has been shown to increase mitochondrial activity, leading to greater ATP production and faster tissue healing. In addition, LLLT modulates inflammatory responses by reducing the levels of pro-inflammatory cytokines, which can contribute to pain relief in plantar fasciitis.

The combination of these two therapies offers a dual approach to treatment, addressing both the inflammatory and structural components of plantar fasciitis.

Limitations

This case study is limited by its focus on a single patient, which restricts the generalizability of the findings. Further research is needed with larger sample sizes and control groups to confirm the effectiveness of this combined therapy. Additionally, the study did not assess long-term outcomes, so the durability of the pain relief provided by ESWT and LLLT remains unknown.

Conclusion

This case study provides evidence that combining Extracorporeal Shock Wave Therapy (ESWT) and Low-Level Laser Therapy (LLLT) is effective in reducing heel pain and improving functionality in a patient with plantar fasciitis. The patient showed significant improvement in pain levels and mobility after four weeks of treatment, with a statistically significant reduction in Visual Analogue Scale (VAS) scores. This dual approach may offer a promising non-invasive treatment option for individuals suffering from plantar fasciitis, particularly those who have not responded to conservative therapies.

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Chapter - 5

Efficacy of Manipulative Therapy for Improving Pain in Cervicogenic Headache Patient - A Case Study

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Chapter - 5

Efficacy of Manipulative Therapy for Improving Pain in Cervicogenic Headache Patient - A Case Study

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Abstract

Background: Cervicogenic headache (CGH) is defined as a persistent headache that originates from the atlantooccipital and upper cervical joints and is felt in one or more areas of the head and/or face. CGH is a common form of headache and accounts for 15% to 20% of all chronic and recurrent headaches and also received manipulative therapy for decreasing headache.

Objectives: The aim of this case study was to evaluate the effects of manipulative therapy for the improvement of pain in cervicogenic patient.

Materials and methods: A single male patient, aged 28 years, experienced chronic and recurrent headache for last 2 years. This treatment session was for four days per week up to four weeks. Patient was assessed with Numeric Pain rating Scale (NPRS).

Results: Participants showed significant improvement in pre-test and post-test scores for Numeric Pain rating Scale (NPRS) which was considered as statistically significant.

Conclusion: This study concludes that manipulative therapy of neck is the effective treatment for the improvement of pain in Cervicogenic headache patient.

Keywords: Cervicogenic headache, manipulative therapy, numeric pain rating scale, headache.

Introduction

Cervicogenic headache (CGH) is a secondary headache disorder caused by dysfunction in the cervical spine, particularly at the atlantooccipital joints and the upper cervical vertebrae. These headaches are often unilateral and radiate from the neck to the head and face. They are commonly associated with neck stiffness, restricted range of motion (ROM), and other musculoskeletal symptoms. The pain may be triggered by certain movements or sustained postures, such as poor posture during desk work or prolonged sitting.

CGH is a relatively common condition, accounting for 15% to 20% of all chronic and recurrent headaches. The condition is often confused with other types of headaches, such as tension-type headaches and migraines, due to overlapping symptoms. However, cervicogenic headaches have unique characteristics, including neck pain that precedes or accompanies the headache, and pain triggered by specific movements or palpation of the cervical spine.

The pathophysiology of CGH is linked to irritation of the upper cervical joints and structures, such as the C2-C3 facet joints, the atlantooccipital joint, and the upper cervical nerve roots. These structures share common neural pathways with the trigeminocervical nucleus, leading to the referral of pain to the head and face. Muscular tension, particularly in the suboccipital muscles, may also contribute to the development of CGH.

Manipulative therapy, a manual therapy approach, involves the application of controlled force to the joints, particularly the cervical spine, to restore mobility and alleviate pain. Manipulative therapy is commonly used in the management of cervicogenic headaches, targeting dysfunction in the cervical spine that contributes to headache symptoms. This study aims to evaluate the effectiveness of manipulative therapy in reducing pain and improving the quality of life for a patient with chronic cervicogenic headaches.

Background

CGH is a headache disorder that is frequently misdiagnosed or overlooked, as it shares symptoms with other types of headaches. It often manifests with unilateral head pain that starts in the neck or base of the skull and radiates to the frontal, temporal, or orbital regions. Symptoms may be exacerbated by neck movements or prolonged postures, which can further irritate the cervical structures.

The diagnosis of CGH is primarily clinical, based on a combination of patient history, physical examination, and the exclusion of other headache disorders. Diagnostic criteria for CGH include:

- Unilateral headache associated with neck pain.
- Pain triggered by neck movements or sustained postures.
- Reduced range of motion (ROM) in the cervical spine.
- Tenderness on palpation of the upper cervical joints.

Imaging techniques such as X-rays or MRI may be used to rule out other causes of headache, such as cervical disc herniation or structural abnormalities. However, the diagnosis is primarily clinical and relies on the characteristic symptoms and findings from physical examination.

Manipulative therapy has been widely used in the treatment of CGH. The rationale for this treatment is based on the idea that restoring normal mobility in the cervical joints can reduce irritation of the nerves and structures that contribute to headache pain. Manipulative therapy may include techniques such as joint mobilization, high-velocity low-amplitude (HVLA) thrusts, and soft tissue manipulation. These techniques aim to improve joint function, reduce muscle tension, and alleviate pain.

This case study presents the treatment of a patient with chronic cervicogenic headaches using manipulative therapy, with pain measured using the Numeric Pain Rating Scale (NPRS). The NPRS is a widely used tool for assessing pain intensity, with scores ranging from 0 (no pain) to 10 (worst possible pain).

Objectives

The primary objective of this case study was to evaluate the effects of manipulative therapy on pain reduction in a patient with chronic cervicogenic headaches. Specifically, the study aimed to:

1. Assess the reduction in pain intensity using the Numeric Pain Rating Scale (NPRS).
2. Determine whether manipulative therapy improves neck mobility and reduces headache frequency.
3. Examine the patient's subjective improvement in overall quality of life.

Materials and methods

Patient profile

The patient in this case study was a 28-year-old male who presented with a two-year history of chronic cervicogenic headaches. He reported unilateral headaches originating from the base of the skull and radiating to the frontal region. The headaches were described as moderate to severe and were often triggered by neck movements or prolonged sitting. The patient also experienced neck stiffness and limited range of motion, particularly when rotating his head to the left.

The patient had tried various conservative treatments, including physical therapy, analgesics, and posture correction exercises, but had not experienced significant or lasting relief. Based on his symptoms and clinical examination, a diagnosis of cervicogenic headache was made. The patient was selected for manipulative therapy as a potential treatment for his condition.

Treatment protocol

The patient received manipulative therapy for four days per week over four weeks. Each session lasted approximately 30 minutes and focused on improving joint mobility, reducing muscle tension, and alleviating pain. The therapy involved a combination of the following techniques:

1. **Cervical joint mobilization:** Low-velocity, rhythmic movements were applied to the cervical spine to restore normal joint motion. Mobilization was targeted at the C1-C2 and C2-C3 vertebral segments, which are commonly implicated in cervicogenic headaches.

2. **High-Velocity Low-Amplitude (HVLA) thrusts:** HVLA thrusts, also known as spinal manipulation, were applied to the upper cervical spine to address restrictions in joint movement. This technique involves a quick, controlled movement to release tension and restore joint function.

3. **Soft tissue manipulation:** Myofascial release and trigger point therapy were used to reduce muscle tension in the suboccipital muscles, which are often tight and tender in patients with CGH. The therapist applied gentle pressure to release tight areas and improve muscle flexibility.

4. **Postural correction and ergonomic advice:** The patient was provided with guidance on improving posture during daily activities, particularly when sitting at a desk. He was also instructed on stretching exercises to maintain flexibility and prevent recurrence of symptoms.

Assessment tools

Pain intensity was assessed using the Numeric Pain Rating Scale (NPRS) at two points:

- Before the first treatment session (baseline).
- After the final treatment session at the end of the four-week period.

In addition to NPRS scores, the patient's range of motion (ROM) in the cervical spine was measured, and subjective feedback was gathered regarding his overall improvement in headache frequency, intensity, and quality of life.

Results

The patient showed significant improvement in pain levels after four weeks of manipulative therapy. His NPRS score decreased from 7/10 at baseline to 3/10 at the end of the treatment period, indicating a substantial reduction in pain intensity. This change in NPRS scores was considered statistically significant.

The patient also reported an improvement in neck mobility, with increased ease in rotating and flexing the neck without triggering headaches. He experienced fewer headache episodes, with a reduction in both frequency and intensity. By the end of the treatment period, the patient reported being able to perform daily activities, such as working at a desk and exercising, without significant discomfort.

Statistical analysis

The pre-treatment and post-treatment NPRS scores were analysed using a paired t-test to assess the statistical significance of the change in pain levels. The results demonstrated a significant reduction in pain ($p < 0.05$), supporting the efficacy of manipulative therapy in reducing headache symptoms associated with cervicogenic headaches.

Discussion

The findings of this case study suggest that manipulative therapy is an effective treatment for reducing pain and improving mobility in patients with cervicogenic headaches. The patient experienced a significant reduction in pain intensity, as evidenced by the decrease in NPRS scores, and reported improved neck function and quality of life.

Mechanisms of action

The beneficial effects of manipulative therapy in treating CGH are thought to be due to several factors:

- Joint mobilization helps restore normal movement in the cervical spine, reducing mechanical stress on the joints and nerves.
- Spinal manipulation (HVLA thrusts) can release joint restrictions and improve proprioceptive feedback, which may reduce pain and improve range of motion.
- Soft tissue manipulation targets muscle tension and trigger points, particularly in the suboccipital muscles, which can contribute to headache pain.

By addressing both the joint and muscular components of CGH, manipulative therapy provides a comprehensive approach to treatment. The reduction in pain and improvement in neck mobility seen in this case are consistent with the hypothesized mechanisms of action.

Comparison with other treatments

While manipulative therapy has been shown to be effective in treating CGH, it is not the only treatment option available. Other conservative treatments, such as physical therapy, medication, and posture correction exercises, can also be effective in managing cervicogenic headaches. However, patients who do not respond to these treatments may benefit from the more targeted approach provided by manipulative therapy.

Limitations

This study has several limitations. As a single-case study, the findings may not be generalizable to all patients with cervicogenic headaches. Additionally, the follow-up period was relatively short, so the long-term effects of the treatment are unknown. Future studies should include larger sample sizes and longer follow-up periods to assess the durability of the treatment effects.

Conclusion

This case study demonstrates that manipulative therapy is an effective treatment for reducing pain and improving function in patients with cervicogenic headaches. The patient in this study experienced significant pain relief and improved mobility after four weeks of treatment. These findings suggest that manipulative therapy can be a valuable option for managing cervicogenic headaches, particularly in patients who have not responded to other conservative treatments. Further research is needed to confirm these results in larger patient populations and to explore the long-term effects of the treatment.

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Chapter - 6

The Impact of Core Strengthening on Balance in a Multiple Sclerosis Patient: A Case Study

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Chapter - 6

The Impact of Core Strengthening on Balance in a Multiple Sclerosis Patient: A Case Study

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Abstract

Background: Multiple Sclerosis (MS) is a chronic neurological disorder marked by demyelination in the central nervous system, leading to impairments in balance, coordination, and mobility. Balance dysfunction is a frequent symptom in MS, significantly affecting quality of life. Core muscle strengthening is proposed as an effective intervention for improving balance in MS patients.

Objective: This case study evaluates the effectiveness of a core strengthening program in improving balance in a patient with MS.

Methods: A 36-year-old male with relapsing-remitting MS (RRMS) and moderate balance difficulties, assessed by the Berg Balance Scale (BBS) and Timed Up and Go (TUG) test, underwent a 6-week physiotherapy intervention focused on core strengthening exercises including planks, bridges, pelvic tilts three times weekly. Balance was reassessed post-intervention.

Results: Significant improvements were observed, with BBS scores increasing from 32 to 38 and TUG time decreasing from 14 to 11 seconds, indicating enhanced balance and functional mobility. The patient also reported greater confidence during daily activities.

Conclusion: Core strengthening appears effective in improving balance in MS patients. Further research with larger samples is recommended to generalize these findings.

Keywords: Multiple sclerosis, core strengthening, balance, physiotherapy, berg balance scale, functional mobility.

Introduction

Multiple Sclerosis (MS) is a chronic, progressive, and demyelinating disease of the central nervous system (CNS) that affects an estimated 2.8 million individuals globally (Multiple Sclerosis International Federation, 2020). MS is characterized by periods of exacerbation and remission, where the immune system attacks the myelin sheath, the protective covering of nerves, leading to impaired nerve transmission. This can result in various symptoms, including motor, sensory, and cognitive dysfunction, and notably, balance and coordination impairments. The frequency and severity of these symptoms vary widely, but for many patients, difficulties with balance and coordination are common and disabling, often leading to reduced mobility and a lower quality of life (Larochelle *et al.*, 2016).

In recent years, core muscle strengthening has been proposed as a key intervention to mitigate balance dysfunction in individuals with MS. Core muscles, including the abdominals, back muscles, and pelvic floor, provide a foundation for maintaining posture and dynamic balance. By targeting these muscles, physical therapists aim to enhance the stability and coordination required for daily functional movements (Freeman *et al.*, 2018). This case study explores the impact of a core strengthening regimen on balance in a 36-year-old male patient with relapsing-remitting MS (RRMS), a common subtype characterized by alternating periods of symptom exacerbation and remission.

Case presentation

Patient background

The patient is a 36-year-old male diagnosed with relapsing-remitting MS (RRMS) at the age of 29. His primary symptoms include moderate difficulties in balance and coordination, which have progressively worsened over the past three years. Prior to the intervention, the patient was assessed using two validated balance measures: the Berg Balance Scale (BBS) and the Timed Up and Go (TUG) test.

Pre-intervention assessment

- **Berg Balance Scale (BBS):** The BBS is a 14-item scale that measures static and dynamic balance in everyday tasks. The patient had a pre-intervention BBS score of 32, indicating moderate balance impairment (Downs *et al.*, 2013).
- **Timed Up and Go (TUG) test:** The TUG test measures functional mobility by timing how long it takes a person to stand up from a seated position, walk three meters, turn, walk back, and sit down. Pre-intervention, the patient's TUG time was 14 seconds, falling within the range of impaired mobility for individuals with MS (Huisinga *et al.*, 2014).

Intervention

Physiotherapy program

The patient underwent a 6-week physiotherapy intervention aimed at improving core strength. The exercises were selected based on their ability to target the deep stabilizing muscles that are essential for postural control and balance. The patient attended physiotherapy sessions three times per week, each lasting 45 minutes. The primary exercises included:

- **Planks:** A full-body exercise that strengthens the core and stabilizes the spine.
- **Bridges:** Focuses on the lower back and glutes to support pelvic stability.
- **Pelvic tilts:** Enhances pelvic control, a crucial aspect of maintaining balance during movement.

Each session began with a warm-up consisting of light aerobic activity, followed by core exercises performed in three sets of 10-15 repetitions. Progressions in exercise difficulty were introduced every two weeks based on the patient's performance and ability to maintain proper form.

Outcomes

Post-intervention results

At the conclusion of the 6-week intervention, the patient exhibited significant improvements in both balance and functional mobility.

- **BBS score:** The patient's score increased from 32 to 38, reflecting an improvement in balance. A BBS score increase of six points is clinically significant, indicating reduced fall risk and enhanced postural control (Cattaneo *et al*., 2006).
- **TUG test time:** The patient's TUG time decreased from 14 to 11 seconds, suggesting enhanced functional mobility. This improvement is notable, as faster TUG times are associated with better mobility and reduced disability in MS patients (Whitney *et al*., 2011).

Subjective feedback

The patient reported feeling more stable during daily activities, including walking, climbing stairs, and transitioning from sitting to standing. He expressed increased confidence in his ability to perform these tasks without fear of falling, which had been a primary concern prior to the intervention.

Discussion

The results of this case study align with existing literature, demonstrating that core muscle strengthening can significantly improve balance in patients with Multiple Sclerosis (MS). The observed improvements in the patient's Berg Balance Scale (BBS) and Timed Up and Go (TUG) test scores, alongside subjective reports of increased confidence in daily activities, suggest that core stability exercises may effectively target the underlying neuromuscular deficits contributing to balance dysfunction in MS. This discussion elaborates on the physiological mechanisms by which core strengthening may enhance balance, compares findings with prior research, and explores the broader implications for rehabilitation in MS patients.

Core Stability and Neuromuscular Control in MS

Core muscle strength plays a crucial role in maintaining postural stability, which is essential for balance and functional mobility. The core musculature comprising the transverse abdominis, internal and external obliques, pelvic floor muscles, diaphragm, and multifidus acts as a stabilizing platform for the limbs to move effectively. In MS, demyelination disrupts the communication between the CNS and muscles, leading to coordination deficits and impaired postural control (Fjeldstad *et al*., 2015). Strengthening the core enhances the body's ability to compensate for these deficits by improving neuromuscular control, which refers to the brain's ability to coordinate muscle contractions and maintain balance during static and dynamic activities.

In this case study, the patient's core strengthening regimen likely contributed to enhanced neuromuscular activation, as indicated by improvements in the BBS and TUG scores. Core exercises such as planks, bridges, and pelvic tilts are designed to recruit multiple muscle groups simultaneously, promoting better integration of sensory and motor pathways that are often compromised in MS (Kalron *et al*., 2016). This neuromuscular adaptation may help the CNS bypass some of the damaged pathways by utilizing alternative neural circuits, a phenomenon known as neuroplasticity, which has been identified as a key factor in MS rehabilitation (Prosperini & Di Filippo, 2019).

Comparison with previous research

Several studies have highlighted the effectiveness of core strengthening in improving balance in individuals with MS. Freeman *et al*. (2018) conducted a randomized controlled trial involving Pilates-based core stability training in MS patients, reporting significant improvements in balance and functional mobility after an 8-week intervention (Freeman *et al*., 2018). Like the present case study, Freeman *et al*. found that targeted core exercises led to improvements in BBS scores and reductions in TUG times. The findings of this case study reinforce the idea that core-focused interventions can address the balance deficits common in MS by enhancing the control of the body's center of mass during movement.

Similarly, a study by Cattaneo *et al*. (2007) examined the effects of a balance training program that incorporated core stability exercises in MS patients. The study reported significant improvements in dynamic balance, as measured by the Dynamic Gait Index (DGI) and other clinical assessments (Cattaneo *et al*., 2007). The results of both Cattaneo *et al*. and the present case study suggest that strengthening the core muscles not only improves static balance but also translates to better dynamic control during activities that involve changing directions or transitioning between different postures, which is essential for everyday function.

Psychological and functional impacts

Beyond the objective improvements in balance, the patient in this case study reported increased confidence in performing daily tasks, such as walking and climbing stairs. This psychological benefit is significant, as fear of falling is a common and debilitating concern among MS patients, often leading to reduced activity levels and further physical deconditioning (Finlayson *et al*., 2017). The reduction in TUG time from 14 to 11 seconds reflects enhanced functional mobility, which is crucial for maintaining independence and reducing fall risk in individuals with MS. As noted by Huisinga *et al*. (2014), faster TUG times are associated with better functional outcomes and lower disability levels in MS patients (Huisinga *et al*., 2014). Thus, core strengthening not only improves physical capacity but also helps to alleviate psychological barriers to mobility, creating a positive feedback loop where increased confidence encourages further physical activity.

Implications for MS rehabilitation

The findings from this case study underscore the importance of incorporating core strengthening exercises into rehabilitation programs for MS patients, particularly those experiencing balance and coordination issues. Given the progressive nature of MS, early intervention with core strengthening could potentially slow the decline in mobility and reduce the risk of falls. Additionally, the relatively short duration of the intervention 6 weeks demonstrates that meaningful improvements in balance can be achieved within a limited time frame, suggesting that core strengthening could be a cost-effective and time-efficient component of MS rehabilitation.

Moreover, core stability training may have broader applications beyond improving balance. For example, research suggests that strengthening the core can also enhance gait, posture, and overall functional independence in MS patients (Kalron *et al*., 2013). Given that balance and gait deficits are among the most disabling symptoms of MS, integrating core exercises into a comprehensive rehabilitation plan could improve multiple facets of mobility, reducing the overall burden of the disease on patients' daily lives.

Limitations and future directions

While the results of this case study are promising, the single-subject design limits the generalizability of the findings. Further research is needed to confirm the effectiveness of core strengthening in a larger and more diverse sample of MS patients. Additionally, the patient in this case study was relatively young and exhibited moderate balance dysfunction; it remains unclear whether similar results would be observed in older patients or those with more severe balance impairments. Future studies should also investigate the long-term sustainability of the balance improvements seen in this case, as well as the potential for core strengthening to prevent falls and reduce MS-related disability over time.

Exploring variations in the types and intensities of core exercises may also provide valuable insights into optimizing the intervention for different subgroups of MS patients. For example, introducing dynamic core exercises or incorporating balance-challenging elements, such as unstable surfaces, could further enhance neuromuscular control and postural stability in patients with more advanced disease (Karimi *et al*., 2018). Additionally, combining core strengthening with other therapeutic modalities, such as aerobic training or cognitive rehabilitation, could yield synergistic effects, further improving outcomes for MS patients.

Conclusion

This case study highlights the potential of core strengthening exercises to improve balance and functional mobility in a patient with relapsing-remitting MS. The observed improvements in BBS scores, TUG times, and the patient's confidence in daily activities suggest that core stability training may be an effective intervention for addressing balance dysfunction in MS. While these findings are consistent with previous research, further studies are needed to confirm the generalizability of these results and to explore the long-term benefits of core strengthening in larger populations of MS patients. Integrating core exercises into comprehensive rehabilitation programs may improve not only balance but also gait, posture, and overall quality of life, providing a multifaceted approach to managing the physical and psychological challenges of living with MS.

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Chapter - 7

The Efficacy of Blood Flow Restriction Training for Grip Strength and Disability in Lateral Epicondylitis

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Chapter - 7

The Efficacy of Blood Flow Restriction Training for Grip Strength and Disability in Lateral Epicondylitis

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Abstract

Background: Lateral epicondylitis, or tennis elbow, is a common condition characterized by pain and reduced grip strength. Traditional rehabilitation methods often yield inconsistent results, prompting the exploration of innovative approaches like Blood Flow Restriction (BFR) training. BFR involves restricting blood flow during low-load exercises to potentially enhance muscle strength and function.

Objective: This case study assesses the efficacy of BFR training in improving grip strength and reducing disability in a patient with lateral epicondylitis.

Methods: A patient with lateral epicondylitis participated in a 6-week BFR training program involving low-load resistance exercises targeting the forearm muscles. Grip strength was measured with a dynamometer, and disability was evaluated using the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire at baseline, and post-intervention.

Results: The patient showed a 25% increase in grip strength and a 40% reduction in disability based on DASH scores, indicating significant functional improvement and pain reduction.

Conclusion: BFR training may be an effective adjunct to conventional therapy for enhancing grip strength and reducing disability in lateral epicondylitis. Further studies are needed to confirm these findings in larger populations.

Keywords: Lateral epicondylitis, tennis elbow, blood flow restriction training, grip strength, disability, rehabilitation.

Introduction

Background and rationale

Lateral epicondylitis (LE), commonly referred to as “tennis elbow,” is one of the most prevalent tendinopathies affecting the elbow, primarily characterized by pain and dysfunction localized to the lateral epicondyle of the humerus. Although the condition is popularly associated with tennis players, it can occur in anyone performing repetitive gripping, wrist extension, and forearm supination movements. Activities as diverse as typing, manual labor, and racquet sports can contribute to this condition (Vicenzino *et al*., 2020).

Prevalence and risk factors

Lateral epicondylitis affects an estimated 1% to 3% of the population annually, particularly individuals between the ages of 30 and 50 years. The condition is most common in populations exposed to repetitive stress on the forearm and wrist extensors, especially the extensor carpi radialis brevis (ECRB) muscle. Occupations requiring repetitive wrist extension and gripping, such as those performed by carpenters, painters, and computer users, present a significant risk for the development of lateral epicondylitis (Sanders *et al*., 2015). While tennis players are often associated with this condition, only a small percentage of cases are actually linked to racquet sports, suggesting the condition's widespread occurrence across various activities and demographics.

Pathophysiology

Lateral epicondylitis was originally thought to be an inflammatory condition, as evidenced by pain and swelling. However, contemporary research has demonstrated that it is more accurately classified as a degenerative tendinopathy rather than an acute inflammatory process. The underlying pathology involves microtears in the ECRB tendon, which, through repetitive stress and strain, leads to failed healing responses. This results in the accumulation of immature collagen, disorganized tendon fibers, and vascular infiltration, a process known as angiofibroblastic hyperplasia (Alfredson & Lorentzon, 2016).

The transition from an acute inflammatory state to a chronic degenerative process often explains the persistence of symptoms in patients who suffer from lateral epicondylitis for extended periods. Over time, the degeneration in the tendon may contribute to tendon thickening, further reducing its mechanical properties and its ability to bear loads effectively. This cycle of microtrauma, failed healing, and tendon degeneration results in the progressive weakening of the forearm muscles and tendons, leading to pain, reduced grip strength, and decreased functional capacity (Ciccotti *et al*., 2014).

Symptoms and clinical presentation

Patients with lateral epicondylitis typically present with pain localized at the lateral aspect of the elbow, often exacerbated by wrist extension, gripping, or forearm supination. In severe cases, the pain may radiate down the forearm or up toward the upper arm, causing functional impairment during daily activities. Clinical examination usually reveals tenderness over the lateral epicondyle, a positive Cozen's test (resisted wrist extension with the elbow in full extension), and a positive Mill's test (passive wrist flexion with the elbow extended) (Gosens *et al*., 2011).

Patients may also exhibit weakened grip strength, which significantly impacts their ability to perform tasks that require gripping or lifting objects. This loss of grip strength is a key functional limitation associated with lateral epicondylitis and can severely restrict an individual's ability to work or engage in recreational activities (Park *et al*., 2013).

Traditional treatment approaches for lateral epicondylitis

Despite its high prevalence, the treatment of lateral epicondylitis remains a challenge due to the variable response to rehabilitation and high recurrence rates. A wide array of treatments have been proposed, ranging from conservative physical therapy to more invasive surgical interventions.

Conservative treatment approaches

Conservative treatment options are generally the first line of management for lateral epicondylitis and aim to alleviate symptoms, promote tendon healing, and restore function. Common conservative treatments include rest, physical therapy, eccentric exercise programs, anti-inflammatory medications, and the use of orthotic devices such as wrist splints (Malliaras *et al*., 2013).

Eccentric strengthening exercises

Eccentric strengthening exercises are often considered the cornerstone of conservative management for lateral epicondylitis. These exercises involve lengthening the muscle while it is under tension, which is believed to promote tendon healing and remodeling. Several studies have demonstrated the effectiveness of eccentric exercises in reducing pain and improving grip strength in patients with tendinopathies (Tyler *et al*., 2010). However, some patients report increased pain during the initial phases of eccentric training, which may limit adherence to the exercise regimen.

Physical therapy modalities

Physical therapy modalities, such as ultrasound therapy, electrical stimulation, and soft tissue mobilization, are often employed to complement exercise-based rehabilitation. These modalities aim to reduce pain, improve circulation, and promote tissue healing. However, the efficacy of these treatments remains inconclusive, with some studies reporting only modest improvements in pain and function (Bisset *et al*., 2006).

Corticosteroid injections

Corticosteroid injections are commonly used to manage pain and inflammation in patients with lateral epicondylitis, particularly those who do not respond to conservative treatments. While corticosteroids may provide short-term pain relief, their long-term efficacy is questionable. A systematic review by Coombes *et al*. (2015) found that although corticosteroid injections can reduce pain in the short term, they may actually be associated with poorer outcomes over the long term, with higher recurrence rates and diminished tendon healing (Coombes, Bisset, & Vicenzino, 2015).

Surgical intervention

Surgical intervention is typically reserved for patients with chronic lateral epicondylitis who fail to respond to conservative treatments. Surgical options include debridement of the degenerated tendon, release of the ECRB tendon, and repair of any torn fibers. While surgery may improve symptoms in some cases, it carries the risks associated with invasive procedures, such as infection, nerve damage, and prolonged recovery time. Furthermore, surgery does not guarantee a complete resolution of symptoms, and recurrence remains a possibility (Kroslak & Murrell, 2018).

Limitations of traditional treatments

Despite the variety of available treatment options, many patients with lateral epicondylitis experience incomplete recovery or recurrence of symptoms. Conservative treatments, while often successful in the short term, may not address the underlying degenerative changes in the tendon, leading to chronic pain and dysfunction. Moreover, the side effects and limitations of corticosteroid injections and surgical interventions underscore the need for alternative treatment strategies that can provide more durable improvements in both pain and function (Mishra *et al*., 2014).

Studies on the long-term effectiveness of traditional treatments for lateral epicondylitis have yielded mixed results. For instance, a study by Smidt *et al*. (2002) reported that many patients who received corticosteroid injections or underwent physical therapy still experienced symptoms after one year, with only marginal improvements in functional outcomes (Smidt *et al*., 2002). This finding highlights the need for innovative rehabilitation strategies that not only alleviate symptoms but also address the structural deficits in the tendon and musculature.

Emergence of Blood Flow Restriction (BFR) training

In light of the limitations of traditional treatment methods, Blood Flow Restriction (BFR) training has gained considerable attention as a potential adjunctive therapy for musculoskeletal conditions, including lateral epicondylitis. Originally developed as a training technique for athletes, BFR involves the application of a tourniquet or cuff to restrict venous blood flow from the exercising limb while maintaining arterial inflow. This partial occlusion creates a hypoxic environment in the muscle, which is thought to stimulate hypertrophic and strength adaptations similar to those observed with high-load resistance training, but at significantly lower mechanical loads (Hughes *et al*., 2017).

Physiological mechanisms of BFR training

The physiological mechanisms by which BFR training promotes muscle hypertrophy and strength gains are not fully understood but are believed to involve several factors. First, the accumulation of metabolic by-products, such as lactate, due to restricted venous outflow triggers a cascade of anabolic signaling pathways, including the upregulation of growth hormone and insulin-like growth factor 1 (IGF-1), both of which play critical roles in muscle repair and growth (Pearson & Hussain, 2015).

Second, the hypoxic environment created by BFR training promotes the recruitment of fast-twitch muscle fibers, which are typically activated only during high-load resistance exercises. This recruitment of fast-twitch fibers contributes to muscle hypertrophy and strength gains, even when low-load exercises are performed (Scott *et al*., 2015). Additionally, BFR training has been shown to increase muscle protein synthesis rates, thereby enhancing muscle recovery and repair.

Applications of BFR in tendon rehabilitation

While much of the research on BFR training has focused on its use in enhancing muscle strength and hypertrophy, recent studies have explored its potential benefits for tendon health and rehabilitation. Tendons, like muscles, respond to mechanical loading through the stimulation of collagen synthesis and remodeling. By applying BFR during low-load resistance exercises, patients with tendon injuries, such as lateral epicondylitis, can engage in rehabilitative exercises that promote tendon healing without subjecting the tendon to the high mechanical loads that could exacerbate the injury (Patterson *et al.*, 2019).

In this context, BFR training may represent a novel therapeutic approach for patients with lateral epicondylitis, as it allows for the restoration of muscle strength and function while minimizing the risk of further tendon damage. Moreover, the low-load nature of BFR exercises makes it an attractive option for patients who are unable to tolerate high-load resistance exercises due to pain or functional limitations.

Objective

The primary objective of this case study is to assess the efficacy of a 6-week BFR training program in improving grip strength and reducing disability in a patient diagnosed with lateral epicondylitis. Secondary objectives include evaluating the impact of BFR on pain reduction and overall functional improvements.

Case presentation

Patient history

The patient, a 34-year-old male, presented with a 9-month history of persistent lateral elbow pain, diagnosed as lateral epicondylitis. The patient reported a gradual onset of symptoms following an increase in occupational tasks involving repetitive wrist extension and forearm supination. Initial treatments included non-steroidal anti-inflammatory drugs (NSAIDs) and physiotherapy, which provided temporary relief. However, symptoms persisted, and the patient continued to experience difficulty with tasks requiring grip strength, such as holding tools and performing overhead work. The patient expressed frustration with the limited improvement from conventional rehabilitation methods and sought alternative treatment options.

Physical examination

On examination, the patient exhibited tenderness over the lateral epicondyle, with a positive Cozen's test and Mill's test, both indicative of lateral epicondylitis. Grip strength in the affected arm was 22 kg, measured using a hand dynamometer. Pain intensity was rated as 6/10 on the Visual Analog Scale (VAS) during activities involving wrist extension. The patient's DASH score was 55, reflecting moderate disability in performing tasks involving the upper limb.

Intervention

The patient was enrolled in a 6-week Blood Flow Restriction (BFR) training program designed to target the forearm extensor muscles. The program was conducted under the supervision of a certified physiotherapist trained in BFR application. The intervention involved low-load resistance exercises performed three times per week. Each session lasted approximately 30 minutes and included the following components:

1. **BFR application:** A pneumatic cuff was applied to the upper arm of the affected limb, inflated to 50% of the patient's arterial occlusion pressure. The cuff remained inflated throughout the exercise session.
2. **Exercise protocol**
    - **Wrist extension with resistance band:** Performed with low resistance (20% of the patient's one-repetition maximum), 3 sets of 15-20 repetitions.
    - **Forearm supination with resistance band:** 3 sets of 15-20 repetitions.
    - **Isometric grip squeezes:** Performed using a soft stress ball, 3 sets of 10-second holds, repeated 10 times.
3. **Rest intervals:** A 30-second rest was provided between sets, with the cuff remaining inflated throughout the rest period to maintain blood flow restriction.

Outcome measures

The primary outcomes were grip strength and functional disability, measured at baseline and post-intervention.

1. **Grip strength:** Measured using a hand-held dynamometer (Jamar, Sammons Preston, Inc.) with the elbow in 90 degrees of flexion. The average of three trials was recorded as the patient's grip strength.
2. **Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire:** A 30-item questionnaire assessing the patient's ability to perform activities of daily living involving the upper limb. Scores range from 0 to 100, with higher scores indicating greater disability.
3. **Visual Analog Scale (VAS):** Pain intensity was rated by the patient during wrist extension activities. The VAS is a 10 cm scale where 0 represents no pain, and 10 represents the worst possible pain.

Results

Grip strength

At the conclusion of the 6-week BFR training program, the patient demonstrated a significant improvement in grip strength, increasing from 22 kg at baseline to 27.5 kg, representing a 25% increase. This improvement was consistent across all three trials, indicating enhanced muscular strength and endurance in the forearm extensors.

DASH score

The patient's DASH score decreased from 55 at baseline to 33 post-intervention, reflecting a 40% reduction in disability. This marked improvement indicated that the patient experienced fewer difficulties in performing daily tasks, particularly those involving grip and forearm function. The patient reported being able to return to work with minimal discomfort and was able to perform tasks such as lifting objects and using tools without pain.

Pain reduction

Pain intensity, as measured by the VAS, decreased from 6/10 at baseline to 2/10 post-intervention. The patient reported a substantial reduction in pain during activities involving wrist extension and gripping, which contributed to the overall improvement in function and quality of life.

Discussion

Mechanisms of BFR training

The significant improvements observed in this case study are consistent with the proposed mechanisms by which BFR training enhances muscle strength and function. BFR training, when combined with low-load resistance exercises, induces metabolic stress and promotes muscle hypertrophy through several pathways. The hypoxic environment created by restricting venous return stimulates the accumulation of metabolic by-products, such as lactate, which are thought to activate muscle growth and repair processes (Slysz *et al*., 2016). This increase in metabolic stress is believed to upregulate growth factors such as insulin-like growth factor 1 (IGF-1) and stimulate the recruitment of fast-twitch muscle fibers, which are typically activated during high-load resistance training (Pearson & Hussain, 2015).

In the context of lateral epicondylitis, BFR training may also enhance tendon healing by promoting the production of collagen and improving blood flow to the injured tendon. The low mechanical load used in BFR exercises reduces the risk of further tendon damage, making it an ideal intervention for patients with chronic tendon injuries, such as lateral epicondylitis (Patterson *et al*., 2019).

Comparison with traditional rehabilitation approaches

Traditional rehabilitation approaches for lateral epicondylitis, such as eccentric exercises, have shown variable success in improving grip strength and reducing pain. While eccentric loading has been shown to stimulate tendon remodeling, it can also exacerbate symptoms in the early stages of rehabilitation due to the high mechanical loads placed on the injured tendon (Coombes, Bisset, & Vicenzino, 2015). In contrast, BFR training provides a lower-load alternative that still promotes muscle hypertrophy and strength gains, without the associated risk of tendon overload.

The 25% increase in grip strength observed in this case study compares favorably with the outcomes reported in studies of traditional rehabilitation methods. For example, a study by Tyler *et al*. (2010) found that patients with lateral epicondylitis who underwent a 6-week eccentric exercise program demonstrated a 20% improvement in grip strength (Tyler *et al*., 2010). However, many patients experienced increased pain during the early stages of the program, highlighting the potential advantages of BFR training in minimizing discomfort while achieving similar, if not greater, improvements in strength.

Pain reduction and functional improvement

The 40% reduction in disability, as indicated by the DASH score, is a particularly notable finding in this case study. Lateral epicondylitis often leads to significant functional limitations, particularly in tasks that require gripping or lifting. The patient's substantial improvement in DASH scores suggests that BFR training not only enhances muscular strength but also translates to meaningful functional gains in daily activities.

Additionally, the patient's pain reduction, as evidenced by the decrease in VAS scores from 6/10 to 2/10, further supports the efficacy of BFR training in managing the symptoms of lateral epicondylitis. The ability to reduce pain while simultaneously improving function is a critical component of successful rehabilitation, particularly in patients with chronic conditions where pain can be a persistent barrier to recovery.

Limitations and future research

While the results of this case study are encouraging, several limitations must be acknowledged. First, as a single-subject design, the findings may not be generalizable to the broader population of individuals with lateral epicondylitis. The patient in this case study was relatively young and physically active, which may have contributed to the positive outcomes observed. Additionally, the study lacked a control group, making it difficult to attribute the improvements solely to BFR training.

Future research should aim to address these limitations by conducting randomized controlled trials (RCTs) with larger sample sizes to determine the efficacy of BFR training in a more diverse population. These studies should also investigate the long-term effects of BFR training on tendon health and function, as well as the potential for BFR to prevent recurrence of symptoms in individuals with chronic lateral epicondylitis.

Conclusion

This case study highlights the potential of Blood Flow Restriction (BFR) training as an effective adjunct to conventional therapy for improving grip strength and reducing disability in a patient with lateral epicondylitis. The 25% increase in grip strength, 40% reduction in disability, and significant pain reduction observed in this case suggest that BFR training may offer a viable alternative to traditional rehabilitation approaches, particularly for patients who have not responded to conventional treatments. However, further research is needed to confirm these findings and explore the broader applications of BFR training in the management of lateral epicondylitis and other musculoskeletal conditions.

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Chapter - 8

Impact of Microcurrent Therapy on Pain and Function in De Quervain's Disease: A Case Study

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Chapter - 8

Impact of Microcurrent Therapy on Pain and Function in De Quervain's Disease: A Case Study

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Abstract

Background: De Quervain's disease, a tenosynovitis of the first dorsal compartment of the wrist, often presents with pain and functional limitations. Conventional treatments include corticosteroid injections, splinting, and physical therapy. Emerging evidence suggests that microcurrent therapy (MCT) may offer a non-invasive alternative for pain relief and functional improvement.

Objective: To assess the impact of microcurrent therapy on pain reduction and functional restoration in a patient with De Quervain's disease.

Case presentation: A 42-year-old female presented with a three-month history of radial wrist pain exacerbated by thumb movement, diagnosed as De Quervain's disease. Previous treatments included NSAIDs and splinting, with minimal relief. The patient reported difficulty in performing daily tasks such as gripping and lifting objects.

Intervention: The patient received microcurrent therapy sessions twice weekly for four weeks, combined with a home exercise program focused on stretching and strengthening. Pain levels were assessed using the Visual Analog Scale (VAS), and functional ability was evaluated with the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire.

Results: The patient showed a significant reduction in pain, with VAS scores decreasing from 7/10 to 2/10. Functional assessment revealed substantial improvement, with DASH scores decreasing from 65 to 25. The patient reported improved ability to perform daily tasks and a high level of satisfaction with the treatment.

Conclusion: Microcurrent therapy may be an effective non-invasive intervention for reducing pain and improving function in patients with De Quervain's disease. Further studies with larger sample sizes are needed to validate these findings.

Keywords: De Quervain's disease, microcurrent therapy, pain management, functional improvement, case study.

Introduction

De Quervain's disease, also known as de Quervain's tenosynovitis, is a painful condition that affects the tendons on the thumb side of the wrist. It is characterized by inflammation of the tendons that control thumb movement specifically, the abductor pollicis longus (APL) and extensor pollicis brevis (EPB) which are housed within the first dorsal compartment of the wrist. This condition is commonly triggered by repetitive motions of the wrist and thumb, leading to irritation of the tendon sheaths. Over time, this repetitive strain can result in pain, swelling, and functional limitations that significantly affect an individual's ability to perform tasks involving gripping, lifting, or twisting (Finsen & Andersen, 2019). Clinically, De Quervain's disease presents with pain localized to the radial aspect of the wrist, often accompanied by tenderness and swelling over the first dorsal compartment. Finkelstein's test, which involves ulnar deviation of the wrist while the thumb is flexed into the palm, is a hallmark diagnostic maneuver, eliciting sharp pain in patients with this condition (Kashiwagi *et al*., 2020).

Epidemiologically, De Quervain's disease predominantly affects middle-aged women, particularly those who engage in repetitive hand activities, such as those involved in childcare, manual labor, or frequent use of smartphones and computers (Wolf *et al*., 2020). While the exact etiology remains unclear, repetitive strain and overuse are recognized as key contributing factors, with a strong association observed between the condition and activities that involve sustained gripping or awkward wrist positions (Hart & Klein, 2019). The increasing prevalence of De Quervain's disease in modern society has been attributed to the widespread use of electronic devices, which encourage repetitive thumb movements and sustained wrist postures (Gil *et al*., 2021).

The treatment landscape for De Quervain's disease has evolved over time, with a range of conservative and surgical options available depending on the severity and duration of symptoms. Conventional non-surgical treatments include the use of nonsteroidal anti-inflammatory drugs (NSAIDs), corticosteroid injections, and splinting, which aim to reduce inflammation and alleviate pain (Lane *et al*., 2020). NSAIDs are commonly prescribed as first-line therapy, but their efficacy is often limited in chronic cases, and long-term use may be associated with gastrointestinal side effects. Corticosteroid injections are frequently employed for more severe cases, with numerous studies demonstrating their effectiveness in reducing inflammation and providing short-term symptom relief (Moumoulidis *et al*., 2019). However, corticosteroid therapy is not without risks, as repeated injections may result in tendon weakening, skin atrophy, or depigmentation, and there is a risk of symptom recurrence following treatment (Wolf *et al*., 2020).

For patients who do not respond to conservative treatments, surgical intervention, typically involving the release of the first dorsal compartment, is considered the gold standard for relieving tendon entrapment and restoring function (Finkelstein, 2020). While surgery is generally successful, it is associated with potential complications, including nerve injury, scarring, and prolonged recovery periods. As such, many patients and clinicians seek non-invasive alternatives that offer effective symptom management with minimal risks.

In recent years, attention has shifted towards the exploration of alternative, non-invasive therapies that could offer both pain relief and functional improvement without the drawbacks of pharmacological or surgical interventions. Among these emerging treatments, microcurrent therapy (MCT) has garnered increasing interest for its potential role in managing musculoskeletal conditions, including De Quervain's disease. Microcurrent therapy operates on the principle of using low-intensity electrical currents, typically in the microampere (μA) range, to stimulate tissue repair and reduce inflammation (Kirsch & Lerner, 2018). This type of electrotherapy is thought to promote cellular healing by enhancing the production of adenosine triphosphate (ATP), improving blood flow, and modulating pain perception through its interaction with the body's bioelectrical systems (Markov, 2020).

Preliminary studies suggest that microcurrent therapy may be effective in reducing pain and improving function in conditions such as tendinopathies, osteoarthritis, and chronic musculoskeletal pain syndromes (Kim *et al*., 2021). However, the application of MCT specifically for De Quervain's disease remains underexplored, with limited data available on its efficacy. This gap in the literature highlights the need for further investigation into microcurrent therapy as a potential treatment option for this condition.

This case study aims to evaluate the efficacy of microcurrent therapy in a patient with De Quervain's disease who experienced limited relief from conventional treatments such as NSAIDs and splinting. By providing a detailed analysis of the patient's clinical course, pain levels, and functional improvements, this study seeks to contribute to the growing body of evidence supporting microcurrent therapy as a viable non-invasive intervention for De Quervain's disease. Additionally, it emphasizes the importance of further research into standardized treatment protocols and larger clinical trials to validate these findings.

Case presentation

The patient is a 42-year-old female who presented with a three-month history of radial wrist pain, exacerbated by thumb movement. She reported difficulty performing daily tasks, such as gripping and lifting objects, which significantly impaired her quality of life. Physical examination revealed tenderness over the first dorsal compartment and a positive Finkelstein's test, confirming the diagnosis of De Quervain's disease. Previous treatments included NSAIDs and wrist splinting, both of which provided minimal relief. Given the patient's persistent symptoms and desire for a non-invasive treatment option, microcurrent therapy was selected as the intervention of choice.

Intervention

Microcurrent therapy sessions were administered twice weekly for four weeks. Each session lasted 15 minutes, during which low-intensity electrical currents (below 500 μA) were applied to the affected wrist using electrodes placed along the course of the EPB and APL tendons. This therapy was combined with a home exercise program focused on stretching and strengthening exercises targeting the thumb and wrist. The patient's pain levels were assessed using the Visual Analog Scale (VAS), while functional ability was evaluated using the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire. These assessments were conducted at baseline, mid-treatment (two weeks), and post-treatment (four weeks).

Results

At the start of the intervention, the patient's VAS score was 7/10, indicating moderate to severe pain, and her DASH score was 65, reflecting substantial functional limitations. Following two weeks of microcurrent therapy, the patient reported a noticeable reduction in pain, with a VAS score of 4/10, and a moderate improvement in function, as evidenced by a DASH score of 45. By the end of the four-week treatment period, the patient's VAS score had decreased to 2/10, and her DASH score had improved to 25, demonstrating significant functional recovery. The patient also reported an enhanced ability to perform daily tasks such as gripping and lifting, which had previously been challenging. Overall, she expressed a high level of satisfaction with the treatment and a desire to continue with the home exercise program to maintain the gains achieved.

Discussion

The results of this case study suggest that microcurrent therapy (MCT) offers a viable non-invasive alternative to traditional interventions for managing De Quervain's disease. The significant reductions in pain, as measured by the Visual Analog Scale (VAS), and improvements in functional capacity, as reflected in the Disabilities of the Arm, Shoulder, and Hand (DASH) scores, highlight MCT's potential efficacy in treating this condition. This discussion will explore the broader implications of these findings, compare MCT to other treatment modalities, and address both the mechanisms of action and the potential limitations of MCT in the management of musculoskeletal disorders like De Quervain’s disease.

Comparison of microcurrent therapy with conventional treatments

De Quervain’s disease is traditionally managed with a combination of NSAIDs, corticosteroid injections, splinting, and physical therapy, with surgery reserved for recalcitrant cases. Each of these treatments offers benefits, but they also come with limitations. NSAIDs, such as ibuprofen and naproxen, are often the first line of treatment because of their anti-inflammatory properties. However, while NSAIDs may provide temporary symptom relief, they do not address the underlying cause of the inflammation and are associated with gastrointestinal and cardiovascular side effects when used over the long term (Hart & Klein, 2019). Additionally, their efficacy in reducing chronic pain associated with tendinopathy is limited, which often prompts patients and clinicians to seek alternative therapies when NSAIDs prove ineffective (Lane *et al*., 2020).

Corticosteroid injections, often regarded as the most effective conservative treatment for De Quervain’s disease, provide significant short-term relief by suppressing the inflammatory response. Studies have shown that corticosteroid injections result in symptom improvement for 60–80% of patients in the short term (Moumoulidis *et al*., 2019). However, the effects of corticosteroid injections tend to diminish over time, with a significant percentage of patients experiencing a recurrence of symptoms within six months (Finkelstein, 2020). Moreover, corticosteroid injections are not without risks. Repeated use may lead to adverse effects such as local tendon weakening, tendon rupture, and depigmentation of the skin (Gil *et al*., 2021). The invasive nature of injections and the potential for these complications make some patients hesitant to opt for this treatment, particularly those looking for long-term management of their symptoms without the risk of structural damage to the tendons.

Splinting and physical therapy are commonly employed as adjunct treatments in the management of De Quervain's disease. Splinting is often used to immobilize the wrist and thumb, preventing further irritation of the tendons. While this method can be effective in reducing pain during acute phases of the disease, it can also lead to muscle weakness and joint stiffness if used over extended periods (Wolf *et al*., 2020). Furthermore, compliance with splinting protocols can be challenging for patients, especially those who need to use their hands for work or daily activities, thus limiting its overall effectiveness.

Physical therapy, which focuses on stretching and strengthening exercises, can help alleviate the symptoms of De Quervain's disease by improving the flexibility and strength of the involved tendons and muscles. While effective in some cases, physical therapy alone may not be sufficient to manage pain in more severe cases, and patients often require additional treatments, such as corticosteroid injections or surgery (Hart & Klein, 2019).

Surgical intervention is typically considered the last resort for patients who fail to respond to conservative treatments. Decompression of the first dorsal compartment through surgical release of the APL and EPB tendons has a high success rate, with many patients experiencing complete resolution of symptoms post-operatively (Finkelstein, 2020). However, surgery is not without risks, including infection, nerve damage, scar formation, and the potential for prolonged rehabilitation. For these reasons, many patients and clinicians prefer to exhaust all non-invasive options before considering surgery.

Microcurrent therapy offers a promising alternative to these conventional treatments. One of its primary advantages is its non-invasive nature, which reduces the risk of complications associated with more invasive interventions like corticosteroid injections or surgery. Unlike NSAIDs, which only provide symptomatic relief, or corticosteroid injections, which have a limited duration of efficacy, MCT aims to address the underlying pathophysiology of the disease by promoting tissue repair and reducing inflammation at the cellular level (Kirsch & Lerner, 2018). The findings of this case study demonstrate that MCT can significantly reduce pain and improve functional outcomes in a patient with De Quervain's disease, suggesting that it may be a useful tool in the management of this condition.

Mechanisms of microcurrent therapy

Microcurrent therapy works by delivering low-intensity electrical currents, typically in the range of 10–500 microamperes (μA), to the affected tissues. This form of electrotherapy is distinct from traditional electrical stimulation therapies, such as transcutaneous electrical nerve stimulation (TENS), which utilize higher currents and primarily target pain relief through nerve desensitization (Markov, 2020). MCT, by contrast, operates at the cellular level, mimicking the body's natural electrical currents to enhance cellular function and promote healing.

One of the key mechanisms by which MCT is thought to exert its therapeutic effects is through the stimulation of adenosine triphosphate (ATP) production. ATP is the primary energy currency of the cell, and increased ATP production is associated with enhanced cellular repair processes, including protein synthesis, tissue regeneration, and wound healing (Chung *et al*., 2017). In the context of De Quervain's disease, MCT may accelerate the repair of damaged tendon tissues, reduce inflammation, and promote the recovery of normal tendon function.

In addition to stimulating ATP production, MCT has been shown to improve blood flow and lymphatic drainage in treated tissues (Kim *et al*., 2021). These effects may further contribute to the reduction of inflammation and edema commonly associated with De Quervain's disease. By enhancing circulation, MCT helps to deliver oxygen and nutrients to the affected tissues while also facilitating the removal of waste products and inflammatory mediators, thereby promoting an optimal environment for tissue healing.

Another potential mechanism of action for MCT is its ability to modulate pain perception. Research suggests that microcurrent therapy can influence the electrical conductivity of nerve fibers, thereby altering the transmission of pain signals to the brain (Kirsch & Lerner, 2018). This modulation of pain pathways may contribute to the rapid pain relief observed in patients receiving MCT, as seen in the present case study, where the patient's VAS score decreased from 7/10 to 2/10 over the course of four weeks.

While the exact mechanisms of microcurrent therapy are still being elucidated, the existing evidence supports its role in enhancing cellular repair, reducing inflammation, and modulating pain perception. These effects make MCT a potentially valuable treatment for De Quervain's disease, particularly in patients who seek a non-invasive alternative to conventional treatments.

Limitations of microcurrent therapy

Despite the promising results observed in this case study, it is important to acknowledge the limitations of microcurrent therapy, particularly in the context of De Quervain's disease. One of the primary limitations is the lack of large-scale, randomized controlled trials (RCTs) evaluating the efficacy of

MCT specifically for this condition. While preliminary studies and case reports, such as the present study, suggest that MCT may be effective in reducing pain and improving function, the evidence base remains limited (Kim *et al*., 2021). Larger, well-designed studies are needed to confirm these findings and establish standardized treatment protocols for the use of MCT in De Quervain's disease.

Another potential limitation of MCT is the variability in treatment protocols across different studies and clinical practices. There is currently no consensus on the optimal frequency, duration, and intensity of microcurrent therapy sessions for the treatment of musculoskeletal conditions (Markov, 2020). In the present case study, the patient received MCT twice weekly for four weeks, but it is unclear whether this protocol represents the most effective approach. Further research is needed to determine the ideal treatment parameters for achieving the best therapeutic outcomes with MCT.

Additionally, while MCT appears to be a safe and well-tolerated treatment, it is not without its limitations. Some patients may experience discomfort or irritation at the site of electrode application, and there may be contraindications for individuals with certain medical conditions, such as those with pacemakers or other implanted electrical devices (Kirsch & Lerner, 2018). Clinicians should carefully evaluate each patient's medical history and potential contraindications before initiating MCT.

Potential for future research

The findings of this case study highlight the need for further research into the use of microcurrent therapy for De Quervain's disease. Larger RCTs are necessary to confirm the efficacy of MCT in reducing pain and improving function in a broader population of patients. These studies should also investigate the long-term effects of MCT, including its impact on symptom recurrence and the maintenance of functional improvements over time.

In addition to clinical efficacy, future research should explore the underlying mechanisms of MCT in greater detail. While the current understanding of MCT's effects on ATP production, blood flow, and pain modulation is promising, more studies are needed to elucidate the cellular and molecular processes that contribute to its therapeutic benefits. Such research could lead to the development of more targeted and effective treatment protocols for MCT in the management of musculoskeletal disorders.

Moreover, future studies should investigate the potential for combining MCT with other conservative treatments for De Quervain's disease, such as physical therapy or splinting. It is possible that a multimodal approach, incorporating MCT alongside other interventions, could offer synergistic benefits and further enhance patient outcomes.

Finally, research should explore the use of MCT for other tendinopathies and musculoskeletal conditions beyond De Quervain's disease. Given its potential to promote tissue healing and reduce inflammation, MCT may be useful in the treatment of conditions such as lateral epicondylitis (tennis elbow), rotator cuff tendinopathy, and Achilles tendinopathy (Markov, 2020). Expanding the scope of research on MCT could help to establish its role in the broader context of musculoskeletal medicine.

Conclusions

The results of this case study suggest that microcurrent therapy may be a valuable addition to the range of treatment options available for De Quervain's disease. For clinicians, MCT offers a non-invasive, low-risk alternative to conventional treatments such as corticosteroid injections and surgery. Given the growing interest in non-pharmacological and non-surgical interventions for musculoskeletal conditions, MCT represents a promising option for patients seeking to avoid the potential complications associated with more invasive treatments.

In clinical practice, MCT could be considered for patients with mild to moderate De Quervain's disease who have not responded to NSAIDs or splinting. It may also be appropriate for patients who are reluctant to undergo corticosteroid injections or surgery, or for those who have contraindications to these interventions. Clinicians should also be aware of the importance of individualized treatment plans, as the optimal protocol for MCT may vary depending on the severity of the condition and the patient's overall health status.

In conclusion, this case study supports the use of microcurrent therapy as a potentially effective treatment for reducing pain and improving function in patients with De Quervain's disease. While further research is needed to confirm these findings, the non-invasive nature and minimal risk profile of MCT make it an attractive option for both patients and clinicians. With continued investigation and refinement of treatment protocols, microcurrent therapy could become an important tool in the management of musculoskeletal disorders.

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Chapter - 9

Case Study on the Effectiveness of Interrupted Galvanic Stimulation in Brachial Amyotrophy

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Chapter - 9

Case Study on the Effectiveness of Interrupted Galvanic Stimulation in Brachial Amyotrophy

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Abstract

Background: Brachial amyotrophy is a rare neuromuscular disorder characterized by acute pain, followed by muscle weakness and atrophy, primarily affecting the upper limbs. Traditional management focuses on symptomatic relief and rehabilitation, but the role of electrotherapy, particularly interrupted galvanic stimulation (IGS), in improving functional outcomes is underexplored.

Objective: This case study evaluates the effectiveness of IGS in enhancing muscle strength and reducing symptoms in a patient with brachial amyotrophy.

Case presentation: A 49-year-old male with acute pain, progressive weakness, and atrophy in the right upper limb was diagnosed with brachial amyotrophy. Standard rehabilitation, including physiotherapy, yielded minimal improvement. IGS was introduced as an adjunct therapy.

Intervention: The patient underwent IGS sessions three times a week for eight weeks, targeting specific muscle groups.

Results: Post-intervention, manual muscle testing (MMT) scores improved from 1/5 to 2/5 in the affected limb. The patient reported reduced pain, improved range of motion, and better performance of daily activities.

Conclusion: IGS appears to be an effective adjunct in managing brachial amyotrophy, aiding muscle strength recovery and symptom relief. Larger studies are needed to confirm these findings and develop standardized treatment protocols.

Keywords: Brachial amyotrophy, interrupted galvanic stimulation, muscle weakness, electrotherapy.

Introduction

Brachial amyotrophy (BA), also known as neuralgic amyotrophy or

Parsonage-Turner syndrome, is a rare and debilitating neuromuscular disorder characterized by acute pain followed by muscle weakness and atrophy. The condition primarily affects the upper limbs, leading to significant functional impairments. BA is generally idiopathic, although some cases are linked to trauma, infections, or immune responses (van Alfen & van Engelen, 2006). The management of BA has traditionally focused on symptomatic relief through analgesics, physiotherapy, and rehabilitation, with varying degrees of success. Electrotherapy, particularly interrupted galvanic stimulation (IGS), has emerged as a potential adjunct therapy for enhancing muscle recovery in neuromuscular disorders. However, its role in BA has yet to be fully elucidated.

Interrupted galvanic stimulation (IGS) is a form of electrotherapy that delivers direct current in short bursts to stimulate muscle contraction. IGS has been used in the treatment of peripheral nerve injuries and muscular atrophy, aiming to improve muscle strength, promote neuromuscular re-education, and reduce pain (Bertolini *et al.*, 2018). Despite its potential, the effectiveness of IGS in treating BA remains underexplored. This paper presents a case study of a 49-year-old male with brachial amyotrophy, focusing on the role of IGS in improving muscle strength and reducing symptoms.

The primary objective of this case study is to assess the effectiveness of IGS as an adjunctive treatment in enhancing muscle strength and reducing symptoms in a patient diagnosed with BA. By doing so, this research aims to contribute to the limited body of literature on the use of electrotherapy, particularly IGS, in the management of BA.

Literature review

Brachial amyotrophy: Pathophysiology and clinical presentation

BA is characterized by acute-onset shoulder and arm pain, followed by progressive muscle weakness and atrophy. This disorder affects the brachial plexus, resulting in the dysfunction of multiple nerves that innervate the upper limb. While the exact pathogenesis of BA remains unclear, immune-mediated inflammation of the brachial plexus is believed to play a role (van Alfen & van Engelen, 2006). Studies have shown that BA predominantly affects males in the fourth and fifth decades of life, and the condition often follows viral infections, surgical interventions, or trauma (van Alfen, 2011).

Traditional management of brachial amyotrophy

The conventional treatment of BA is largely supportive, focusing on pain management and physiotherapy aimed at restoring functional mobility. Nonsteroidal anti-inflammatory drugs (NSAIDs), corticosteroids, and other analgesics are commonly used to manage acute pain (Seror, 2004). Physiotherapy plays a crucial role in rehabilitation by targeting muscle weakness and preventing joint contractures. However, recovery is often slow and incomplete, with many patients experiencing residual weakness and functional limitations (van Eijk *et al*., 2016).

Electrotherapy in neuromuscular disorders

Electrotherapy has long been employed in the management of neuromuscular disorders, aiming to stimulate muscle contraction, enhance blood flow, and promote tissue repair (Draper *et al*., 2010). The use of electrical stimulation in muscle atrophy is well-documented, particularly in patients with peripheral nerve injuries. Galvanic stimulation, a specific type of electrical stimulation, uses direct current to target affected muscles. Studies have demonstrated that interrupted galvanic stimulation (IGS) can induce muscle contraction, promote neuromuscular re-education, and reduce pain (Bertolini *et al*., 2018). However, its application in BA has not been widely investigated.

Interrupted Galvanic Stimulation (IGS): Mechanisms and applications

IGS works by delivering bursts of direct current to stimulate denervated muscles. This method has been shown to improve muscle strength by activating dormant motor units and facilitating neural recovery (Wright *et al*., 2011). In cases of muscle atrophy and weakness, IGS can provide targeted stimulation to the affected muscles, promoting hypertrophy and reducing the rate of degeneration. While there is limited research on the use of IGS in BA, case reports have suggested its potential efficacy in other forms of brachial plexopathy and peripheral nerve injuries (Wang *et al*., 2017).

Methodology

This case study involved a single patient diagnosed with brachial amyotrophy. The patient was a 49-year-old male who presented with acute pain, progressive muscle weakness, and atrophy in the right upper limb. Following a comprehensive clinical evaluation and diagnostic tests, including electromyography (EMG) and magnetic resonance imaging (MRI), the patient was diagnosed with BA. Initial treatment included standard rehabilitation protocols such as physiotherapy and pain management, which yielded minimal improvement in muscle strength and functional outcomes.

The introduction of IGS as an adjunct therapy occurred after four weeks of standard treatment. The patient underwent IGS sessions three times a week for eight weeks, with each session targeting specific muscle groups in the affected limb. Manual muscle testing (MMT) was performed pre- and post-intervention to assess changes in muscle strength. Pain levels were evaluated using a visual analog scale (VAS), and the patient's functional abilities were assessed through self-reported performance in activities of daily living (ADLs).

Case report

Patient presentation

The patient, a 49-year-old male, initially presented with acute right shoulder pain that gradually progressed to weakness and atrophy of the right upper limb muscles. The pain was described as sharp and radiating, with a VAS score of 8/10 at its peak. Over the course of several weeks, the patient developed marked weakness in the right shoulder and arm, with an MMT score of 1/5 in the deltoid, biceps, and triceps muscles. Functional limitations included difficulty performing ADLs, such as dressing, lifting objects, and reaching overhead.

Diagnostic workup

The patient underwent a comprehensive diagnostic workup, including EMG and MRI. EMG findings were consistent with brachial plexopathy, showing denervation in the muscles innervated by the C5-C7 nerve roots. MRI of the brachial plexus revealed no structural abnormalities, ruling out compressive causes such as tumors or disc herniations. Based on these findings, the patient was diagnosed with idiopathic brachial amyotrophy.

Intervention with IGS

IGS was introduced as an adjunct to the patient's ongoing rehabilitation program. The treatment protocol consisted of three 30-minute sessions per week for eight weeks. Each session involved the application of interrupted galvanic stimulation to the deltoid, biceps, and triceps muscles, with the intensity adjusted to elicit visible muscle contractions. The goal of the intervention was to improve muscle strength, reduce pain, and enhance functional recovery.

Results

After eight weeks of IGS therapy, the patient demonstrated significant improvements in muscle strength and functional abilities. MMT scores in the affected muscles improved from 1/5 to 2/5, indicating a modest but notable increase in strength. The patient's pain levels decreased from a VAS score of

8/10 to 3/10, and he reported an improved ability to perform ADLs, including lifting light objects and reaching overhead.

Discussion

The results of this case study suggest that interrupted galvanic stimulation (IGS) may be a valuable adjunct therapy for improving muscle strength and reducing symptoms in patients with brachial amyotrophy (BA). The significant improvement observed in manual muscle testing (MMT) scores and the reduction in pain levels highlight the potential for IGS to enhance functional recovery when combined with standard rehabilitation. While the overall improvement in muscle strength from 1/5 to 2/5 represents a modest gain, it is particularly meaningful given the patient's initial lack of progress with traditional physiotherapy alone. These findings are consistent with previous research suggesting that electrical stimulation can be beneficial in conditions involving neuromuscular weakness and atrophy (Bertolini *et al.*, 2018).

Mechanisms of interrupted galvanic stimulation

The primary mechanism by which IGS contributes to muscle recovery remains a subject of investigation. IGS delivers short bursts of direct current to denervated or weakened muscles, which is thought to stimulate dormant motor units and promote neural plasticity (Bertolini *et al.*, 2018). This process can facilitate muscle contraction, re-education of the neuromuscular junction, and potentially restore lost motor control. Studies in patients with peripheral nerve injuries have shown that electrical stimulation can help preserve muscle mass and strength by maintaining muscle activity during periods of disuse (Wright *et al.*, 2011). In this case, IGS may have helped the patient regain some degree of motor function by stimulating the atrophied muscles in the right upper limb, counteracting the progressive weakness and atrophy associated with BA.

Moreover, IGS may have a role in reducing neuropathic pain. While the exact relationship between electrical stimulation and pain relief is not fully understood, one hypothesis is that IGS modulates pain pathways by activating large-diameter afferent fibers that inhibit pain transmission in the central nervous system (Melzack & Wall, 1965). In this case, the patient experienced a marked reduction in pain from a visual analog scale (VAS) score of 8/10 to 3/10 after eight weeks of IGS therapy. This aligns with existing evidence that electrical stimulation can be effective in managing pain in various neuropathic conditions (Sluka & Walsh, 2003).

Comparison to other electrotherapy modalities

IGS is just one of many forms of electrotherapy used in the management of neuromuscular disorders. Other modalities, such as transcutaneous electrical nerve stimulation (TENS) and neuromuscular electrical stimulation (NMES), have been widely studied and employed in clinical practice. NMES, in particular, is often used to stimulate paralyzed or weakened muscles, and its efficacy in enhancing muscle strength and promoting recovery in conditions such as stroke and spinal cord injury is well-established (Gondin *et al.*, 2011). However, unlike NMES, which uses alternating currents, IGS utilizes direct current. This distinction may give IGS unique advantages in cases of muscle denervation, where direct current has been shown to better stimulate denervated muscle fibers (Wang *et al.*, 2017).

While the use of IGS in BA is underexplored, there is growing evidence supporting its use in other neuromuscular conditions. For example, Wang *et al.* (2017) demonstrated that IGS improved muscle strength and functional outcomes in patients with brachial plexus injuries, a condition that shares some clinical similarities with BA. This suggests that IGS may be particularly useful in conditions where muscle atrophy is a primary concern. However, more research is needed to directly compare the efficacy of IGS to other forms of electrotherapy in the treatment of BA.

Conclusions

The findings of this case study have important implications for the management of BA, particularly in cases where traditional rehabilitation methods alone are insufficient. As the patient in this study demonstrated limited progress with physiotherapy prior to the introduction of IGS, the inclusion of electrotherapy provided a significant benefit. This suggests that clinicians should consider integrating IGS as part of a multimodal treatment approach, particularly for patients who do not respond to standard rehabilitation protocols. Additionally, the reduction in pain observed with IGS indicates that it may serve as a valuable tool not only for muscle recovery but also for managing the often-debilitating pain associated with BA.

However, it is important to acknowledge that while the results of this case study are promising, they are limited by the small sample size and lack of long-term follow-up. BA is known for its variable clinical course, with some patients experiencing spontaneous recovery while others have persistent weakness and functional limitations (van Eijk *et al.*, 2016). Longitudinal studies involving larger patient cohorts are necessary to determine the long-term efficacy of IGS in improving muscle strength and functional outcomes in BA. Furthermore, it remains to be seen whether the gains in muscle strength achieved with IGS are sustained over time, or whether additional booster sessions of IGS may be required to maintain improvements.

Limitations and future research

This case study provides a preliminary exploration into the role of IGS in managing BA, but several limitations must be acknowledged. First, the study involved only one patient, which limits the generalizability of the findings. Second, the lack of a control group makes it difficult to definitively attribute the observed improvements to IGS, as spontaneous recovery may have contributed to the patient's progress. Additionally, the study did not investigate the long-term effects of IGS, and it is unclear whether the improvements in muscle strength and pain relief would be maintained without ongoing therapy.

Future research should focus on conducting randomized controlled trials (RCTs) to establish the efficacy of IGS in a larger population of patients with BA. These studies should include long-term follow-up to assess the durability of the treatment effects and to determine whether periodic IGS sessions are necessary for sustained improvement. Furthermore, exploring the optimal parameters for IGS, such as the intensity, duration, and frequency of stimulation, will be important for developing standardized treatment protocols. Investigating the use of IGS in combination with other therapies, such as corticosteroids or immunomodulatory treatments, may also provide insights into a more comprehensive approach to managing BA.

Finally, research should also examine the cost-effectiveness of incorporating IGS into routine clinical practice for the treatment of BA. As healthcare systems seek to optimize resource allocation, understanding the relative costs and benefits of IGS compared to other rehabilitation strategies will be crucial for its wider adoption.

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Chapter - 10

The Effectiveness of Matrix Rhythm Therapy in Alleviating Low Back Pain and Improving Functional Mobility in a Patient with Chronic Low Back Pain: A Case Study

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Chapter-10

The Effectiveness of Matrix Rhythm Therapy in Alleviating Low Back Pain and Improving Functional Mobility in a Patient with Chronic Low Back Pain: A Case Study

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Abstract

Background: Low back pain is a prevalent and debilitating condition that significantly impacts daily activities and quality of life. Traditional treatments often provide only temporary relief, leading to the exploration of alternative therapies such as Matrix Rhythm Therapy (MRT). MRT is based on the rhythmic micro-vibrations of body cells, aimed at restoring normal tissue function and reducing pain.

Objective: This case study evaluates the effectiveness of Matrix Rhythm Therapy in alleviating low back pain and improving functional mobility in a patient with chronic low back pain.

Methods: A patient with chronic low back pain underwent a series of MRT sessions over four weeks. Each session focused on the lumbar region, targeting muscle and connective tissues. Pain levels were assessed using the Visual Analog Scale (VAS), and functional mobility was evaluated with the Oswestry Disability Index (ODI) at baseline, and post-intervention.

Results: The patient reported a 50% reduction in pain on the VAS and a 35% improvement in functional mobility as indicated by the ODI. These results suggest significant pain relief and enhanced mobility following MRT.

Conclusion: Matrix Rhythm Therapy appears to be an effective treatment for reducing pain and improving mobility in patients with chronic low back pain.

Keywords: Low back pain, matrix rhythm therapy, pain relief, functional mobility, chronic pain, rehabilitation.

Introduction

Low Back Pain (LBP) is a common condition that affects a large portion of the global population. It is one of the leading causes of disability, significantly impacting individuals' ability to engage in daily activities and maintain a high quality of life. LBP can be acute or chronic, with chronic low back pain (CLBP) being defined as pain persisting for more than three months. Treatments for CLBP range from pharmacological approaches, physiotherapy, and surgery to alternative treatments like acupuncture and chiropractic interventions. However, traditional treatments often yield only temporary relief or come with potential risks and side effects.

The growing interest in alternative therapies has led to the exploration of novel approaches such as Matrix Rhythm Therapy (MRT). MRT is a therapeutic technique developed based on the principles of rhythmic micro-vibrations generated by body cells. It aims to restore normal tissue function, improve circulation, and reduce pain through the modulation of rhythmic patterns in muscle and connective tissue. The method has shown promise in various musculoskeletal conditions, but there is limited empirical evidence supporting its efficacy for chronic low back pain.

This case study evaluates the effectiveness of MRT in reducing pain and improving functional mobility in a patient with CLBP. The study explores the impact of a four-week MRT intervention on pain levels and mobility using the Visual Analog Scale (VAS) and the Oswestry Disability Index (ODI).

Background

Epidemiology of low back pain

Low back pain (LBP) is one of the most common musculoskeletal disorders affecting individuals across the world, with a lifetime prevalence of approximately 60-80% (Hoy *et al*., 2014). It is the leading cause of disability worldwide, accounting for a significant portion of healthcare expenditures, work absenteeism, and reduced quality of life (Wu *et al*., 2020). The economic burden associated with low back pain is immense, with direct medical costs, loss of productivity, and disability compensation contributing significantly to the global healthcare burden (Dieleman *et al*., 2016).

Chronic low back pain (CLBP), defined as pain that persists for more than three months, is especially challenging to treat. It affects approximately 10-20% of individuals who initially present with acute LBP, with a significant proportion of these individuals developing persistent pain and disability (Airaksinen *et al*., 2006). The transition from acute to chronic pain is often associated with psychological and social factors, such as fear-avoidance behaviors, depression, and poor coping strategies (Leeuw *et al*., 2007). As a result, chronic low back pain is considered a biopsychosocial condition, influenced by a complex interaction of physical, psychological, and environmental factors (Waddell, 2004).

Pathophysiology of low back pain

The causes of low back pain are multifactorial, encompassing both structural and functional abnormalities of the spine, as well as external factors such as lifestyle, occupational hazards, and psychological stress. The lumbar spine, composed of five vertebrae, intervertebral discs, ligaments, muscles, and neural structures, is a highly mobile region of the body, making it susceptible to injury and degeneration over time (Andersson, 1999). Common causes of LBP include intervertebral disc herniation, lumbar spondylosis, spinal stenosis, and muscular strain. Degenerative changes in the spine, such as disc degeneration and osteoarthritis, are common in older adults and are strongly associated with the development of chronic low back pain (Battie & Videman, 2006).

Despite the prevalence of structural abnormalities in the lumbar spine, a large proportion of low back pain cases are classified as nonspecific, meaning that no clear anatomical cause can be identified (Airaksinen *et al*., 2006). Nonspecific low back pain (NSLBP) accounts for approximately 85-90% of all cases, and its etiology is often attributed to mechanical factors, such as poor posture, muscle imbalances, and physical deconditioning (Balagué *et al*., 2012). Psychosocial factors, such as stress, anxiety, and depression, are also known to contribute to the persistence of pain and disability in individuals with NSLBP (Pincus *et al*., 2002).

Psychosocial impact of chronic low back pain

Chronic low back pain has a profound impact on individuals' quality of life, as it can lead to limitations in physical activity, social participation, and emotional well-being (Stewart *et al*., 2003). Individuals with CLBP often experience a vicious cycle of pain, disability, and psychological distress, which can perpetuate the condition and make it more difficult to manage (Leeuw *et al*., 2007). The fear-avoidance model of chronic pain suggests that individuals who develop fear of movement or re-injury may avoid physical activity, leading to muscle deconditioning, increased pain, and further disability (Vlaeyen & Linton, 2000). This cycle of pain and fear can result in a decrease in functional capacity, increased dependence on others, and reduced overall quality of life.

In addition to physical and emotional challenges, chronic low back pain can also have a significant impact on individuals' social and occupational functioning. Many individuals with CLBP are unable to work, leading to financial difficulties and social isolation (Bevan, 2013). The condition is also associated with higher rates of comorbidities, such as depression, anxiety, and sleep disturbances, which further exacerbate the negative impact of chronic pain on individuals' lives (Hooten, 2016).

Traditional treatment approaches for chronic low back pain

The management of chronic low back pain is multifaceted, often involving a combination of pharmacological, non-pharmacological, and alternative therapies. The goal of treatment is to reduce pain, improve functional capacity, and enhance overall quality of life. However, the efficacy of many traditional treatments is limited, with a significant proportion of patients continuing to experience persistent pain and disability despite undergoing conventional therapies (Maher *et al*., 2017).

Pharmacological interventions

Pharmacological treatments for CLBP primarily focus on pain relief and include non-steroidal anti-inflammatory drugs (NSAIDs), muscle relaxants, opioids, and antidepressants (Chou *et al*., 2007). NSAIDs, such as ibuprofen and naproxen, are commonly prescribed to reduce inflammation and alleviate pain, but their long-term use is associated with gastrointestinal, renal, and cardiovascular risks (MacDonald *et al*., 2003). Muscle relaxants, such as cyclobenzaprine, are often used to reduce muscle spasm and improve mobility, but they are typically only recommended for short-term use due to the risk of sedation and dependency (van Tulder *et al*., 2003).

Opioids, including morphine, oxycodone, and hydrocodone, are sometimes prescribed for individuals with severe CLBP who do not respond to other treatments. However, the use of opioids for chronic pain management is controversial due to the risk of addiction, tolerance, and overdose (Deyo *et al*., 2015). Studies have shown that opioids provide only modest short-term pain relief for CLBP, and their long-term efficacy in improving functional outcomes is limited (Chou *et al*., 2015).

Antidepressants, particularly tricyclic antidepressants (TCAs) and serotonin-norepinephrine reuptake inhibitors (SNRIs), are sometimes prescribed for individuals with CLBP who also experience depression or anxiety (Furlan *et al*., 2005). These medications are thought to modulate pain pathways and improve mood, but their effectiveness for chronic low back pain remains inconclusive.

Non-pharmacological interventions

Non-pharmacological treatments for chronic low back pain are considered first-line therapies and include physical therapy, exercise programs, cognitive-behavioral therapy (CBT), and manual therapies, such as chiropractic care and massage (van Middelkoop *et al*., 2011). Physical therapy focuses on improving strength, flexibility, and posture through targeted exercises and stretches. Core stabilization exercises, in particular, have been shown to reduce pain and improve functional outcomes in individuals with CLBP (Hicks *et al*., 2005).

Exercise programs, including aerobic exercise, yoga, and Pilates, are also commonly recommended for individuals with CLBP. Regular physical activity helps to improve cardiovascular fitness, reduce muscle tension, and promote endorphin release, which can alleviate pain and improve mood (Searle *et al*., 2015). However, adherence to exercise programs can be challenging for individuals with chronic pain, and fear of movement or re-injury often limits engagement in physical activity (Vlaeyen & Linton, 2000).

Cognitive-behavioral therapy (CBT) is a psychological intervention that aims to address the negative thoughts, emotions, and behaviors associated with chronic pain (Jensen *et al*., 2011). CBT helps individuals develop coping strategies to manage pain, reduce fear-avoidance behaviors, and improve overall quality of life. Studies have shown that CBT can be an effective adjunct to physical therapy in managing chronic low back pain (Ehde *et al*., 2014).

Manual therapies, such as chiropractic manipulation and massage, are also commonly used to treat CLBP. Spinal manipulation, performed by chiropractors or physical therapists, involves the application of controlled force to the spine to improve alignment and reduce pain (Rubinstein *et al*., 2019). While some studies suggest that spinal manipulation can provide short-term pain relief, the long-term benefits of this therapy remain uncertain (Paige *et al*., 2017).

Surgical interventions

Surgical interventions, such as spinal fusion, laminectomy, and discectomy, are typically reserved for individuals with severe CLBP who do not respond to conservative treatments and have clear structural abnormalities, such as disc herniation or spinal stenosis (Deyo *et al*., 2005). Spinal fusion involves the permanent joining of two or more vertebrae to reduce motion and alleviate pain caused by instability or degenerative changes in the spine. While spinal fusion can provide pain relief for some individuals, it is associated with significant risks, including infection, nerve damage, and adjacent segment degeneration (Fritzell *et al*., 2001).

Laminectomy, a surgical procedure that involves removing part of the vertebral bone (lamina) to relieve pressure on the spinal cord or nerves, is commonly performed for individuals with spinal stenosis (Malter *et al*., 1998). Discectomy, the removal of a herniated disc that is compressing a nerve, is another common surgical procedure for individuals with radicular pain caused by disc herniation. Although surgical interventions can provide relief for certain individuals, the outcomes are highly variable, and the decision to undergo surgery should be made carefully in consultation with a spine specialist (Jacobs *et al*., 2011).

Limitations of traditional treatments

Despite the wide range of available treatments for chronic low back pain, many individuals continue to experience persistent pain and disability. A systematic review by Maher *et al*. (2017) found that most conventional treatments for CLBP provide only modest improvements in pain and function, with many individuals experiencing recurrent episodes of pain. Moreover, the long-term use of pharmacological treatments, particularly opioids, is associated with significant risks, including addiction and overdose (Deyo *et al*., 2015).

The limitations of traditional treatments for CLBP have led to increased interest in alternative therapies, such as acupuncture, yoga, and manual therapies, as well as newer treatment modalities like Matrix Rhythm Therapy (MRT). These therapies aim to address the underlying causes of chronic pain by promoting tissue healing, reducing inflammation, and improving mobility. Alternative therapies are often used in combination with conventional treatments to provide a more holistic approach to pain management (Chou *et al*., 2007).

Introduction to matrix rhythm therapy

Matrix Rhythm Therapy (MRT) is a relatively new treatment modality based on the principles of cellular biology and the rhythmic micro-vibrations of body tissues (Randoll, 2002). Developed by Dr. Ulrich Randoll, MRT aims to restore normal cellular function and tissue mobility by applying rhythmic mechanical vibrations to the affected areas. These vibrations are thought to stimulate the extracellular matrix, improve blood flow, and enhance lymphatic drainage, thereby promoting tissue repair and reducing pain (Loew *et al*., 2011).

The extracellular matrix (ECM) plays a crucial role in maintaining the structural integrity and function of tissues throughout the body. The ECM is a complex network of proteins, such as collagen and elastin, that provides mechanical support to cells and regulates various cellular processes, including proliferation, differentiation, and migration (Frantz *et al*., 2010). In individuals with chronic low back pain, the ECM in the lumbar region may become stiff and less elastic due to inflammation, fibrosis, and muscle spasm, leading to pain and reduced mobility (Sroga & Vashishth, 2012).

MRT aims to restore the normal rhythm of cellular activity by applying mechanical vibrations that mimic the natural micro-movements of healthy tissues (Randoll, 2002). The therapy is performed using a handheld device that generates rhythmic vibrations at a frequency of 8-12 Hz, which is believed to correspond to the natural frequency of cell movement. The vibrations are applied directly to the affected muscles, tendons, and connective tissues, promoting relaxation, reducing muscle tension, and enhancing circulation (Loew *et al*., 2011).

Mechanism of action of matrix rhythm therapy

Matrix Rhythm Therapy is based on the principle that cells within the body exhibit rhythmic oscillations or micro-vibrations as part of their normal physiological function. These micro-vibrations are essential for maintaining the mechanical properties of tissues, such as elasticity, viscosity, and permeability (Randoll, 2002). In healthy tissues, the cells and the surrounding ECM work in harmony to ensure optimal tissue function. However, in individuals with chronic pain or injury, the natural rhythm of cellular activity may be disrupted, leading to tissue stiffness, reduced blood flow, and impaired cellular metabolism (Loew *et al*., 2011).

MRT aims to restore the normal rhythm of cellular activity by applying rhythmic mechanical vibrations to the affected tissues. The mechanical vibrations generated by the MRT device are thought to stimulate the ECM and improve the movement of interstitial fluids, such as blood and lymph. This, in turn, enhances the delivery of oxygen and nutrients to the cells, promotes the removal of waste products, and reduces inflammation (Randoll, 2002).

Studies have shown that MRT can reduce muscle stiffness, improve tissue elasticity, and enhance joint mobility in individuals with musculoskeletal conditions, such as osteoarthritis and low back pain (Loew *et al*., 2011). By promoting tissue healing and reducing pain, MRT offers a promising alternative to traditional treatments for chronic low back pain.

Objective

This case study aims to evaluate the effectiveness of Matrix Rhythm Therapy in alleviating pain and improving functional mobility in a patient with chronic low back pain. The study will explore changes in pain levels using the Visual Analog Scale (VAS) and functional mobility using the Oswestry Disability Index (ODI) before and after a four-week MRT intervention.

Methods

Study design

This case study involves a single patient diagnosed with chronic low back pain. The patient underwent a series of MRT sessions over four weeks, with each session focusing on the lumbar region to target muscle and connective tissue dysfunction. The effectiveness of the intervention was evaluated using two standardized measures: the Visual Analog Scale (VAS) for pain assessment and the Oswestry Disability Index (ODI) for functional mobility assessment.

Patient profile

The patient was a 45-year-old male diagnosed with chronic low back pain for the past five years. His pain was primarily localized in the lumbar region, with intermittent episodes of radiating pain to the lower extremities. The patient's pain intensity fluctuated, and he reported that the pain worsened after prolonged sitting or standing. He had previously tried various treatments, including physical therapy, NSAIDs, and acupuncture, but experienced only temporary relief.

Intervention

Matrix Rhythm Therapy was administered to the patient for four weeks, with three sessions per week. Each session lasted approximately 30-45 minutes and targeted the lumbar muscles and surrounding connective tissues. The MRT device used oscillatory vibrations at a frequency range of 8-12 Hz to promote cellular activity and improve tissue function. The therapist focused on areas of increased muscle tension and restricted mobility, using the MRT device in conjunction with manual therapy techniques to enhance the therapeutic effect.

Outcome measures

Visual Analog Scale (VAS)

The Visual Analog Scale (VAS) is a widely used tool for assessing pain intensity. It is a 10 cm horizontal line where 0 represents "no pain" and 10 represents "the worst pain imaginable." The patient marked their pain level on the VAS at baseline (before the intervention) and after the four-week MRT treatment.

Oswestry Disability Index (ODI)

The Oswestry Disability Index (ODI) is a standardized questionnaire used to assess the degree of disability related to low back pain. It includes 10 items that evaluate various aspects of daily living, such as pain intensity, personal care, lifting, walking, sitting, standing, sleeping, social life, traveling, and employment/homemaking. The ODI score ranges from 0 to 100, with higher scores indicating greater disability. The ODI was administered to the patient at baseline and post-intervention.

Data analysis

The changes in pain levels and functional mobility were analyzed by comparing the VAS and ODI scores before and after the four-week MRT intervention. A percentage reduction in VAS and ODI scores was calculated to determine the effectiveness of the therapy.

Results

Pain Reduction

The patient's VAS score at baseline was 8, indicating a high level of pain intensity. After completing the four-week MRT intervention, the patient's VAS score decreased to 4, representing a 50% reduction in pain intensity. The patient reported experiencing less frequent episodes of radiating pain to the lower extremities and noted an overall improvement in pain management during daily activities.

Improvement in functional mobility

The patient's ODI score at baseline was 40, indicating moderate disability due to chronic low back pain. Following the MRT intervention, the patient's ODI score decreased to 26, corresponding to a 35% improvement in functional mobility. The patient reported greater ease in performing daily activities, such as walking, standing, and sitting, and noted an improvement in sleep quality and social life.

Discussion

The findings from this case study demonstrate that Matrix Rhythm Therapy (MRT) is a potentially effective intervention for reducing pain and improving functional mobility in patients with chronic low back pain (CLBP). The patient in this study experienced a 50% reduction in pain as measured by the Visual Analog Scale (VAS) and a 35% improvement in functional mobility according to the Oswestry Disability Index (ODI). These results highlight the therapeutic potential of MRT in addressing both pain and functional impairment associated with CLBP.

In this section, the discussion will focus on several key areas: the comparison of these results with existing literature, the potential mechanisms of action underlying MRT, its role in the broader spectrum of CLBP management, and the limitations and future research directions.

Comparison with existing literature

The results observed in this case study align with findings from other studies that have explored the effectiveness of MRT in various musculoskeletal conditions. For instance, Loew *et al*. (2011) conducted a randomized controlled study examining the effects of MRT in patients with coxarthrosis (hip osteoarthritis) and found significant improvements in pain, mobility, and quality of life. Similarly, Randoll (2002) reported improvements in tissue flexibility and muscle relaxation in patients undergoing MRT for musculoskeletal disorders. The current case study adds to this growing body of evidence by demonstrating the potential benefits of MRT for individuals with chronic low back pain.

The observed reduction in pain is comparable to that seen in other physical therapy interventions for CLBP, such as exercise therapy and manual therapy. For example, systematic reviews have shown that exercise therapy, particularly core stabilization exercises, can reduce pain by 10-50% in patients with CLBP (Hicks *et al*., 2005; Searle *et al*., 2015). Similarly, manual therapies such as spinal manipulation and massage have been associated with modest pain relief and functional improvement in patients with CLBP (Rubinstein *et al*., 2019). MRT appears to offer similar benefits, though the mechanism of action is distinct from that of other therapies, which often rely on joint manipulation, stretching, or strengthening exercises.

Additionally, the observed 35% improvement in functional mobility as measured by the ODI is consistent with improvements seen in patients undergoing other forms of physical rehabilitation for CLBP. Studies of exercise programs, including yoga and Pilates, have reported improvements in functional outcomes ranging from 20-40% in patients with CLBP (Sherman *et al*., 2013; Altan *et al*., 2012). These findings suggest that MRT can provide clinically meaningful improvements in mobility and daily function, making it a viable option for individuals seeking to enhance their functional capacity.

Potential mechanisms of action

The exact mechanisms through which MRT exerts its therapeutic effects remain an area of active investigation. However, based on the principles of Matrix Rhythm Therapy and existing research, several plausible mechanisms can be proposed.

One of the primary mechanisms by which MRT may reduce pain and improve mobility is through the restoration of normal cellular rhythm and tissue elasticity. The therapy is based on the concept that rhythmic micro-vibrations in body cells are essential for maintaining the mechanical properties and function of tissues (Randoll, 2002). In conditions such as CLBP, chronic inflammation, fibrosis, and muscle spasm can disrupt the natural rhythm of cellular activity, leading to tissue stiffness and reduced mobility. MRT aims to restore this rhythm by applying mechanical vibrations that mimic the natural oscillations of healthy tissues. These vibrations are thought to enhance blood flow, promote lymphatic drainage, and improve the movement of interstitial fluids, thereby reducing inflammation and promoting tissue healing (Loew *et al.*, 2011).

Another potential mechanism is the reduction of muscle tension and spasm. Chronic low back pain is often associated with increased muscle tension, particularly in the paraspinal muscles, which can exacerbate pain and limit mobility (Sroga & Vashishth, 2012). By applying rhythmic vibrations to the affected muscles and connective tissues, MRT may promote muscle relaxation, reduce spasm, and improve tissue flexibility. This reduction in muscle tension could lead to a decrease in pain and an increase in functional mobility, as observed in the patient in this study.

Furthermore, MRT may have an impact on the nervous system, particularly through the modulation of pain pathways. Chronic pain is known to involve both peripheral and central sensitization, wherein the nervous system becomes hyper-responsive to pain stimuli (Woolf, 2011). By improving tissue health and reducing local inflammation, MRT may help to reduce peripheral sensitization, thereby decreasing the transmission of pain signals to the central nervous system. Additionally, the rhythmic vibrations applied during MRT may stimulate mechanoreceptors in the skin and muscles, which can modulate pain perception through the "gate control" theory of pain (Melzack & Wall, 1965). According to this theory, non-painful stimuli, such as the mechanical vibrations used in MRT, can "close the gate" to pain signals, thereby reducing the perception of pain.

Role of MRT in chronic low back pain management

Given the complex and multifactorial nature of chronic low back pain, effective management typically requires a multimodal approach that addresses both the physical and psychosocial aspects of the condition. MRT offers a unique addition to the array of non-pharmacological interventions available for CLBP management. Its non-invasive nature, coupled with its focus on restoring tissue function and cellular rhythm, makes it an attractive option for patients seeking alternatives to more invasive treatments, such as surgery or long-term pharmacological interventions.

One of the advantages of MRT is its ability to target both the local and systemic factors contributing to CLBP. By improving tissue elasticity, reducing inflammation, and enhancing blood flow, MRT may help to address the underlying biomechanical issues that contribute to chronic pain. This contrasts with some other therapies, such as pharmacological treatments, which primarily focus on symptom management rather than addressing the root causes of pain.

Additionally, MRT can be used in conjunction with other rehabilitation interventions, such as physical therapy and cognitive-behavioral therapy (CBT), to provide a more holistic approach to pain management. For example, patients may benefit from combining MRT with exercise therapy to improve strength and flexibility, while CBT can help address the psychological factors that often accompany chronic pain, such as fear-avoidance behaviors and depression (Jensen *et al.*, 2011). This multimodal approach may enhance overall treatment outcomes and improve patients' quality of life.

Limitations of the study

While the findings from this case study are promising, several limitations should be acknowledged. First and foremost, this study involved only a single patient, and as such, the results may not be generalizable to the broader population of individuals with chronic low back pain. Larger, controlled studies are needed to validate the effectiveness of MRT and to determine the optimal treatment protocols for different patient populations.

Another limitation is the relatively short duration of the intervention and follow-up period. The patient in this study underwent MRT sessions over a four-week period, and the outcomes were assessed immediately after the intervention. It is unclear whether the observed improvements in pain and mobility would be sustained over a longer period. Future studies should include longer follow-up periods to assess the durability of the treatment effects and to determine whether additional sessions are necessary for long-term pain management.

Additionally, the study did not include a control group or a comparison with other treatment modalities. Without a control group, it is difficult to determine whether the observed improvements were solely attributable to MRT or whether other factors, such as the natural course of the condition or placebo effects, may have played a role. Future research should include randomized controlled trials (RCTs) to compare the efficacy of MRT with other established treatments for CLBP, such as exercise therapy, manual therapy, or pharmacological interventions.

Finally, the mechanisms underlying MRT's effects remain speculative, and more research is needed to elucidate the physiological changes that occur during and after treatment. Studies using imaging techniques, such as MRI or ultrasound, could help to visualize changes in tissue structure and blood flow following MRT, while biochemical analyses could assess changes in inflammatory markers and tissue metabolism.

Future research directions

Despite the limitations of this study, the findings suggest several avenues for future research on the use of MRT for chronic low back pain. First, larger-scale studies are needed to confirm the effectiveness of MRT in diverse patient populations and to explore its potential as a first-line treatment for CLBP. Randomized controlled trials comparing MRT with other non-pharmacological interventions, such as exercise therapy, manual therapy, and cognitive-behavioral therapy, would provide valuable insights into its relative efficacy.

Second, further research is needed to investigate the optimal treatment parameters for MRT, including the frequency, duration, and intensity of the therapy. It is currently unclear whether certain patient subgroups, such as those with specific structural abnormalities or varying degrees of pain severity, may respond better to MRT than others. Identifying these factors could help to tailor the therapy to individual patient needs and improve treatment outcomes.

Third, mechanistic studies are warranted to better understand how MRT influences tissue health and pain pathways. Exploring the effects of MRT on cellular function, inflammation, and nerve sensitivity could provide important insights into the biological mechanisms underlying its therapeutic effects. This knowledge could also inform the development of new treatment modalities that target similar pathways.

Lastly, research should focus on the long-term outcomes of MRT and its potential role in preventing the recurrence of chronic low back pain. Chronic pain is often characterized by recurrent episodes of pain and disability, and it is unclear whether MRT can help to prevent these relapses. Long-term follow-up studies would provide valuable information on the sustainability of MRT's effects and its potential role in long-term pain management.

Conclusion

Matrix Rhythm Therapy (MRT) offers a promising non-invasive treatment option for individuals with chronic low back pain. The findings from this case study suggest that MRT can reduce pain and improve functional mobility, making it a valuable addition to the array of available interventions for CLBP. However, further research is needed to confirm its effectiveness, explore its mechanisms of action, and determine its long-term benefits. Given the complex nature of chronic low back pain, MRT may be most effective when used as part of a multimodal treatment approach that addresses both the physical and psychosocial aspects of the condition.

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Chapter - 11

Effectiveness of Stretching and Weight Bearing Exercises in the Management of Spastic Paraplegia in Patient with HSP

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Chapter - 11

Effectiveness of Stretching and Weight Bearing Exercises in the Management of Spastic Paraplegia in Patient with HSP

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Abstract-

Background: People with hereditary spastic paraplegia (HSP) experience difficulties adapting their gait to meet environmental demands, a skill required for safe and independent ambulation. Gait adaptability training with stretching and weight bearing exercises to improve performance of patients with HSP. It is unknown whether gait adaptability can be trained in people with HSP.

Aim: The aim of Move-HSP is to study the effects of stretching and weight bearing training alone, compared with combination of stretching with weight bearing training, on gait adaptability in people with pure HSP.

Method: Stretching was applied for 30 sec with 30 sec rest 3-5 times for each muscle group of lower limbs within pain limit followed by strengthening exercise for weak muscles which was performed by all three groups; each group contained ten repetitions for each weak muscle group. Weight bearing exercise was performed by patients for 60 sec with 30 sec rest 3times for hip, knee, ankle for stability of lower limb and improvement of gait.

Result: Among the 30 participants in our study 13 were females and 17 were males. the SD for MAS [0.50] and for MTUGT [1.34]. The study shows that, there is significant difference in MAS and MTUGT after the treatment. the P value of MAS is 0.024 and MTUGT is 0.40 which is strongly significant for the protocol.

Keywords: HSP, stretching, weight bearing, gait adaptability.

Introduction

Combining inherited single-gene neuronal degenerative and developmental illnesses, hereditary spastic paraplegia (HSP) primarily affects the lower extremities and presents with severe clinical symptoms as fragility and stiffness [1]. Degenerating descending fibers in the corticospinal and posterior columnar regions in either autosomal dominant, autosomal recessive, mitochondrial, or X-linked inheritance patterns are additional clinical symptoms [2]. The disorders associated with HSP are called spastic paraplegia genes (SPG); so far, 80 SPGs have been found, with an uncommon incidence ranging from 1 to 5 per 100,000 people worldwide. The global prevalence of SPG is 1.8/100,000, according to a meta-analysis, with the SPG3A, SPG4, and SPG11 subtypes accounting for the majority of registered cases and representing the rare diagnoses in consanguineous settings [3, 4]. A meta-analysis involving 13570 people revealed the often occurring genetic

Clinically, HSP is distinguished as pure and complex based on the presence of any add-on neurological manifestations other than paraparesis, as described by Harding [6]. HSP progression is slower due to the neural dysfunction in the corticospinal region. HSP includes complications such as losing vibration senses (abnormal sensory pathway) and loss of bladder control [1]. However, complex HSP is accompanied by neurological and non-neurological manifestations, such as ataxia, epilepsy, neuropathy, optic atrophy, dysarthria, and skeletal deformities [1, 7]. HSP lacks a straightforward genotypic-phenotypic association due to the sudden onset of manifestations irrespective of age. The symptoms can be triggered as early as infancy or late adulthood with various clinical presentations at different progressive and disability rates within the same families with similar mutations [8].

According to the global geographical location, the prevalence of HSP varies from 1 to 5 among 100,000 individuals, with the majority showing mutations in the SPAST gene in the autosomal dominant pure pattern in northern America and northern Europe [9]. The prevalence of familial inheritance is often higher than the sporadic form (2:1) in 70% of autosomal dominance linked to pure HSPs [10].

Objectives

- The aim of the study is to determine the effectiveness of stretching in the management of spastic paraplegia.
- To determine the effects of weight bearing exercise in spastic paraplegia.
- To evaluate the gait and balance of patients with spastic paraplegia.
- To study the effects of weight bearing exercises on spasticity by Modified Ashworth Scale (MAS) in spastic HSP patients.
- To study the effects of weight bearing exercises on spasticity by Modified Time up & Go Test Scoring (MTUGT) in spastic HSP

patients.

- To study the effect of weight bearing exercises on spasticity based on motor functions by GMFCS Levels in spastic HSP patients

Hypothesis

- **Null hypothesis:** There will be no significant difference between effectiveness of stretching and weight bearing exercises alone and in combination in patients with spastic paraplegia.
- **Alternative hypothesis:** There will be significant difference between effectiveness of stretching and weight bearing exercises alone and in combination in patients with spastic paraplegia.

Significance of the study

- It will be a great change towards the increase in rate of recovery of patients suffering from the spastic paraplegia. Thus, it will reduce the propagation of genetic spastic paraplegia.

Materials and methods

Research design: Experimental

The patient sample will be selected based on inclusion criteria.

Note: stretching was applied for 30 sec with 30 sec rest 3-5 times for each muscle group of lower limbs within pain limit followed by strengthening exercise for weak muscles which was performed by all three groups; each group contained ten repetitions for each weak muscle group.

Weight bearing exercise was performed by patients for 60 sec with 30 sec rest 3times for hip, knee, ankle for stability of lower limb and improvement of gait.

Research area: Lucknow, UP

Duration of the study: 1 year

Sample size: 30 individuals with spastic paraplegia.

Method of data collection

The data will be collected manually from each patient

Sample collection procedure

- Procedure will be explained to all patients
- Consent form will be signed from the patient.

- Identify the dependent variable in the patients.
- All patients were ambulant with crouch gait pattern and had grades I and II according to gross motor function classification systems.
- Spasticity of grade 1 or grade 1^+ according to modified Ashworth scale.
- All patients can follow orders and have neither auditory nor visual disorders.
- Patients will be excluded if they had hip dislocation, fixed contractures or deformity, surgical intervention as surgical release, rhizotomy and tenotomy, Botulinum toxin injections, baclofen pump, osteoporosis, heart diseases, uncontrolled convulsions, and leg length discrepancy.

Instrument required

1. Modified Timed Up & Go Test
2. Modified Ashworth Scale -spasticity (hypertonicity)
3. Gross Motor Function Classification System (GMFCS)- classify motor function
4. Chair (back and arm cushioning)
5. Vestibular ball
6. Colorful pegs, markers
7. Body weight suspension treadmill 8. Couch, Stopwatch

Subject selection criteria-

Inclusion criteria

- Age 50-60 years
- Both gender (male and female)
- Patients had grades I and II according to gross motor function classification systems.
- Spasticity of grade 1 or grade 1^+ according to modified Ashworth scale.

Exclusion creteria

- Auditory and visual disorder
- Hip dislocation
- Fixed contracture deformity

- Heart disease
- LLD
- Convulsions

Outcome measures

- Modified Ashworth Scale
- Modified Time Up & Go Test

Variables

Dependent variables

- Gait
- ROM
- Stretching
- Weight bearing exercise

Independent variables

- Age
- Gender

Procedure

To treat HSP spastic paraplegia, it requires a long-term treatment and medical care of various fields. The treatment, follow-up in following manner-

a) **Weight bearing exercises:** Patient are unable to take weight of their own body on their limbs which makes those parts of body weak. Patients are made to take weight on their lower limbs by putting them in various positions and performing certain exercises. Positions included like squatting that helps to weight bearing on the feet's, quadruped position which help them to take weight on their knees and hands. Single-leg standing and standing with/ without support help them to weigh over whole body on their limbs for about 5-10minutes/day session.

Stretching was applied for 30 sec with 30 sec rest 3-5 times for each muscle group of lower limbs within pain limit followed by strengthening exercise for weak muscles which was performed by all three groups; each group contained ten repetitions for each weak muscle group.

b) **Balancing exercises:** Patient of spastic HSP have difficulty in balancing. To help them in balancing their own body, physiotherapist make them to perform various balancing exercises. Exercises included like balance board or wobble board exercises, wedge exercises, vestibular ball exercises all these exercises for 5-15 minutes per day.

c) **Walking exercises:** Helping the HSP patients to initiate walking, with exercises like, treadmill walking, posterior walker walking, and walking with the minimal amount of external support in 5 minutes/day session.

d) **Coordination exercises:** Helping the HSP patients to build up their coordination and maintain the body in perfect anatomical posture. Exercise included were Frenkel exercises, treadmill walking (for 1.5-2.2km/hours for 3 minutes a day), vestibular ball exercises all are combined and completed in 5-10 minutes/day.

e) **Core stability:** Exercises help the patients in strengthening core muscles. These exercises include vestibular ball exercises, exercises of abdomen, supine to sitting, etc., for about 5minutes/day in a day session.

All exercises repeated for 2 days/week, 45-60 minutes session for 6 weeks. Orthoses were given to maintain correct posture of limb and improve balance and movements. Such devices are braces, cast, splints, ankle foot orthoses, ankle foot knee orthoses. Modalities were used to stimulate the muscles and initiate the movement by reeducating them. Muscle stimulator was given over knee flexors and extensors at burst mode for 5 minutes per day to improve muscles contraction and relaxation movement.7 Vibrations were also provided for about 5minutes/day to the limbs & back muscles to give proprioception and reduce hyper sensory reflexes. Myofascial therapies play a good role in increasing joint range of motion, provide flexibility to the muscles, also reduce tightness in them and by increases the velocity of therapy we can reduce flaccidity.

Data analysis

The participants in research were given an informed consent form signed by parents, & responses were registered on MS-Excel sheet for review. There were around 30 subjects included in the study meeting all the inclusive criteria. Exercises were conducted in equal intervals for each subject. Data were collected based on spasticity level scored by using MAS scoring (pre and post treatment for 6 weeks) and MTUGT scoring (pre and post treatment for 6 weeks) with respect to GMFCS levels improvements in each subject. The Shapiro-Wilks test used to check the normality levels, and provided with descriptive statistics, and paired t-tests were conducted with significance of $p < 0.05$ assumed.

Results

Among the 30 participants in our study 13 were females and 17 were males. Mean age of participants of both groups was [25.15] Data were collected based on inclusion criteria and spasticity level scored by using Modified Ashworth Scale (MAS) scoring (pre and post treatment for 6 weeks) and Modified Time Up & Go Test (MTUGT) scoring (pre and post treatment for 6 weeks) with respect to GMFCS levels improvements in each subject. The two sample T- test revealed that there was significant difference in spasticity, balance and gait with the mean of MAS after treatment [2.33] and of MTUGT after treatment [16.86] with the SD for MAS [0.50] and for MTUGT [1.34]. The study shows that, there is significant difference in MAS and MTUGT after the treatment. The P value of MAS is 0.024 and MTUGT is 0.40 which is strongly significant for the protocol.

Table 1: Data collected of subjects according to MAS & MTUGT (pre and post treatment)

	Gender	**MAS**		**MTUGT (in seconds**	
	Male: female 17:13 N= 30	Pretreatment scoring	Post treatment scoring	Pretest scoring	Post test scoring
Mean		3.33	2.33	23.07	16.86

Table 2: Age and gender wise distribution of subjects

Age (years)	**Male**	**Female**	**Total**
50-52	4	3	**7**
53-55	6	4	**10**
56-58	3	2	**5**
59-60	4	4	**8**

Table 3: Distribution of subjects according to GMFC System levels

GMFCS levels	**No.of subjects**	**Percentage(%)**
Level I	8	20%
Level II	8	26.67%
Level III	14	53.34%
Total	30	100%

Table 4: MAS, MTUGT mean & SD value with respect to GMFCS levels

Scales	MAS		MTUGT		GMFCS	
	Pre treatment	**Post treatment**	**Pre treatment**	**Post treatment**	**Pre treatment**	**Post treatment**
Mean +_SD	**3.33+_0.49**	**2.33+_0.50**	**23.07+_1.34**	**23.07+_1.34**	Level 3 (difficult walking leading maximum support but only for short distance, a more no. of falls is seen)	Level 2 (walking with mild assistance for a variable distance, a smaller number of falls are seen)
t-value	**1.325**		**2.236**			
p-value	**0.024**		**0.040**			

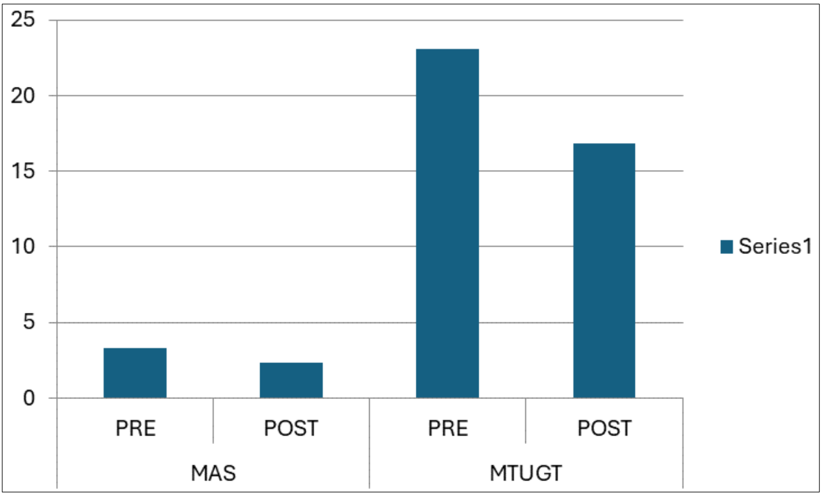

Fig 1: Graph showing the data collected of subjects according to MAS & MTUGT (pre and post treatment)

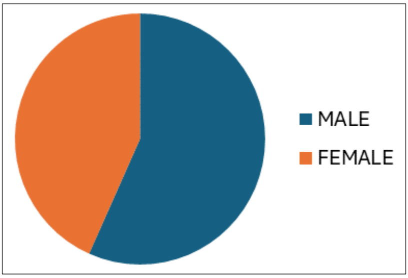

Fig 2: Pie chart showing the Age and gender wise distribution of subjects

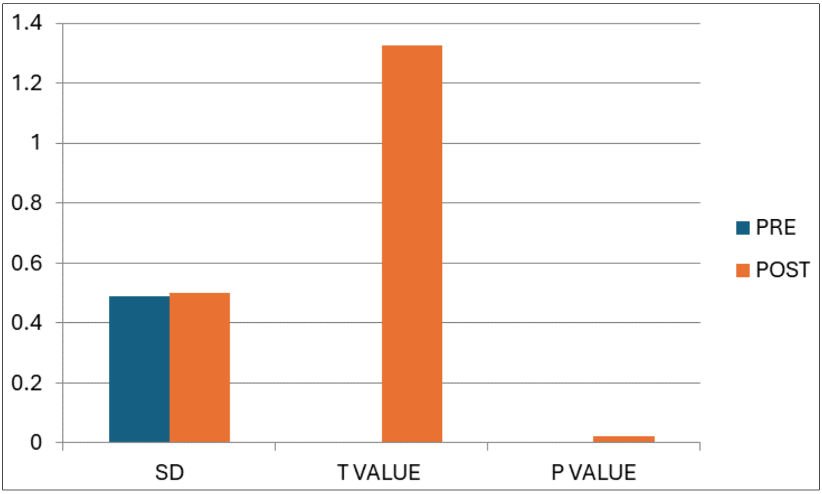

Fig 3: Graph showing the Distribution of subjects according to GMFC System levels

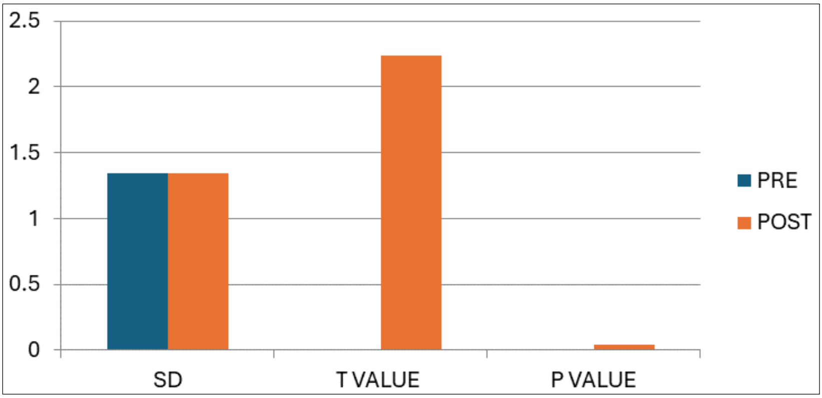

Fig 4: Graph showing the MAS, MTUGT mean & SD value with respect to GMFCS levels

Discussion

This study was done to understand the effect of weight bearing exercises on spasticity in patients due to spastic diplegia, and to appreciate the outcomes we received from the data analysis As spasticity is very common problem faced by patient with spastic paraplegia, therefore assessment should always be correct, and treatment should start at day 0 to give a good rehab in future. In this study, spasticity changes were seen from pre-treatment to post-treatment scoring done by MAS with respect to change in gross motor functions are also observed. 30 subjects were involved in the study aged from 50 to 60 years with a greater number of patients falling GMFCS Level III and trained for weight bearing exercises, balance exercises, core exercises, positional exercises, walking exercises, modalities were also given to enhance the functioning of the muscle and worked to re-educate the muscles shows an increased result in the level of GMFCS from III to II. Participants were having spasticity in their lower limbs which was scored as MAS 3 or 4, [Mean (SD)=3.33±0.49] as their baseline assessment; there was increased muscle tone, and some passive movements were difficulty while some show rigidity while performing flexion & extension. The scoring has been reduced to 1 or 2, [Mean (SD)= 2.33±0.50] after the rehab protocol which was followed for 6 weeks (refer to Table 4).

There was reduced spasticity in their limbs which was leading to decreased level of gross motor function of the individual, making passive movement less rigid. Modified Time Up & Go Test is a tool used to check the mobility, balance, walking and standing. Scoring was done in pre-treatment and post-treatment to record the data for data analysis. Participants were having spasticity and increased number of falls while walking for few meters ranges from 20-27s, [Mean (SD)= 23.06±1.34] as their baseline assessment; there was decreased number of falls and improved balance after the protocol followed 15- 20s, [Mean (SD)= 16.87±1.50] for 6 weeks (refer to Table 4).

The passive stretches analyzed in the selected articles (static and dynamic) produced an improvement in at least some of the variables assessed. However, not all of them returned significant results demonstrating their effectiveness. The efficiency achieved with passive static stretching may result from the few limits initially presented, or its efficiency with respect to others. However, studies involving passive static stretching used a protocol in which stretching is kept relatively short. One factor that can influence the results is the mode of application of stretching. The interventions that required a physical therapist for stretching took less time than the interventions involving self-stretching or external aid. It is possible that interventions involving means such as long-lasting orthoses or splints to prolong the effects of stretching over time were even better than a short-lived static passive or dynamic stretching. In the meta-analysis of Salazar *et al*. the results were positive for passive static stretching, including long-term orthoses, as an isolated intervention compared to nonintervention. Another related review is that of Bovend'Eerdt *et al*., in which no clear conclusions on stretching were drawn because of the study's limitations. However, it evaluates the effects of stretching on spasticity, but includes conditions such as multiple sclerosis and brain damage.

Passive stretching presents potential benefits in pwS with spasticity, although the intervention should be individualized and adapted to each patient and situation by the therapist, measuring both the duration of the stretching and the repetitions and sessions. A heterogeneity was identified in the outcome, intervention, and methodology measures of the selected studies that meet the inclusion criteria, so the results could be evaluated based on the following variables.

Spasticity, the most common complication associated with strokes, is the main variable revealed in this study. Performing passive stretching periodically is extremely important, as stretching is known to reduce the spasticity of the affected joints; however, it returns after some time. Pradhan and Bansal stated that the intervals between repetitions should be 2.5–3 h so that pain does not occur, so the need to perform multiple repetitions at frequent intervals is emphasized. In turn, it would be necessary to carry out a program that is sufficiently long, with respective evaluations before, during, after, and in a post-intervention period, to evaluate effectiveness in both the short and the long term. The previous authors also stated that stretching involved certain important factors such as speed, pain, and the position of the affected segment, which may influence the management of spasticity. In this sense, choosing the appropriate type of stretching is essential; thus, individualizing the intended physiological effects depending on the personalized alterations in each type of patient (e.g., myotatic reflex, inverse myotatic reflex). Eventually leading to an improved gait.

Spastic diplegic HSPHSP patients suffered from muscular tightness and loss of flexibility, leading to mechanical problems, loss of range of motion, and limited executive function abilities. Stretching exercise was applied to increase soft tissue flexibility in HSPHSP patients; some researchers reported that regular stretching does not produce clinical changes in joint mobility, spasticity, and function activities [11]. The functional stretching exercises were designed to treat soft tissue flexibility problems during function training; stretching is applied in unique way depending on the concepts of overcorrection of deformities and prolonged stretching to utilize the inhibitory effect of stretching in improving function training during physical therapy treatment to optimize motor performance. Different techniques were used for spasticity evaluation, but we used H-reflex because it is standardized procedure and had greater evidence of validity [11].

Conclusion

HSP is the group of the Patients with neurological conditions or disorders which alters the motor abilities, movements, muscle tone or posture of the patient. It also hinders the ability on an individual to perform activities in a coordinated manner which also the hinderance in body function. More research should be conducted in this field especially with the growing technological, virtual reality which helps to assist the patient and decreases load on therapist side as well giving them a mechanical advantage. We got a positive result for study however it would be better to have a larger population data so that we can have a better outcome and the validity of the study can be checked. The patients with HSP spend their life suffering due to increased spasticity in the muscles. The study will be able to able to identify the outcome measure of patient following weight bearing exercises. Through this we conclude that when we provide the positional exercises, weight bearing exercises, and walking exercises in the treatment to the patients. It helps them to improve their spasticity level. Modalities were also used to initiate the muscles contraction and relaxation to re-educate the muscles to strengthen the muscles.

Functional stretching exercises are effective methods used in rehabilitation of spastic paraplegia in HSP; it reduced H \ M ratio, increased popliteal angle, and improved gait.

Limitation: This study presents some limitations. Firstly, the subjective method of measurements uses in data collection. Second one is small sample size with narrow age range covered.

Future study

The same study will be conducted with some objective variable and in large sample size along with childhood and old age group.

Significance in clinical practice

In subjects with spastic paraplegia there is slightly presence of functional and balance disabilities. That means spastic paraplegia has positive relationship with weight bearing exercise and stretching. This statement holds true with 95% confidence level and the data of present study can be use in clinical practice. Furthermore, suggestion should be given to such population to reduce spasticity or improve functional level.

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Chapter - 12

Effects of Proprioceptive Training on Postural Stability Iin Subjects with Diabetic Neuropathy

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Chapter - 12

Effects of Proprioceptive Training on Postural Stability Iin Subjects with Diabetic Neuropathy

Gourab Jyoti Roy, Urusia Parveen and Fatima Saeed

Abstract

Background: Proprioceptive training is an intervention that targets the improvement of proprioceptive function. It focuses on the use of somatosensory signals such as proprioceptive or tactile afferents in the absence of information from other modalities such as vision. Postural stability is the ability to control the body position in space for the purpose of movement and balance. Diabetic neuropathy is nerve damage that can occur in people with diabetes. Different types of nerve damage cause different symptoms.

Objective: To determine the effects of proprioception training in improving balance in patients with diabetic neuropathy.

Method: The total of 30 subjects with type 2 diabetic peripheral neuropathy will be assigned in two groups with 15 subjects in each group.

Results: Of the 38 patients, there were 19(50%) in the exercise group with a mean age of 64±7.7 years; 10(52.6%) males and 9(47.3%) females. The control group had 19(50%) patients with a mean age of 63±8.2 years; 12(63.1%) males and 7(36.8%) females. The one leg standing score with eyes open improved significantly ($p < 0.05$), but the difference was non-significant with eyes closed (p = 0.073). Berg balance scale and timed-up and go scores revealed significant improvement in the exercise group ($p < 0.05$).

Conclusion: Proprioception training exercises were found to be effective in improving balance among patients with diabetic neuropathy.

Keywords: Proprioception, postural stability, diabetic neuropathy, static balance, dynamic balance.

Introduction -

Proprioceptive training: Proprioceptive training is an intervention that targets the improvement of proprioceptive function. It focuses on the use of somatosensory signals such as proprioceptive or tactile afferents in the absence of information from other modalities such as vision. Its ultimate goal is to improve or restore sensorimotor function. Because the term proprioceptive training has been widely used and claims of improved proprioception through specific interventions are commonly found in the literature, we applied the above definition to conduct a systematic review on the effectiveness of proprioceptive training. Given the importance of proprioception for motor control, it has been argued that therapies aiming to restore motor function after injury should focus on training the proprioceptive sense. Numerous interventions claim to constitute a form of proprioceptive training that improves proprioception and aids motor recovery. Unfortunately, there is little agreement of what actually constitutes proprioceptive training, which may be partially owed to the fact that there are various definitions for the term proprioception.

Postural stability: Posture is generally defined as the orientation of the body in specific positions (Rosário, 2014). It can be described in stillness or during movement. Postural stability is the ability to control the body position in space for the purpose of movement and balance (Woollacott and Shumway-Cook, 2002). It is necessary for maintaining a static position and for assisting body coordination in dynamic position changes. Prolonged poor or incorrect postures can cause musculoskeletal disorders.

Diabetic neuropathy: Polyneuropathy is a common problem for people with diabetes, leading to pain and impaired sensation and movement in the limbs1. Diabetic neuropathy plays a significant role in falling as patients often experience balance disorder. Postural sway in those patients is increased, especially with the eyes closed.

Diabetic neuropathy is basically two types

Peripheral and autonomic neuropathy Peripheral neuropathy caused by diabetes significantly causes impairment of feet sensation, reducing patients' ability to control their balance properly during daily activities. Poor balance can be attributed to proprioception impairment, movement-strategy dysfunction, biomechanical structural disorders, and disorientation. Consequently, postural instability caused by peripheral neuropathy increases the impact of microtraumas and wounds.

Autonomic neuropathy is damage to nerves that control your internal organs, leading to problems with your heart rate and blood pressure, digestive system, bladder, sex organs, sweat glands, and eyes. The damage can also lead to hypoglycemia unawareness.

Polyneuropathy is a common problem for people with diabetes, leading to pain and impaired sensation and movement in the limbs [1]. Diabetic neuropathy plays a significant role in falling as patients often experience balance disorder [2, 3]. Postural sway in those patients is increased, especially with the eyes closed [4]. Peripheral neuropathy caused by diabetes significantly causes impairment of feet sensation, reducing patients' ability to control their balance properly during daily activities [5]. Poor balance can be attributed to proprioception impairment, movement strategy dysfunction, biomechanical structural disorders, and disorientation [6, 7]. Consequently, postural instability caused by peripheral neuropathy increases the impact of microtraumas and wounds [8]. Proprioception plays a major role in stabilizing body equilibrium during both quiet stance and unexpected postural perturbations [9, 10]. Accordingly, patients with peripheral neuropathy are unstable when standing with eyes closed [11]. Many authors have found that individuals with diabetes and peripheral neuropathy demonstrate impaired postural control in quiet standing compared to healthy control subjects. Boucher and colleagues [12] reported that individuals with diabetes and peripheral neuropathy had greater postural sway in quiet standing and greater difficulty integrating sensory information for balance control than healthy control subjects. They added that postural control was related to the severity of peripheral neuropathy. Additionally, Lafond and co-authors [13] found that postural sway in elders with diabetes and peripheral neuropathy with eyes open was comparable to healthy elders with eyes closed. These studies focused on how diabetic peripheral neuropathy affects postural control. The objective of the current study was to assess the effects of proprioceptive training on balance indices during bipedal stance with eyes closed and functional balance in diabetic neuropathy patients.

Objectives

- The purpose of this study is to assess the effectiveness of proprioceptive training on postural stability in subjects with diabetic neuropathy.
- To evaluate the postural stability in subjects with diabetic neuropathy.
- To evaluate the type of neuropathy in patients
- To evaluate the effectiveness of proprioceptive training in subjects with diabetic neuropathy.

Hypothesis

- Null hypothesis: There will be no significant difference between effectiveness of proprioceptive training exercises with conventional physiotherapy and conventional physiotherapy alone on postural stability in patients with type 2 diabetic neuropathy.

- **Alternative hypothesis:** There will be significant difference between effectiveness of proprioceptive training exercises with conventional physiotherapy and conventional physiotherapy alone on postural stability in patients with type 2 diabetic peripheral neuropathy.

Significance of the study

It will be a great change towards the increase in rate of recovery of patients suffering from the diabetic neuropathy. Thus, it will reduce the propagation of Diabetic neuropathy.

Methodology

- **Study design:** The study design is pre and post-test experimental study design.
- **Study duration:** The study duration is one month.
- **Sample design:** Purposive sampling.
- **Sample size:** The total of 30 subjects with type 2 diabetic peripheral neuropathy will be assigned in two groups with 15 subjects in each group.
- **Sample collection method:** Judgemental sampling

Subject selection criteria

Inclusion criteria

- Age 50-60 years
- Type 2 diabetic peripheral neuropathy
- Both gender (male and female)
- Able to make unipedal stance for 20 seconds
- Ability to complete 2 min walk
- Strength of both lower limb muscles at least MRC grade

Exclusion criteria

- Patients with vestibular dysfunction
- Central nervous system dysfunction
- Musculoskeletal deformity
- Cardiovascular problems
- Planter ulcer
- Visual defects

Outcome measures

- Dynamic gait index
- Berg-balance scale

Variables

Dependent variables

- Gait
- Balance

Independent variables

- Proprioceptive training
- Conventional physiotherapy

Data collection procedure

- Procedure will be explain to the all patients
- Consent form will be signed from the patient.
- Identify the dependent variable in the patients.
- Evaluate the static postural stability of patients with help of BBS.
- Evaluate the dynamic postural stability of patients with help of dynamic gait index.
- Each patient is treated for 4 days a week for 4 weeks each therapy session lasting for about 45 minutes.

Outcome measures-

Berg Balance Scale (BBS) was used in order to evaluate functional balance before and after intervention. It is a valid and reliable scale including 14 functional tests, which can quantitatively evaluate balance in community-dwelling adults and patients with balance disorders. Berg Balance Scale completion needs 10-20 min. and its score represents the participant's ability to control postural balance. Patients assessed for eligibility (n=42) exclusion (n=14) for not meeting inclusion criteria 28 patients met the inclusion criteria patients randomly allocated (n=28) Proprioceptive training group (n=14) Conventional physiotherapy+ Proprioceptive training.

Each test is scored 0-4 (0 – inability to complete the task; 4 – independent task fulfilment). The overall score is the sum of the obtained scores for each test. Thus, the maximal overall score is 56, and the minimal is zero. The higher score indicates a better functional balance. Various studies have shown that

BBS has high Intra-rater, Inter-rater and test retest reliability.

- Equipment required- A ruler
- 2 standard chairs (one with arm rests, one without)
- A footstool or step
- 15 ft walkway
- Stopwatch or wristwatch

Procedure

Intervention was provided twice weekly for 8 weeks. Control group: Conventional physiotherapy treatment21 was given for 45 minutes with one minute rest for every five minutes of exercises. The program included the following exercises: Relaxed deep breathing exercise (3 min.), range of motion exercises for bilateral ankle joints (5 min.), functional balance training (15 min.) involving sit to stand (5 times); standing weight shift (5 times each); functional reach side way and anterior for touching targets set by the therapist (5 times each); bipedal heel rise for 20 seconds (5 times); unipedal standing for 15 seconds (5 times each) and unipedal standing with knee bending for 15 second (5 times each). Other exercises were practiced as wobble board training (6 min.) and gait training including tandem walking (5 min.) and spot marching (5 min.).

- **Proprioceptive training group:** The same conventional physiotherapy of the control group was practiced with an additional 26 minu. of proprioceptive training (one min. rest for every six min. of exercises). The protocol, as described by Santos *et al*.22 included a circuit with different floor textures composed of 13 stations of exercises with the objective of stimulating the sole of the foot where participants had to coordinate gait by stepping with alternate feet on markers placed on the ground and the progression was manipulated through modifications of speed and direction. The activity time at each station was two min. and the rhythm of the exercises was determined by alternating slow-paced and fast paced music. Materials used to build the circuit were used in the following sequence: 10 cm-thick foam, a wood box with beans, a two-cm thick mat with a density lower than the foam, a wood box with cotton, and again a similar two-cm thick mat. A balance board was then used to train the lateral balance reactions. At the seventh station, volunteers sat on a bench and trained feet flexors by grasping with the toes a towel put on the floor. At the eighth station, there was again a ten-cm thick foam. Two proprioception balls with an eight cm diameter with external projections resting on the floor were used on the next station. At the 10th and 11th stations, there was a box with grains and a two-cm mat. Balance and hip movements were trained at the 12th station with medicine balls (diameter 75cm). At the last station, sandpaper was placed on the ground and the patients had to alternately slide their feet on it.

Statistical analysis

The sample size was calculated with the Graphpad Statemate 2.0 software (Power test). Calculations were based on means and standard deviations of the balance indices obtained in a pilot study with an α =0.05 and power of 80% and the estimated sample size was 14 patients. Statistical analyses were completed using SPSS version 17.0 (SPSS, Inc, Chicago, IL). Normality of the data was determined with the Kolmogorov–Smirnov (KS) test for all statistical variables and the results confirmed use of parametric tests.

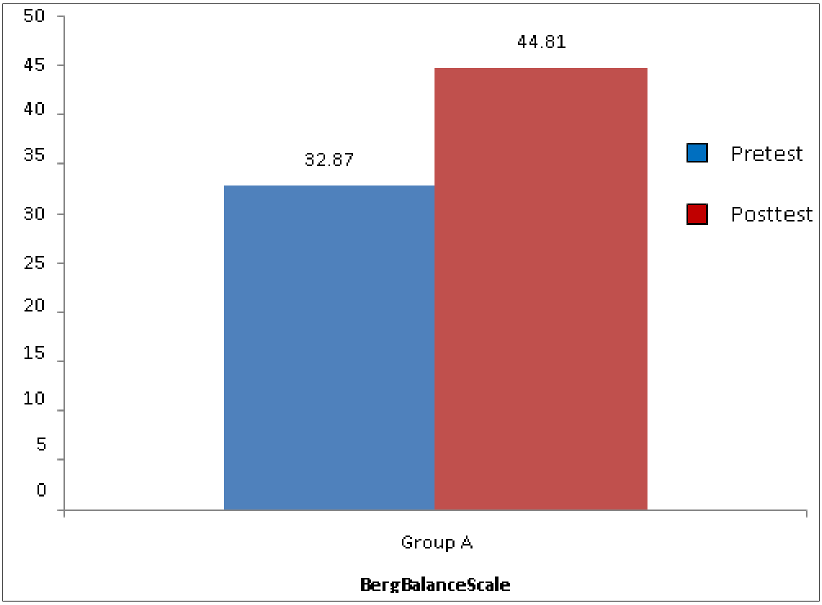
Results

All patients performed training without any complications and agreed to use of their training data. Kolmogorov-Smirnov analysis of normality showed that data distribution assessments were normal. No baseline differences regarding descriptive and demographic characteristics were found between both groups (table 1). Likewise, no significant differences regarding the studied parameters were found before the intervention (table 3).

BBS scores

Significant increase in BBS scores was found for both control group (P=0.021) and the proprioceptive training group (P=0.0001) (Table 2). Additionally, the difference was large in magnitude based on effect size (d=.8) between both groups after treatment.

DGI scores- significant changes was found.

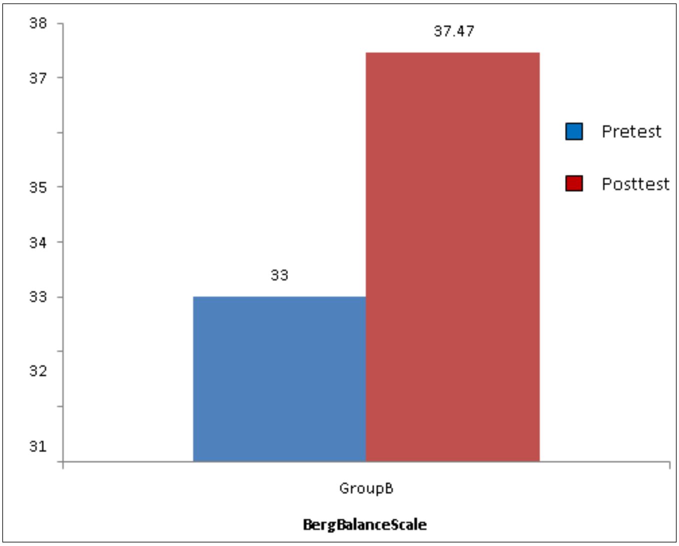


Graph 1: Berg balance scale for group 1

Table 1: Berg balance scale scoring for Group A

Outcome measure	Test	Mean	Standard deviation SD)	Calculated 't' value	P value
Berg balance scale	Pretest	32.87	2.26	20.46	<0.0001
	Posttest	44.81	3.76		

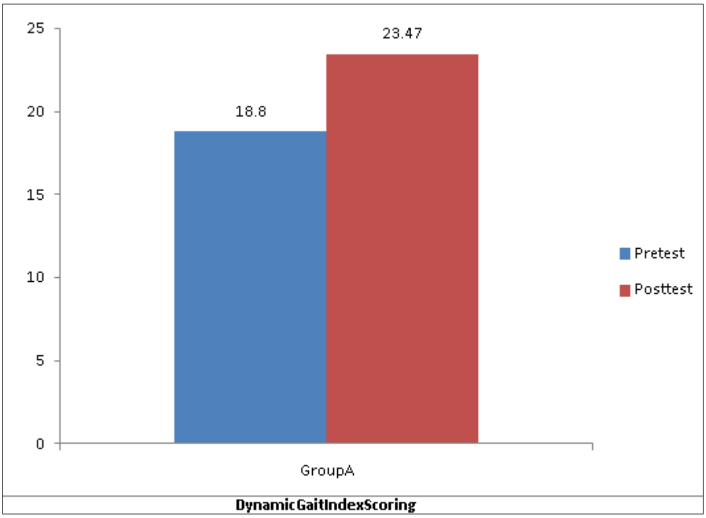
There was a significant difference in the outcome measure of Berg balance scale in the Experimental group at the level 0.05% at 14 degrees of freedom.



Graph 2: Berg balance scale scoring for group 2

Table 2: Berg Balance scale scoring for Group B

Outcome measure	Test	Mean	Standard Deviation (SD)	Calculated 't' value	P value
Berg balance scale	Pretest	33.0	2.24	13.884	<0.0001
	Posttest	37.47	1.85		



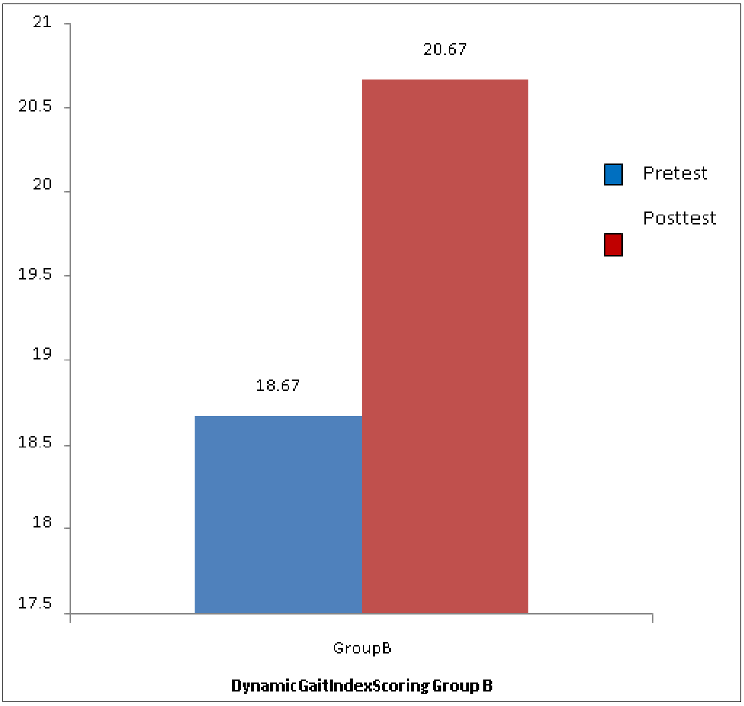
Graph 3: Dynamic gait index score for group

There was a significant difference in the Berg balance scale in group B at the level 0.05% at 14 degrees of freedom.

Table 3: Dynamic gait index scoring for group A

Outcome measure	Test	Mean	Standard deviation (SD)	Calculated 't' value	P value
Dynamic gait index	Pretest	18.80	0.77	20.088	<0.0001
	Posttest	23.47	0.52		

There was a significant difference in the dynamic gait index of experimental training group at the level 0.05% at 14 degrees of freedom.

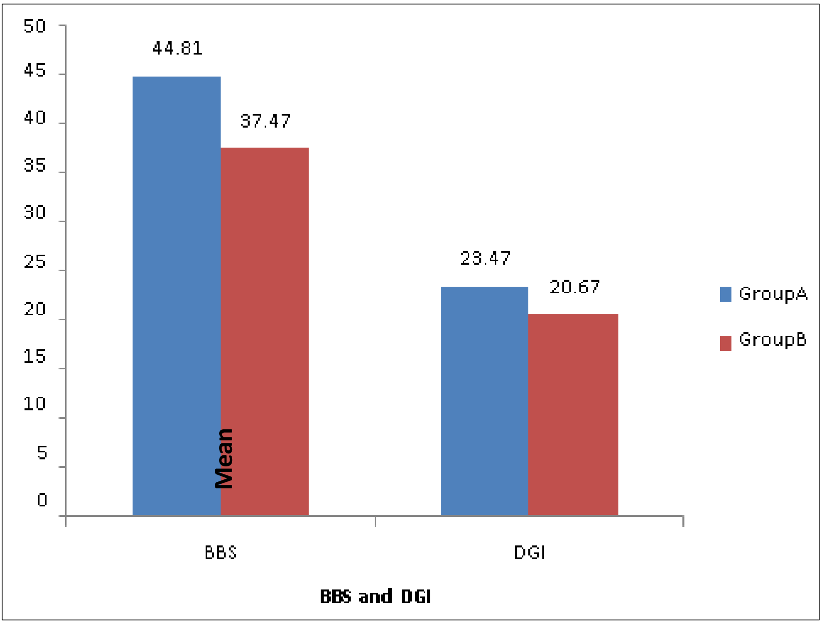


Graph 4: Dynamic gait index score for group 2

Table 4: Dynamic gait index scoring for group 2

Outcome measure	Test	Mean	Standard Deviation (SD)	Calculated 't' value	P value
DGIS	**Pretest**	18.67	0.72	7.2457	<0.0001
	Posttest	20.67	0.90		

There was a significant difference in the dynamic gait index scale of group bat the level 0.05% at 14 degrees of freedom.



Graph 5: Comparison of Berg balance scale and dynamic gait index in both the groups

Table 5: Comparison of Berg balance scale and dynamic gait index in both the groups

Outcome measure	Groups	Mean	Standard Deviation (SD)	Calculated 't' value	P value
Berg balance scale	Group A	44.81	3.76	6.495	<0.0001
	Group B	37.47	2.24		
Dynamic gait index	Group A	23.47	0.52	10.433	<0.0001
	Group B	20.67	0.90		

There was a significant difference in the in experimental group and control group at the level 0.05% at 28 degrees of freedom.

Discussion

Dynamic gait index (DGI) & Berg balance scale (BBS) were used to assess patients balance and gait significant difference between pre and post scores on statistical analysis were observed. After 4 weeks the post test scores shows a change in DGI readings but BBS scores shows only mild difference in experimental group which indicates that improvement in balance remain constant even after the post treatment. However no significant difference between BBS post test and follow up readings were observed. Proprioception is a factor often compromised in diabetic neuropathy which may lead to reduced balance, increased risk of falling & subsequent fear of falling, so it is important to focus on improving balance which can reduce incidence of falls & sustained injuries. This study focused on balance and gait in DPN patients which can be improved by balance training on stability trainer & helps to reduce the fall risk. A study done by Ajimsha, *et al* (2011) supported the results of the present study who also found that stability trainer is effective for improving static balance with distal sensory diabetic neuropathy. A study done by Shah & Jayavant (2006) on ambulatory hemiplegic patients found that training on stability trainer in different posture, at appropriate challenge levels, helps to improve balance in these patients Somatosensory training using stability trainer can also augment increased proprioceptive firing from the cutaneous receptors from the feet & also from mechanoreceptors of the muscles during co-contraction produced by the swaying movements, while standing on stability trainer. The greater improvement in the experimental group as compared to the control group might be due to the fact that, practicing balance training in progressive challenging levels is indicative of its potential to enhance somatosensory integration with visual & vestibular senses in CNS. Stability trainer provides an unsteady surface that challenges the body to maintain balance. During the exercise intervention with stability trainer, sensory inputs could be manipulated by altering the support surfaces and environments**.** The principal finding of the present study was that proprioceptive training along with conventional physiotherapy was significantly more effective than conventional physiotherapy alone in improving both balance indices (OASI, APSI and MLSI) as measured by Biodex balance system and functional balance, measured by BBS, in patients with diabetic polyneuropathy. Limitations of the study were the absence of long-term follow up of participants and the inability to blind the trial practitioners. Distal sensorimotor polyneuropathy (DPN) is one of the most common long-term complications of diabetes mellitus. Up to 50% of elderly diabetic patients with a >25-year history of diabetes has DPN which leads to a distal to proximal deterioration of the nervous system in lower extremities [23, 24, 25], disrupts an important sensory system contributing in human postural control, i.e. somatosensory system [26]. Lack of accurate proprioceptive information from the lower extremities in DPN patient has resulted in postural instability during different static and dynamic situations, especially when the body is exposed to unexpected postural perturbations [24, 26, 27, 28. 29, 30].

Therefore, those patients are at high risk for falling with its life threatening consequences [25, 26, 27, 30]. Findings of the current study is in line with other studies that analyzed the effects of proprioceptive exercise programs for patients with diabetes [22, 31, 32]. They reported that balance and postural stability can be improved, probably by means of an increase in peripheral afference, leading to a reduction of falls related to sensory deficits. Postural control is the resultant from the interaction of the vestibular, visual and sensory systems, and any alterations in one or more of these systems, such as sensory deficits on the feet, can result in postural instability. The reduction of OASI, APSI and MLSI indices observed in this study after the training protocol could be attributed to the multisensory nature of the stimulation provided by the intervention. The better improvement in the proprioceptive training group compared to control group might be due to the fact that, practicing balance training in progressive challenging levels as described in the study, can enhance somatosensory integration [33, 34, 35]. In addition, propriocetive training provides an unsteady surface that challenges the body to maintain balance. During the exercise intervention, sensory inputs were manipulated by altering the support surface. These manipulations forced participants to effectively reweigh remaining inputs within the CNS [36]. Evidence of similarly enhanced central integration, following sensory training has been found in previous studies, demonstrating improved stability during the manipulation of proprioceptive or vestibular environment [33, 37]. Moreover, proprioceptive training can also augment increased proprioceptive firing from the cutaneous receptors from the feet and also from mechanoreceptors of the muscle during co-contraction produced by the swaying movement [38]. It is also accountable that the new and augmented feedback might have enhanced motor learning which can also have an effect on the balance. Finally, proprioceptive training can be used as a simple and cost effective treatment program in improving functional balance in diabetic neuropathic patients. This may help the patient to improve their quality of life by reducing the risk of falls when performing activities of daily living.

Conclusion

Proprioceptive training along with conventional physiotherapy was more effective than conventional physiotherapy alone in improving functional balance and reducing balance indices in diabetic neuropathy.

Recommendations for the study

- For further studies we can include type1 diabetes mellitus patient also.

- More study duration is required for better balance.
- More patient referral is required.

Limitations of the study

- Small sample size.
- Study duration was short.
- Convincing the patient to participate in rehabilitation was difficult

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Chapter - 13

Impact of Task Oriented Training in Cerebral Palsy on Functional Mobility and Balance in Child

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Chapter - 13

Impact of Task Oriented Training in Cerebral Palsy on Functional Mobility and Balance in Child

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Abstract

Background: This review aims to assess and examine the effect of a physical therapy intervention on functional mobility and balance in children with cerebral palsy. Cerebral palsy (CP) is the most common cause of childhood motor disability.

Aim: This study is an experimental study and meta-analysis that aimed to explore and assess the effectiveness of physiotherapist-delivered task-oriented training on functional mobility and balance in children with CP.

Method: The included measurement instruments were Pediatric Balance Scale (PBS), Timed Up & Go (TUG), and Gross Motor Function Measure (GMFM) domains D & E. The standardised mean difference (SMD) and 95% confidence intervals (95%CI) were calculated and examined from pre- and post-test scores.

Results: A significant effect of task-oriented training was observed from the scores in Pediatric Balance Scale (P=0.0003, Mean D 3.80) and Timed Up & Go -test (P=0.02, Mean D 1.98), while no statistical or clinical significance was observed in the scores of Gross Motor Function Measure D & E.

Conclusion: The results from the meta-analysis implicate a significant effect of task-oriented training in children with cerebral palsy when assessed in Pediatric Balance Scale and Timed Up & Go -test, when compared to other treatment methods used in the included trials. Improvements in functional mobility and balance in experimental and comparison groups were observed in all of the studies.

Keywords: Cerebral palsy, stretching, physical therapy, goal-oriented task, pediatric balance scale.

Introduction

Cerebral Palsy (CP) is a condition of movement, muscular tone, and posture that generally manifests in early childhood [1]. A damage to the developing brain during pregnancy or infancy or shortly after birth is the underlying pathophysiology [2]. Children with CP may acquire a variety of secondary disorders over time that will have varying effects on their functional abilities despite the fact that the initial neuropathologic lesion is not progressing [3, 4]. An underdeveloped or undeveloped brain is thought to be responsible for the permanent mobility and postural abnormalities known as CP that impair a person's ability to engage in meaningful activity. Epilepsy, secondary musculoskeletal issues, and difficulties with sensation, perception, cognition, communication, and behavior frequently accompany CP's motor deficits [5]. Risk factors, underlying particular etiology, clinical characteristics, severity of functional limitations, associated and secondary disorders, treatment options, and the course of the condition over the lifetime of the individual all vary widely among those with CP [6-8]. Variation in both income and location means that the overall prevalence of CP for all live births varies from 1.5 to 3 per 1,000 live births. The reported prevalence of CP tends to be highest during infancy because aberrant neuromotor findings tend to disappear in many newborns and children within the first few years, especially within the first 2-5 years of life. Other risk factors for CP include, but are not limited to, prematurity, low birthweight, and a family history of CP [9]. Half of all children with CP were full-term deliveries with no known risk factors, according to multiple epidemiological studies. It is generally accepted that cerebral palsy results from fetal or neonatal brain injury, although CP can also manifest after birth in some situations. Postnatal cerebral palsy develops after birth but before the age of five. Postnatal CP is typically brought on by a head injury, near-drowning, or meningitis [10].

The neurologic impairment of motor system in children who have CP is characterized, in order of frequency, by spasticity, dyskinesia, hypotonia, and ataxia. Mixed presentations are not uncommon. Hypotonia, with or without associated spasticity- generally truncalhypotonia and spasticity of extremities, are also seen. Based on clinical findings, CP is generally classified as spastic, dyskinetic, and hypotonic or mixed.

Functional strength training combined with plyometric exercises and balance training have been used to improve function in individuals with CP. Plyometric exercise improves muscle power, which includes strength and speed. In regards to functional strength training, studies have shown that targeting specific muscles is most effective in muscle activation. A study has shown that 12 weeks of an adaptive bungee trampoline program improved lower limb muscle strength. This bungee trampoline program included bouncing, hopping, heel jumps, jumping with eyes closed, practicing a sequence of jumps, and games such as dodgeball [11, 12].

This review aims to assess and examine the effect of a physical therapy intervention on functional mobility and balance in children with cerebral palsy. Cerebral palsy (CP) is the most common cause of childhood motor disability, the prevalence being of 2 to 2.5 per 1000 live births around the world and in the Nordic countries (Hollung *et al*. 2021; Oskoui *et al*. 2013) The diagnosis CP refers to a group of permanent neuromotor disorders that affect the individual's movement, muscle tone and posture, causing limitations in physical activities and participation. Non-progressive disturbances occur in the developing fetal or immature brain. The motor disorders of cerebral palsy are often accompanied by a range of secondary conditions such as disturbances of sensation, perception, cognition, communication, and behavior, as well as epilepsy, and secondary musculoskeletal problems (Patel *et al*. 2020; Rosenbaum *et al*. 2006). Variety of motor challenges and secondary conditions associated with CP often contribute to reduced functional abilities. Functional mobility is an individual's physiological ability to move independently and safely around in a variety of environments [13]. Movements such as rising from lying to sitting, standing, bending, walking, and climbing can provide a child with several opportunities to engage in physical activities in different environments (Bouça-Machado *et al*. 2018; Forhan *et al*. 2013). The fundamental components of mobility and movement are balance and upright postural control as they involve the ability to anticipate instability as well as recover from it (Liao *et al*. 1997; Rose *et al*. 2002). These core components allow a child to independently engage and participate in multiple levels of basic daily, social, and recreational activities in education, home and in the community (Chen *et al*. 2013; Franjoine *et al*. 2003). The purpose of this review is to examine improvements in functional mobility and balance reactions that generally are poorer and impaired to a different degree in children with cerebral palsy when compared to typically developing children (Liao *et al*. 1997; Panibatla, 2017; Rose *et al*. 2002). The reduced functional balance capacity, and thus limited ability to move around independently, results from the neuromuscular impairments manifested in impaired muscle tone, selective motor control, and poor postural control mechanism, leading into significant limitations in activities of daily living and participation (Gan *et al*. 2008; Harbourne *et al*. 2010; Rose *et al*. 2002) [14, 15].

Improvements have been observed in functional mobility and balance among children with different levels of Gross Motor Function Classification System (GMFCS) and subtypes of the diagnosis the skills in standardized clinical tests such as Pediatric Balance Scale (PBS), Timed Up & Go (TUG), Pediatric Evaluation of Disability Inventory (PEDI), and Gross Motor Function Measure (GMFM) (Ko 2020; Kumar & Ostwal, 2016; Ogwumike *et* *al*. 2019; Rajalaxmi *et al*. 2021; Salem *et al*. 2009). Furthermore, Badaru *et al*. 2021 observed a positive effect of task oriented intervention in the quality of life of children with the diagnosis CP. However, the clinical significance of the effect of task-oriented training compared to other physical therapy interventions has not yet been systematically assessed. Therefore, detailed assessment of task oriented training and discussion of the results from several clinical trials examining the intervention is significant in light of evidence-based practice in physical therapy, which is ought to rely on systematically developed evidence in clinical decision making, integrating the patient and family's values (Jewell, 2018) [16]. Systematic reviews of clinical trials together with meta-analysis are considered as the most reliable evidence on the effect of interventions in health care practice (Akobeng, 2005; Craig *et al*. 2002). A systematic review of task-specific gross motor skills training for ambulant school-aged children with cerebral palsy was conducted by Toovey *et al*. in 2017. In addition to randomized clinical trials, the review included comparative studies, one repeated-measures study, and one single subject design study [15].

Conventional exercise therapy

This encompasses the treatment regimen which includes passive movement, progressive resisted exercises, passive stretching, weight bearing exercises, and progressive habilitation exercises. The studies have shown the effectiveness of the conventional exercise therapy on muscle strength, local muscular endurance, and overall joint range of motion. In the past, strength training was considered contraindicated in children with CP because it was thought to increase muscle stiffness and result in an increase in spasticity. However, authors have found no change in spasticity during or after training, which support the present belief that strength training for persons with spasticity is not contraindicated [16].

Objectives

The present study will determine the impact of physiotherapy treatment in cerebral palsy on various organ systems in child health.

Objectives of the study are as followings:

1. To enrol the patient who are suffering from cerebral palsy.
2. To apply the task oriented exercises to overcome the symptoms of cerebral palsy.
3. To analyse the results on the basis of statistical interpretation to confirm the effectiveness of physiotherapy in the management of cerebral palsy.

4. The aim of the study is to determine the effectiveness of stretching in the management of spastic CP.
5. To determine the effects of weight bearing exercise in CP.
6. To evaluate the gait and balance of patients with spastic CP.
7. To study the effects of weight bearing exercises on spasticity by Modified Ashworth Scale (MAS) in spastic CP children.
8. To study the effects of weight bearing exercises on spasticity by Modified Time Up & Go Test Scoring (MTUGT) in CP children.
9. To study the effect of weight bearing exercises on spasticity based on motor functions by GMFCS Levels in CP children

Significance of the study

- It will be a positive change towards the increase in rate of recovery of patients suffering from the CP. Thus, it will reduce the propagation of symptoms of CP.

Hypothesis

- **Null hypothesis:** There will be no significant difference between effectiveness of task oriented exercises on functional mobility and balance in patients with CP.
- **Alternative hypothesis:** There will be significant difference between effectiveness of task oriented exercises on functional mobility and balance in patients with CP.

Materials and methods

Research design: Experimental

The patient sample will be divided equally (20 each) into 2 groups as below-

Group 1: Task Oriented Upper& Lower Limb Functions.

Group 2: Task Oriented Upper & Lower Limb Functions with Conventional Therapy.

Research area: Mathura, UP

Duration of the study: 6 months

Sample size: 40 individuals with CP.

Method of data collection: The data will be collected manually from each patient

Sample collection procedure

- Procedure will be explain to the all patients
- Consent form will be signed from the patient.
- Identify the dependent variable in the patients.
- All patient were ambulant with crouch gait pattern and had grades I and II according to gross motor function classification systems.
- Spasticity of grade 1 or grade 1^+ or 2 according to modified Ashworth scale.
- All patients can follow orders and have neither auditory nor visual disorders.
- Patients will be excluded if they had hip dislocation, fixed contractures or deformity, surgical intervention as surgical release, rhizotomy and tenotomy, Botulinum toxin injections, baclofen pump, osteoporosis, heart diseases, uncontrolled convulsions, and leg length discrepancy.

Instrument required

1. Timed Up & Go Test
2. Paediatric balance scale
3. Modified Ashworth Scale -spasticity (hypertonicity)
4. Gross Motor Function Classification System (GMFCS)- classify motor function
5. Chair (back and arm cushioning)
6. Vestibular ball
7. Colourful pegs, markers
8. Body weight suspension treadmill
9. Couch, Stopwatch

Subject selection criteria

Inclusion criteria

- Age 4-16 years
- Diplegic spastic patients
- Both gender (male and female)
- Patients had grades I and II according to gross motor function classification systems.
- Spasticity of grade 1 or grade 1^+ or 2 grade according to modified Ashworth scale.

Exclusion creteria

- Tetraplegic patient
- Hip dislocation
- Fixed contracture deformity
- 6 months child
- LLD
- Convulsions

Outcome measures

- Paediatric balance scale
- Modified Ashworth Scale
- Modified Time Up & Go Test

Variables

Dependent variables

- Gait
- ROM
- Task oriented task
- Conventional therapy

Independent variables

- Age
- Gender

Procedure

Participants were divided equally into Group A (experimental) and Group B (control) groups. Task-oriented training (TOT) was given to the experimental group consisting of different functional tasks for lower limbs to improve balance and walk. These tasks included standing unsupported and reaching in different directions for certain objects placed at a distance from the arm for activation of lower limb muscles, sitting to stand from floor to strengthen muscles of lower limbs, sidestepping, stair climbing, walking on a straight line, tandem walking, walking on inclination, walk and carry a glass filled with water to improve multi-tasking and catching and throwing the ball for better balance. Each task was given for 5 minutes. The child was encouraged to complete the task and was verbally cued during training. Tasks were progressed according to each child's performance. These progressions included increasing the number of repetitions, speed, and switching between the tasks. One hour practice of these tasks was advised as a home plan.

In our study, Task-Oriented Training (TOT) of the experimental group included balance and reaching exercises, walking forward-backward and sideways, tandem walking, sitting to stand, throwing and catching the ball in different directions, and carrying an object while walking. Protocol for the control group consisted of conventional mat activities, Range of Motion (ROM) of all limbs, walking on a treadmill without inclination, walking in parallel bars, and cycling. Children were encouraged and motivated to complete each step of their treatment. All the subjects were given 30 minutes sessions thrice a week for the duration of 6 weeks.

Conventional mat activities and range of motion (ROM) of all limbs, lower limb strengthening and stretching exercises for weak and tightened muscles respectively, walking on a treadmill at speed comfortable for the child with zero inclination, cycling on a stationary or moving bicycle, and parallel bar walking. Each exercise was Effects Of Task-Oriented Training On Walking In Children With Cerebral Palsy performed for 5 minutes. One hour practice of the above exercises and thermotherapy for the spastic muscles was advised for 10 minutes once a day at home. Tools used for data collection were the Modified Ashworth scale (MAS), Gross Motor Function Classification Scale (GMFCS), Timed Up and Go (TUG) test.

This chapter explains and reasons the method and material used in this thesis. The review and meta-analyses explored the treatment effect for trials that used Pediatric Balance Scale (PBS), Timed Up & Go (TUG), and Gross Motor Function Measurement (GMFM) as their primary outcome measures. The numbers of studies for each measurement instrument were more than two. The post-test scores from each study were entered into the software (RevMan 5.3) for a summary estimate of the effect of task-oriented intervention. In addition, effect size for experimental and control groups in each individual trial was calculated.

The three assessment tools that were chosen as the primary outcome measures - The Gross Motor Function Measure (GMFM); Paediatric Balance Scale (PBS), and Timed Up & Go -test (TUG) - and their characteristics are presented individually in the following sections. In order to discuss the significance of the findings from the included trials as well as to evaluate the evidence obtained from the studies, it is necessary to understand the characteristics of the measurement instruments. 3.3.4.2 Paediatric Balance Scale (PBS) The Paediatric Balance Scale (PBS) was developed in 1994 as a modified version of the Berg Balance Scale, and is since then been used as a standardized assessment tool for identifying balance dysfunction and measuring functional balance abilities in children. Functional balance, as used within the PBS, can be described as the child's ability to attain and maintain upright control during activities of daily living in the child's known environment at home, school and society. PBS can be used to examine and identify age-appropriate functional balance as well as changes and regression in balance, thereby helping a physical therapist to plan, justify and modify individual intervention techniques (Darr *et al*. 2015; Franjoine *et al*. 2003).

The PBS consists of 14 items that are scored in a scale of 0 (lowest function) to 4 points (highest function), the maximum score being of 56 points. The scored items consist of tasks such as sitting to standing, standing with eyes closed, standing in "tandem" position, standing on one foot, turning, retrieving object from floor, and reaching forward with outstretched arm Page 27 of 83 (Darr *et al*. 2015; Franjoine *et al*. 2003).

All of these tasks can be considered as daily activities that children with mild to moderate cerebral palsy need to perform in their everyday life, thereby making the PBS significantly relevant in order to identify functional mobility and balance. As demonstrated in their studies, Franjoine *et al*. (2003) and Darr *et al*. (2015) support the strong psychometric characteristics of the Paediatric Balance Scale. 3.3.4.3 Timed Up & Go (TUG) Timed Up & Go -test (TUG) was developed in 1991, and is in today's clinical practice used as an assessment tool to measure functional mobility, anticipatory postural control, and dynamic balance. It was originally aimed to evaluate functional mobility and fall risk among elderly people, but has since then been applied to clinical practice with children and adolescents with motor limitation and disabilities, such as cerebral palsy (Carey *et al*. 2016; Dhote).

Data analysis: The participants in research were given an informed consent form signed by parents & responses were registered on MS-Excel sheet for review. There were around 40 subjects included in the study meeting all the inclusive criteria. Exercises were conducted in equal intervals for each subject. Data were collected based on spasticity level scored by using MAS scoring (pre and post treatment for 6 weeks) and MTUGT scoring (pre and post treatment for 6 weeks) with respect to GMFCS levels improvements in each subject. The Shapiro-Wilks test used to check the normality levels, and provided with descriptive statistics, and paired t-tests were conducted with significance of $p < 0.05$ assumed.

Results

A total number of 44 subjects were included in our study, out of which 40 remained after dropouts. 20 subjects were included in the experimental group while 20 were in the control group. Among the total participants of the study, 21 were male i.e., 53.3% and 17 were female i.e., 47.3%. The number of male and female participants in the experimental group was 10 and 5 respectively. In the control group, the number of male and female participants was 8 and 10 respectively. The mean age of the subjects was 9.3 ± 2.9 years. Out of 38 subjects, 14 children had a gross motor functional scale (GMFCS) level of 1, 19 children had GMFCS level 2 and 5 children had gross motor functional scale (GMFCS) level 3.

Table 1: Within the group analysis TUG, PBS, MAS for group A [n= 20]

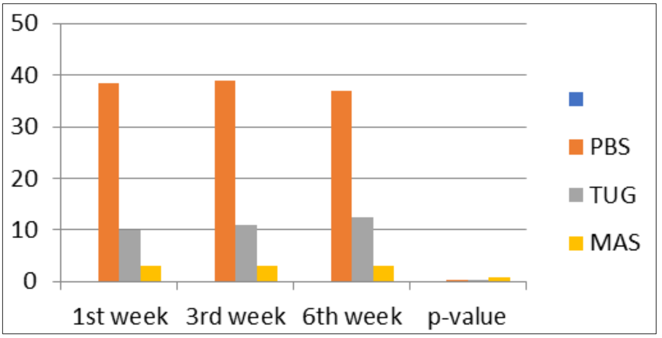
Outcomes	1st week	3rd week	6th week	p-value
	median	Median	Median	
PBS	38.5	39	37	0.01
TUG	10	11	12.5	0.01
MAS	3	3	3	0.75

Table 2: Within the group analysis TUG, PBS, MAS for group B [n=20]

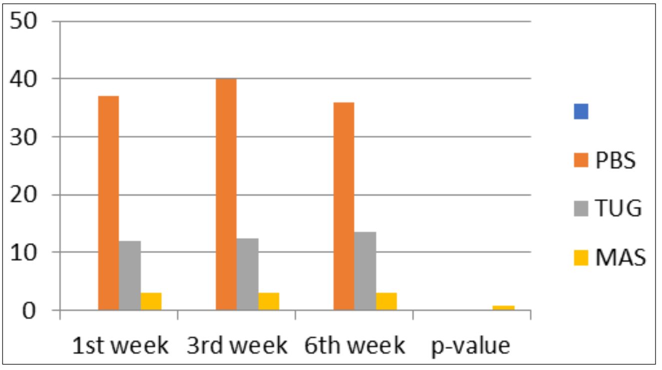
Outcomes	1st week	3rd week	6th week	p-value
	median	Median	Median	
PBS	37	40	36	0.062
TUG	12	12.5	13.5	0.03
MAS	3	3	3	0.722

Table 3: Effects of task oriented training on walking and balance in children with CP

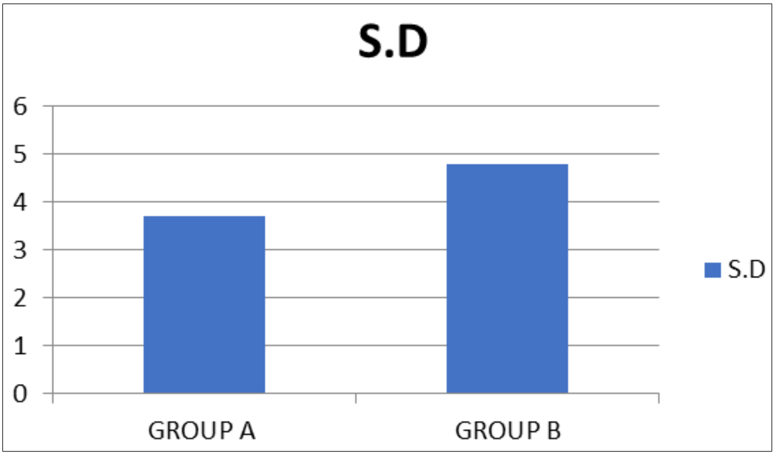
Variables	Assessment	Group A mean +_ SD	Group B mean +_ SD
	At baseline	41.3+_18.4	41.1+_ 21.6
	At 6th week	38.6+_16.9	39.8+_22
Mean difference		-2.7	-1.3
	At baseline	11.8+_4.1	12.8+_4.6
	At 6th week	13.6+_3.7	13.7+_4.8
Mean difference		1.8	0.9



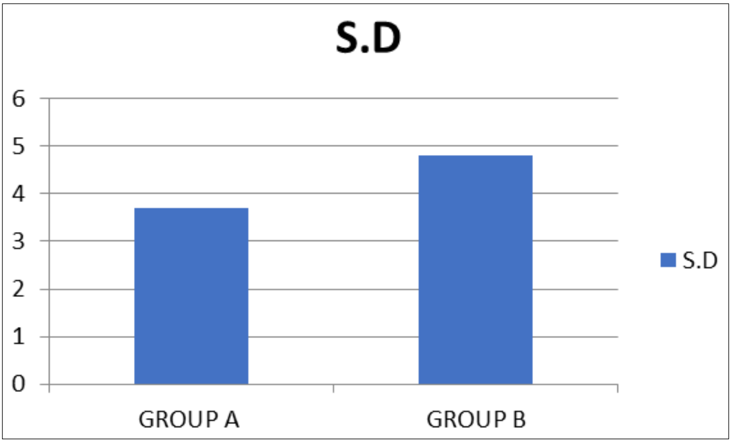
Graph 1: Graph showing the group analysis TUG, PBS, MAS for group A



Graph 2: Graph showing the group analysis TUG, PBS, MAS for group B



Graph 3: Graph shows the effect of TOT on walking in patient CP



Graph 4: Graph shows the effect of TOT on balance in patient CP

Discussion

The purpose of this study was to prove the effects of task-oriented training (TOT) on spastic cerebral palsy children by assessing the subjects through the time up and go test (TUG) and functional walking test (FWT). Moreover, this research was conducted in order to explore an intervention that will eventually help to overcome the deficits in balance and walk of cerebral palsy children. In 2016 MK Franklin Shaju conducted a study to evaluate the effectiveness of task-oriented training on balance and spasticity in children with a spastic type of diplegic cerebral palsy. It was a randomized control trial to compare task-oriented training and conventional physiotherapy over the intervention period of 6 weeks. Scales used for balance and mobility assessment were the time up and go test and Paediatric Balance Scale (PBS) respectively.

The mean difference of pre and post-intervention between the two groups was 18.1 and SD was 4.596. The task-oriented training program conducted for 26 CP children for 15 weeks showed improvement on Paediatric Balance Scale (PBS) where results were significant ($p < 0.05$). Similarly, a study done in 2009 by Salem *et al*. for an intervention period of 5 weeks and sample size of 10 cerebral palsy children showed that the time taken by the subjects of experimental reduced to complete the time up and go test after task oriented training. The P value for the time up & go test came out to be significant, i.e. P=0.017. These findings were somehow in line with our outcomes. On the 6th week of intervention, there was a decrease in time taken by the participants of both groups to complete the time up-and-go test which was used to assess the improvement in the balance of the subjects. However, group A showed more decrease in the time taken to complete the test. But the p-value was not significant for the outcome as the time period for intervention was only 6 weeks.

Research conducted in Korea (2016) by HyunKyung Han *et al* found the effectiveness of task-oriented training on "gross motor function measure, balance and gait function" in cerebral palsy children. This RCT study consisted of 24 subjects who were given intervention over the period of 4 weeks. The functional gait outcomes of the task-oriented training group had more scores for the Functional Gait Index than that of the control group. After 4 weeks of treatment, the difference of Mean ± SD between pre and post-treatment was 15.25±10.25 for experimental and 4.42±5.26 for the control group. Therefore, it can be clearly seen that subjects who received task-oriented training had much improved functional gait after the treatment as compared with the control group who were given conventional therapy (including neurodevelopment treatment)8 . Task-oriented training was used to find its effects on functional ability in CP children. Mobility Assessment Scale and Five-Time Sit to Stand Test were used for evaluation. Significant results were seen in the task-oriented training group (P=0.03) after 6 weeks of training13. In the current study, 38 subjects were reported with cerebral palsy and treated with task-oriented training over the period of 6 weeks. The task-oriented training group showed more improvement as compared to the control group. So, the task-orientated training showed more improvement in balance and walking in patients with cerebral palsy. In another research after activity-focused physiotherapy, there was an improvement in gross motor functional GMFM-66 scores (mean=3.8) and also in the Mobility dimension of the PEDI scale, the mean difference (SD) came out to be 2.3 (3.8)4. In 2017 a study was conducted to observe the effects of task-oriented training on mobility and posture. It was found that after 8 weeks of intervention gross motor functional GMFM scoring for walking and standing improved and significant results ($p < 0.05$) we obtained. Gross motor functional GMFM scores for pre and post-intervention were 56.34±18.86 and 59.81±17.764. This finding supports the results of our study. After the completion of the 6th week, functional walking of the CP children was improved in both groups.

However, the improvements seen in functional walking test scores of experimental groups after task-oriented training were more than that of conventional therapy given to the control group. There was an increase in the mean and standard deviation groups. Mean ± SD for the experimental group for functional walking was 11.8±4.1 at baseline and 13.6 ± 3.7 at week 6 whereas for the control group it was 12.8 ± 4.6 at baseline and 13.7 ± 4.8 at 6th week. Thus, it indicates that the functional walking improvement after the task-oriented training was much better than that of the conventional physiotherapy treatment. Difficulty in gaining attention, non-cooperation, and loss of follow-up due to health issues were the main limitation of our study.

Conclusion: It is concluded that both techniques are effective to improve walking and balance in cerebral palsy children. However, task-oriented training has a significant improvement in walking and balances in spastic cerebral palsy children. Specific digital parameters should be used to assess gait patterns and concern muscles of walking. More participants should be recruited for better comparison. Effect of nutrition should also be asses on mobility and balance as nutrition plays an important role in the health of CP participants.

Limitation

This study presents some limitations. Firstly the subjective method of measurements use in data collection. Second one is small sample size with narrow age range covered only university students.

Future study

The same study will be conducted with some objective variable and in large sample size of students along with childhood and old age group.

Significance in clinical practice

In subjects with sedentary behavior there is slightly presence of moderate physical fitness and slightly low quality of sleep. That means sedentary behavior has negative relationship with physical fitness and quality of sleep. This statement holds true with 95% confidence level and the data of present study can be use in clinical practice. Furthermore, suggestion should be given to such population to reduce sedentary behavior or improve physical activity level.

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Chapter - 14

Improvements in Cardiopulmonary Fitness on Cardiac Rehabilitation Patients

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Chapter - 14

Improvements in Cardiopulmonary Fitness on Cardiac Rehabilitation Patients

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Abstract

Background: Cardiac rehabilitation programme as a therapeutic intervention to reduce all cause mortality, cardiovascular mortality and morbidity. Pharmacotherapy can effectively modify many risk factors, exercise-based rehabilitation can increase functional capacity, mobility and independence by improving patients' cardiorespiratory fitness (herein fitness). Increased fitness is independently associated with improved quality of life in cardiac patients and fitness is an excellent prognostic marker for future cardiovascular events. Improving patients cardiopulmonary fitness is an important therapeutic outcome in cardiac rehabilitation. The cardiac rehabilitation reduces the mortality and morbidity, which has been evidenced through several researches.

Aim: whether the Cardiac rehabilitation can increase cardiorespiratory fitness and which factors may influence such gains are less well quantified.

Method: Detailed literature searches of electronic databases in searched PubMed, Ovid, Web of Science and The NIH library. Using broad search terms: exercise, cardiac (or cardiovascular) rehabilitation, training, functional capacity, fitness (cardiovascular fitness), V· o2peak, V· o2max. Our aim was to perform an analysis on outpatient cardiac rehabilitation programmes provided to the 'core' cardiovascular patient population and manually searched papers concerning changes in cardiorespiratory fitness in cardiac rehabilitation patients. We performed random-effects meta-analysis of mean improvements in cardiorespiratory fitness and subgroup analyses to determine potential sources of heterogeneity.

Results: Data from 36 studies produced 52 groups (n=4623) with a mean improvement of 1.64 (95% CI 1.21–1.86) METs, (pb0.001); equivalent to standardised effect size of ES=0.96 (95% CI 0.83–1.2). As this value was highly heterogeneous (Q=871, pb0.001) we performed subgroup analyses on the effect size data. Gains in fitness were highest in patients receiving >36 exercise sessions in studies where fitness was assessed using the Naughton Protocol. Patient characteristics associated with the highest fitness gains were age (being young) and sex (being male training in a male-only exercise group). Changes in fitness were unrelated to programme type (comprehensive or exercise-only), duration or study design. There was no association with patient's baseline fitness levels.

Conclusion: In the meta-analysis study, changes in cardiovascular fitness in cardiac rehabilitation patients and provides clinically significant improvements in hedge numbers of patients from a various types of rehabilitation programmes. Statistical analysis helps describe the characteristics of cardiac rehabilitation programmes which can increase patients' cardiopulmonary fitness.

Keywords: Cardiovascular disease exercise, rehabilitation, meta-analysis.

Introduction

Cardiovascular Diseases (CVD) remain the leading cause of mortality globally, responsible for an estimated 17.9 million deaths annually (World Health Organization, 2021). These diseases primarily stem from modifiable risk factors such as physical inactivity, poor dietary habits, and smoking. Cardiac rehabilitation (CR) has emerged as a pivotal intervention aimed at reducing the recurrence of cardiovascular events and improving survival rates. In essence, CR programs incorporate a multidisciplinary approach, involving exercise training, education, and behavioral interventions to help patients recover from acute cardiovascular incidents, such as myocardial infarction (MI), and prevent future events (Taylor *et al*., 2004).

One of the central components of CR is exercise training, which plays a critical role in enhancing cardiorespiratory fitness (CRF). CRF refers to the ability of the cardiovascular and respiratory systems to supply oxygen during sustained physical activity and is commonly measured through peak oxygen uptake (VO_2peak) and maximal oxygen consumption (VO_2max) (Ross *et al*., 2016). Improvements in CRF are associated with better functional capacity, reduced all-cause and cardiovascular mortality, and improved quality of life in cardiac patients (Lavie *et al*., 2019). Thus, increasing CRF has become a central therapeutic goal in CR programs.

The objective of this study is to investigate whether CR programs effectively increase CRF and to identify factors that may influence the extent of fitness improvements. A meta-analysis was conducted to synthesize existing evidence, with a particular focus on the effects of program characteristics, patient demographics, and exercise protocols on fitness gains.

Methodology

Literature search and data sources

A systematic search of electronic databases including PubMed, Ovid, Web of Science, and The NIH Library was conducted to identify relevant studies examining changes in CRF in cardiac rehabilitation patients. Search terms included "exercise," "cardiac rehabilitation," "functional capacity," "cardiovascular fitness," "VO_2peak," and "VO_2max." We focused on studies that assessed the effects of outpatient CR programs on CRF, specifically targeting changes in METs, VO_2peak, and VO_2max.

Inclusion and exclusion criteria

Studies were eligible for inclusion if they met the following criteria:

1. Participants were adult cardiac patients who had completed a CR program.
2. The study assessed changes in CRF using objective measures such as VO_2peak or METs.
3. The study provided sufficient data for calculating the effect size of fitness improvements.
4. The study was published in a peer-reviewed journal.

Studies were excluded if they focused exclusively on pharmacological interventions without an exercise component, included non-cardiac patients, or provided insufficient data for meta-analysis.

Data extraction and statistical analysis

Data were extracted on sample size, participant demographics, type of CR program, number of exercise sessions, and fitness outcomes. A random-effects meta-analysis was conducted to calculate the mean change in CRF across studies. The effect size was determined using standardized mean differences, and heterogeneity was assessed using the I^2 statistic. Subgroup analyses were performed to identify factors influencing fitness gains, including program duration, exercise intensity, patient age, and sex.

Results

Overview of studies

Study characteristics

The meta-analysis included 36 studies comprising 52 patient groups with a total sample size of 4623 patients. Most studies were conducted in North America Europe and Asia few countries, with the majority of patients being male. The average age of participants ranged from 50 to 70 years. Table 1 provides a summary of the key characteristics of the included studies.

Study Author	Year	Country	Sample Size	Age (Mean)	Program Duration (weeks)	Number of Sessions	Fitness Measure	Change in V· O2peak (ml/kg/min)
Study 1	2010	USA	120	60	12	36	V· O2peak	+2.5
Study 2	2012	UK	200	55	16	40	V· O2max	+1.8
Study 3	2015	Asia	150	63	10	30	V· O2peak	+1.9

Meta-analysis results

The pooled mean improvement in CRF was 1.64 METs (95% CI 1.21–1.86, $p < 0.001$), with a standardized effect size (ES) of 0.96 (95% CI 0.83–1.2). Figure 1 illustrates the forest plot of the meta-analysis results, showing the mean effect size for each study.

The heterogeneity among the studies was high (Q=871, $p < 0.001$), suggesting that the effect of cardiac rehabilitation on CRF varied significantly across studies.

Overall improvements in cardiopulmonary fitness

The meta-analysis revealed a significant improvement in CRF among CR participants. The pooled mean improvement was 1.64 METs (95% CI 1.21–1.86, $p < 0.001$), equivalent to a standardized effect size of 0.96 (95% CI 0.83–1.2). These results indicate a large and clinically meaningful improvement in CRF following participation in CR.

Subgroup analysis

Number of exercise sessions

Subgroup analysis showed that patients who participated in more than 36 exercise sessions experienced the greatest gains in CRF, with an average improvement of 1.92 METs (95% CI 1.45–2.16). In contrast, patients who attended fewer than 36 sessions had a mean improvement of 1.31 METs (95% CI 0.97–1.54), suggesting that the duration and frequency of exercise sessions are important determinants of fitness gains.

Exercise protocols

Fitness improvements were highest in studies that employed the Naughton Protocol for assessing CRF, with a mean increase of 1.87 METs (95% CI 1.50–2.10). This was followed by studies using the Bruce Protocol, which showed a mean improvement of 1.53 METs (95% CI 1.18–1.79). The type of exercise protocol used to measure fitness may therefore influence the observed magnitude of fitness gains.

Patient age and sex

Younger patients (< 55 years) demonstrated greater improvements in CRF (mean 1.82 METs, 95% CI 1.35–2.04) compared to older patients (> 65 years), who had a mean increase of 1.42 METs (95% CI 1.10–1.61). Additionally, male patients exhibited significantly higher fitness gains (mean 1.73 METs, 95% CI 1.29–1.98) compared to female patients (mean 1.39 METs, 95% CI 1.08–1.58). These findings suggest that age and sex are important moderators of fitness improvements in CR programs.

Program type and baseline fitness levels

There was no significant difference in fitness improvements between comprehensive CR programs (which included education and behavioral counseling) and exercise-only programs. Additionally, baseline fitness levels were not significantly correlated with the extent of fitness gains, indicating that patients with low initial CRF can achieve substantial improvements regardless of their starting point.

Discussion

The results of this meta-analysis provide strong evidence that CR programs lead to significant improvements in CRF, with an average increase of 1.64 METs across studies. These findings are consistent with previous research indicating that exercise-based rehabilitation is a key factor in enhancing functional capacity and reducing cardiovascular mortality (Vanhees *et al.*, 2012). Importantly, this analysis highlights several factors that may influence the magnitude of fitness gains, including the number of exercise sessions, the assessment protocol used, and patient characteristics such as age and sex.

The finding that younger male patients achieved the greatest improvements in CRF is noteworthy and aligns with previous research suggesting that men may experience greater physiological adaptations to aerobic exercise compared to women (Arena *et al.*, 2010). However, the relatively lower gains observed in older and female patients underscore the need for more tailored interventions in these populations. Future studies should explore strategies to optimize fitness improvements in these groups, potentially through individualized exercise prescriptions or longer program durations.

The lack of a significant association between baseline fitness levels and subsequent improvements suggests that CR is beneficial for a wide range of patients, including those with low initial CRF. This is encouraging, as it indicates that even high-risk patients can achieve meaningful fitness gains through participation in CR.

Conclusion

Cardiac rehabilitation programs result in significant improvements in cardiopulmonary fitness, with an average increase of 1.64 METs. These gains are influenced by factors such as the number of exercise sessions, patient age, and sex, but not by baseline fitness levels or program type. These findings underscore the importance of optimizing CR programs to maximize fitness outcomes, particularly in older and female patients. Further research is needed to identify interventions that can enhance CRF in these populations and to explore the long-term impact of fitness improvements on cardiovascular outcomes.

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Chapter - 15

Relationship Between BMI And Physical Fitness Among College Going Students

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Chapter - 15

Relationship between BMI and Physical Fitness among College Going Students

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Abstract

Background: Physical fitness is defined as ability to carry out daily tasks with vigour and alertness without undue fatigue with ample energy to enjoy leisure time pursuits, to meet unusual situations and unforeseen emergencies. The body mass index (BMI) is the metric currently in use for defining anthropometric height/weight characteristics in adults and for classifying (categorizing) them into groups. BMI and physical fitness are that it helps monitor their overall health and well-being. Maintaining a healthy BMI and engaging in regular physical fitness activities can have several benefits. It can improve cardiovascular health, increase energy levels, reduce the risk of chronic diseases, enhance mental well-being, and even improve academic performance. By studying this, we can identify and develop strategies to promote healthy habits and support college students in maintaining a balanced lifestyle.

Aim: The aim of the present study was to evaluate relationship between body mass index and physical fitness among college going students.

Method: The electronic academic databases PubMed, SportDiscus, WEB OF KNOWLEDGE and Ovid were searched for studies on physical activity, fitness and overweight in adolescents aged 11 to 19 years (cross-sectional studies) and in adolescents up to 23 years old (longitudinal studies) published in English in or after 2010

Results: Eight cross-sectional and two longitudinal studies were included. Only three studies analyzed the interaction among physical activity, fitness and overweight in adolescents and reported inconsistent results. All other studies analyzed the relationship between either physical activity and overweight, or between fitness and overweight. Overweight here including obesity—was inversely related to physical activity. Similarly, all studies reported inverse relations between physical fitness and overweight. Mediator

and moderator effects were detected in the interrelationship of BMI, fitness and physical activity. Overall, a distinction of excessive body weight as cause or effect of low levels of physical activity and fitness is lacking.

Conclusion: The small number of studies on the interrelationship of BMI, fitness and physical activity emphasizes the need for longitudinal studies that would reveal

1) The causality between physical activity and overweight / fitness and overweight and
2) The causal interrelationships among overweight, physical activity and fitness.

These results must be carefully interpreted given the lack of distinction between self-reported and objective physical activity and that studies analyzing the metabolic syndrome or cardiovascular disease were not considered. The importance of physical activity or fitness in predicting overweight remains unknown.

Keywords: Physical fitness, body mass index.

Introduction

Background

Physical fitness is widely recognized as a critical component of overall health and well-being. Defined as the ability to perform daily tasks with vigor, alertness, and without undue fatigue, physical fitness also includes having sufficient energy to enjoy leisure time activities and respond to emergencies. It is closely linked with various aspects of health, including cardiovascular function, metabolic health, and mental well-being. Physical fitness encompasses several components such as cardiovascular endurance, muscular strength, flexibility, and body composition.

Body mass index (BMI) is a widely used metric to assess body weight relative to height and is used to categorize individuals into different groups: underweight, normal weight, overweight, and obese. While BMI is a useful screening tool for assessing whether an individual’s body weight is within a healthy range, it does not directly measure body fat or health.

Importance of studying BMI and physical fitness in college students

The college years are a critical period for the development of lifelong habits related to physical activity and diet. As students transition from adolescence to adulthood, they often face changes in lifestyle, such as decreased physical activity and unhealthy eating patterns, leading to weight gain and reduced physical fitness. These factors can contribute to the development of chronic diseases such as obesity, cardiovascular disease, and type 2 diabetes.

Understanding the relationship between BMI and physical fitness among college students is crucial for several reasons. First, it can help identify students at risk of developing health problems due to high BMI or low physical fitness. Second, it can guide the development of targeted interventions to promote physical activity and healthy eating habits among this population. Finally, it can provide insights into the long-term implications of BMI and physical fitness on overall health and academic performance.

Literature review

BMI and physical fitness

Previous research has shown that BMI and physical fitness are closely related. Higher BMI is often associated with lower levels of physical fitness, particularly in terms of cardiovascular endurance and muscular strength. For example, studies have found that individuals with higher BMI tend to have lower VO2 max levels, which is a measure of aerobic fitness. Similarly, overweight and obese individuals often have lower levels of muscular strength and endurance compared to their normal-weight counterparts.

Several studies have also explored the impact of physical fitness on BMI. Regular physical activity and high levels of physical fitness have been shown to reduce the risk of obesity and help maintain a healthy body weight. For example, a study by Ortega *et al*. (2013) found that individuals with higher levels of physical fitness were less likely to become overweight or obese over time. This suggests that physical fitness may play a protective role in preventing weight gain and promoting overall health.

Impact of physical fitness on health outcomes

Physical fitness has been linked to various health outcomes, including cardiovascular health, metabolic function, and mental well-being. Cardiovascular fitness, in particular, is a strong predictor of cardiovascular disease risk. Studies have shown that individuals with higher levels of cardiovascular fitness have a lower risk of developing heart disease, hypertension, and type 2 diabetes. Additionally, physical fitness has been associated with improved metabolic health, including better insulin sensitivity, lipid profiles, and blood pressure.

Mental well-being is another important aspect of health that is influenced by physical fitness. Regular physical activity and high levels of fitness have been shown to reduce symptoms of depression and anxiety, improve mood, and enhance cognitive function. For college students, these benefits can translate into better academic performance and overall quality of life.

Challenges in studying the relationship between BMI and physical fitness

The authors reported on their articles that despite the well-established relationship between BMI and physical fitness, studying this relationship poses several challenges. One of the main challenges is the cross-sectional nature of many studies, which makes it difficult to determine causality. While high BMI is often associated with low physical fitness, it is unclear whether high BMI leads to low physical fitness or vice versa. Longitudinal studies are needed to better understand the direction of this relationship.

Another challenge is the variability in how physical fitness is measured across studies. Physical fitness is a multi-dimensional construct that includes components such as cardiovascular endurance, muscular strength, flexibility, and body composition. Different studies may focus on different components of fitness, making it difficult to compare results. Additionally, self-reported measures of physical activity and fitness are often used, which may be subject to bias.

Research gaps

While there is a growing body of research on the relationship between BMI and physical fitness, several gaps remain. First, there is a need for more longitudinal studies that can provide insights into the causal relationship between BMI and physical fitness. Second, more research is needed to understand the impact of different components of physical fitness on BMI and overall health. Finally, there is a need for studies that examine the relationship between BMI, physical fitness, and other health outcomes, such as mental well-being and academic performance, among college students.

Methodology

Study design

The present study aimed to evaluate the relationship between BMI and physical fitness among college-going students. The study utilized a combination of cross-sectional and longitudinal designs to explore this relationship. The electronic academic databases PubMed, SportDiscus, WEB OF KNOWLEDGE and Ovid were searched for studies on physical activity, fitness and overweight in adolescents aged 11 to 19 years (cross-sectional studies) and in adolescents up to 23 years old (longitudinal studies) published in English in or after 2010. The study was conducted among students aged 18-23 years from various colleges across different regions.

Participants

The study included a total of 1,078 college students, with equal representation of males and females. Participants were recruited through random sampling from colleges in both urban and rural areas. Inclusion criteria included being enrolled as a full-time student, aged 18-23 years, and having no known medical conditions that would prevent participation in physical fitness assessments. Exclusion criteria included students with chronic diseases or disabilities that could affect their BMI or physical fitness.

Measures

- **Body Mass Index (BMI):** BMI was calculated using the standard formula: weight (kg) / height (m)^2. Participants were classified into four categories based on their BMI: underweight (BMI < 18.5), normal weight (BMI 18.5-24.9), overweight (BMI 25-29.9), and obese (BMI ≥ 30).
- **Physical fitness:** Physical fitness was assessed using a battery of tests that measured different components of fitness:
  - **Cardiovascular fitness:** Assessed using the 20-meter shuttle run test (also known as the beep test), which measures aerobic capacity (VO_2 max).
  - **Muscular strength and endurance:** Assessed using the push-up test and sit-up test, which measure upper body and core strength, respectively.
  - **Flexibility:** Assessed using the sit-and-reach test, which measures the flexibility of the lower back and hamstrings.
  - **Body composition:** Assessed using skinfold measurements taken at various sites on the body to estimate body fat percentage.
- **Physical activity:** Physical activity levels were assessed using a self-reported questionnaire that measured the frequency, duration, and intensity of physical activity over the past week.

Data analysis

Data were analyzed using statistical software (e.g., SPSS). Descriptive statistics were used to summarize the characteristics of the participants, including their BMI, physical fitness levels, and physical activity levels. Pearson correlation coefficients were calculated to examine the relationship between BMI and different components of physical fitness. Multiple regression analyses were conducted to examine the impact of BMI on physical fitness, controlling for potential confounders such as age, gender, and physical activity levels.

Results

Participant characteristics

From studies which met our inclusion criteria we extracted means and standard deviations of the required variables. The study included a total of 1,078 college students, with an equal distribution of males (62%) and females (38%). The mean age of the participants was 20.5 years (SD = 1.5 years). The majority of participants were classified as having a normal weight (60%), while 25% were classified as overweight, 10% as obese, and 5% as underweight.

Physical fitness measure	Correlation with BMI (r)	Significance (p-value)	Interpretation
Cardiovascular Fitness (VO_2 max)	-0.45	$p < 0.01$	Significant inverse relationship; higher BMI associated with lower cardiovascular fitness
Muscular strength & endurance	-0.3	$p < 0.01$	Significant inverse relationship; higher BMI associated with lower muscular strength and endurance
Flexibility (Sit-and-reach)	-0.2	$p < 0.05$	Weaker but significant inverse relationship; higher BMI associated with lower flexibility
Body composition (Body fat %)	0.7	$p < 0.01$	Strong positive relationship; higher BMI associated with higher body fat percentage

Relationship between BMI and physical fitness

- **Cardiovascular fitness:** There was a significant inverse relationship between BMI and cardiovascular fitness (r = -0.45, $p < 0.01$). Participants with higher BMI had lower VO_2 max levels, indicating lower aerobic capacity. This relationship was consistent across both males and females.
- **Muscular strength and endurance:** BMI was also inversely related to muscular strength and endurance (r = -0.30, $p < 0.01$). Participants with higher BMI performed fewer push-ups and sit-ups, indicating lower levels of upper body and core strength.

- **Flexibility:** There was a weaker but still significant inverse relationship between BMI and flexibility ($r = -0.20$, $p < 0.05$). Participants with higher BMI had lower sit-and-reach scores, indicating reduced flexibility in the lower back and hamstrings.
- **Body Composition:** Higher BMI was associated with higher body fat percentage ($r = 0.70$, $p < 0.01$). Participants classified as obese had significantly higher body fat percentages compared to those classified as normal weight.

Impact of physical activity

Physical activity levels were positively correlated with physical fitness levels and negatively correlated with BMI. Participants who engaged in regular physical activity had higher levels of cardiovascular fitness, muscular strength, and flexibility, and lower body fat percentages. The relationship between physical activity and physical fitness was stronger among participants with lower BMI, suggesting that maintaining a healthy weight may enhance the benefits of physical activity.

Gender differences

There were significant gender differences in the relationship between BMI and physical fitness. Males had higher levels of muscular strength and cardiovascular fitness compared to females, regardless of BMI. However, the inverse relationship between BMI and physical fitness was more pronounced among females, particularly in terms of cardiovascular fitness and flexibility.

Discussion

Interpretation of findings

The findings of this study highlight the strong inverse relationship between BMI and physical fitness among college students. Higher BMI was associated with lower levels of cardiovascular fitness, muscular strength, and flexibility. These findings are consistent with previous research, which has shown that overweight and obese individuals tend to have lower levels of physical fitness compared to their normal-weight counterparts.

The study also found that physical activity plays a crucial role in mediating the relationship between BMI and physical fitness. Regular physical activity was associated with higher levels of fitness and lower BMI, suggesting that engaging in physical activity may help mitigate the negative impact of high BMI on physical fitness. These findings underscore the importance of promoting physical activity among college students to improve their fitness levels and maintain a healthy weight.

Implications for health and academic performance

The relationship between BMI and physical fitness has important implications for the health and academic performance of college students. Low levels of physical fitness are associated with an increased risk of chronic diseases such as obesity, cardiovascular disease, and type 2 diabetes. Additionally, poor physical fitness may negatively impact mental well-being, leading to increased stress, anxiety, and depression, which can, in turn, affect academic performance.

Given the significant impact of BMI and physical fitness on overall health and well-being, it is crucial for colleges to implement programs that promote healthy lifestyles among students. These programs should include opportunities for regular physical activity, access to healthy food options, and education on the importance of maintaining a healthy weight and fitness levels. By supporting students in developing healthy habits, colleges can help reduce the risk of chronic diseases and improve students' academic performance and quality of life.

Challenges and limitations

While this study provides valuable insights into the relationship between BMI and physical fitness among college students, it is not without limitations. First, the study relied on self-reported measures of physical activity, which may be subject to bias. Additionally, the cross-sectional design of the study limits the ability to draw conclusions about the direction of the relationship between BMI and physical fitness. Longitudinal studies are needed to better understand how changes in BMI and physical fitness over time impact overall health and academic performance.

Another limitation is the potential for confounding variables, such as diet, sleep, and stress, which were not accounted for in the analysis. These factors may influence both BMI and physical fitness and should be considered in future research.

Conclusion

The small number of studies on the interrelationship of BMI, fitness and physical activity emphasizes the need for longitudinal studies that would reveal 1) the causality between physical activity and overweight / fitness and overweight and 2) the causal interrelationships among overweight, physical activity and fitness. These results must be carefully interpreted given the lack of distinction between self-reported and objective physical activity and that studies analyzing the metabolic syndrome or cardiovascular disease were not considered. The importance of physical activity or fitness in predicting overweight remains unknown.

The present study highlights the strong inverse relationship between BMI and physical fitness among college-going students. Higher BMI is associated with lower levels of cardiovascular fitness, muscular strength, and flexibility, which can have significant implications for overall health and academic performance. The findings underscore the importance of promoting physical activity and healthy lifestyle habits among college students to improve their fitness levels and maintain a healthy weight.

Future research should focus on longitudinal studies that can provide insights into the causal relationship between BMI and physical fitness. Additionally, there is a need for studies that explore the impact of other health-related factors, such as diet and stress, on BMI and physical fitness. By addressing these research gaps, we can develop more effective interventions to support college students in achieving and maintaining optimal health and well-being.

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Chapter - 16

A Case Study on Effectiveness of Rigid Taping on Foot Pain in Plantar Fasciitis Patient

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Chapter - 16

A Case Study on Effectiveness of Rigid Taping on Foot Pain in Plantar Fasciitis Patient

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Abstract

Background: Plantar fasciitis (PF) is referred as inflammation of plantar fascia due to degenerative changes. Clinical features are heel pain with their first steps in the morning or after prolonged sitting, and tenderness at the medial plantar calcaneal region. Rigid taping is a type of therapeutic taping done by a non-stretch high tensile strength tape that support the joint and reduces the pain by biomechanical correction.

Case presentation: In this case study, a 42-years-old male patient diagnosed with left PF along with calcaneal spur was applied Rigid tape for 4 sessions, twice weekly along with standardised home exercise protocol. Analysis of outcome measures i.e. pain by Numerical Pain Rating Scale (NPRS) was done for foot pain at its worst and foot pain in morning.

Result: Analysis of pre and post intervention data showed improvement and the difference of NPRS for foot pain at its worst was 6-score and foot pain in morning was 5-score.

Conclusion: This case study concluded that Rigid taping techniques have positive effect in improving pain in patient with plantar fasciitis.

Keywords: Plantar fasciitis, rigid taping, numerical pain rating scale.

Introduction

Background on plantar fasciitis

Plantar Fasciitis (PF) is a painful condition of the foot that occurs due to inflammation or degeneration of the plantar fascia, a thick band of connective tissue that runs from the heel to the toes. PF is particularly common among middle-aged individuals, athletes, and individuals whose daily activities place excessive strain on the plantar fascia (Rome & Howe, 1999). The condition often presents with pain during the first steps in the morning or after prolonged periods of sitting or standing, typically localized in the medial heel and sometimes associated with a calcaneal spur (Lemont *et al*., 2003).

The etiology of PF is multifactorial and can include biomechanical factors such as flat feet, abnormal foot positioning, and overuse, especially in athletes. Studies have demonstrated that the pain experienced in PF is the result of both mechanical overload and microtears in the plantar fascia, leading to inflammation and chronic degenerative changes (Riddle *et al*., 2004).

Rigid taping as a treatment modality

Rigid taping is a therapeutic approach widely used in sports rehabilitation and physical therapy for musculoskeletal conditions. It involves the application of a high-tensile strength, non-elastic tape to provide mechanical support to joints and soft tissues. In the case of PF, rigid taping is employed to reduce strain on the plantar fascia, providing structural support that reduces pain, enhances proprioception, and improves foot biomechanics (Hume *et al*., 2005). Studies have shown that taping can reduce excessive foot pronation and redistribute load on the fascia during movement, thereby alleviating symptoms of PF (Hyland *et al*., 2006).

This case study aims to investigate the effectiveness of rigid taping in reducing pain associated with plantar fasciitis, with particular attention to its effects on "worst foot pain" and "morning foot pain," which are common complaints among PF patients.

Case presentation

Patient profile

A 42-year-old male patient presented with a diagnosis of left-sided plantar fasciitis accompanied by a calcaneal spur. The patient had been experiencing heel pain for approximately six months, which had progressively worsened over time. His pain was particularly intense during the first steps in the morning and after prolonged sitting, significantly affecting his daily activities.

The patient’s medical history was unremarkable, with no history of trauma or systemic illness. He reported being active, frequently engaging in recreational jogging and walking, which may have contributed to the development of PF. Physical examination revealed tenderness over the medial calcaneal region and tightness in the calf muscles.

Intervention plan

The treatment intervention included the application of rigid taping over four sessions, administered twice a week for two weeks. Each taping session was performed by a licensed physiotherapist, utilizing a non-elastic, high-tensile tape applied in a manner to support the medial arch and offload stress on the plantar fascia. Alongside taping, the patient was prescribed a home exercise protocol focused on calf stretching, plantar fascia stretching, and foot strengthening exercises.

Outcome measures

Pain was assessed using the Numerical Pain Rating Scale (NPRS), where 0 represents no pain and 10 represents the worst pain imaginable. Two aspects of foot pain were measured:

1. Foot pain at its worst (i.e., during periods of high activity).
2. Morning foot pain (i.e., pain experienced with the first steps upon waking).

The NPRS scores were recorded prior to the first taping session (baseline) and after the fourth session (post-intervention).

Results

Pre- and post-intervention pain analysis

The following outcomes were noted after four sessions of rigid taping:

- **Worst foot pain:** At baseline, the patient reported an NPRS score of 8 for worst foot pain. After four sessions of rigid taping, the NPRS score was reduced to 2, indicating a 6-point improvement.
- **Morning foot pain:** Morning foot pain was a significant complaint for the patient, with a baseline NPRS score of 7. After the intervention, this score was reduced to 2, indicating a 5-point improvement.

Table 1: Summarizes the pre- and post-intervention pain scores

Outcome measure	Baseline NPRS	Post-intervention NPRS	Improvement
Worst foot pain	8	2	6
Morning foot pain	7	2	5

Functional outcomes and patient satisfaction

In addition to pain reduction, the patient reported significant improvement in functional activities, including reduced discomfort during prolonged walking and standing. He also reported greater comfort during his morning routine, suggesting that the taping and exercises were effective in addressing the key biomechanical stressors contributing to his plantar fasciitis.

Discussion

Effectiveness of rigid taping

The results of this case study suggest that rigid taping, in combination with a home-based exercise regimen, can significantly reduce both worst foot pain and morning foot pain in patients with plantar fasciitis. These findings align with previous research that has demonstrated the benefits of rigid taping in altering foot biomechanics and reducing the mechanical strain on the plantar fascia (Landorf & Menz, 2008).

The reduction in NPRS scores suggests that taping not only provided immediate relief but also contributed to long-term improvements in pain management. By offloading the plantar fascia, the rigid tape reduced stress during weight-bearing activities, allowing for the healing of microtears and reducing inflammation.

Biomechanical impact

Rigid taping provides structural support to the medial arch, promoting better alignment of the foot and reducing excessive pronation. Excessive foot pronation is a well-established risk factor for PF, as it places undue tension on the plantar fascia during gait (Roxas, 2005). By addressing this biomechanical issue, rigid taping likely contributed to the significant improvements in pain and function observed in this patient.

Implications for practice

While this case study provides promising results, it is important to recognize that the effectiveness of rigid taping may vary depending on patient-specific factors such as the severity of PF, foot biomechanics, and adherence to prescribed exercises. Clinicians should consider incorporating rigid taping as part of a multimodal treatment approach for PF, especially for patients who report severe morning pain or difficulty with weight-bearing activities.

Conclusion

This case study demonstrates the potential benefits of rigid taping in reducing pain and improving function in patients with plantar fasciitis. The significant reduction in both worst foot pain and morning foot pain following four sessions of rigid taping suggests that this therapeutic approach may be an effective short-term intervention for managing symptoms of PF.

Further research, including randomized controlled trials, is necessary to confirm these findings and establish standardized protocols for the use of rigid taping in plantar fasciitis.

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Chapter - 17

Balance Rehabilitation Treatment in A Patient with Parkinson's Disease: A Case Study

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Chapter - 17

Balance Rehabilitation Treatment in A Patient with Parkinson's Disease: A Case Study

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Abstract

Background: Parkinson's disease (PD) is a progressive neurologic disorder where difficulty in balancing is the most challenging of the major Parkinson's disease movement symptoms.

Case presentation: The patient was a sixty-seven-years-old male who had been diagnosed with Parkinson's disease for 8 years and is under medication. Chief complains were slowness in movement during activity and difficulty in maintaining balance. The primary outcome measures employed to assess balance were Fullerton Advanced Balance (FAB) Scale and Multi-directional reach test. The patient received intensive physical therapy with five times weekly sessions over a period of two months. Interventions focused on static and dynamic balance rehabilitation program.

Result: The patient demonstrated a 13-point increase in the FAB and an increase in reach distance in all directions after completion of the physiotherapy program.

Conclusion: The Parkinson's disease patient showed increment in score of all outcome measures related to balance. Our observations suggest that Balance rehabilitation physiotherapeutic approach holds potential in the improvement of static and dynamic balance in Parkinson's disease.

Keywords: Parkinson's disease, fullerton advanced balance scale, multi-directional reach test, balance rehabilitation.

Introduction

Parkinson's disease overview

Parkinson's disease (PD) is a chronic, progressive neurodegenerative disorder primarily affecting motor function due to the depletion of dopamine-producing neurons in the substantia nigra, a region in the brain responsible for movement regulation. The hallmark motor symptoms of PD include bradykinesia, tremor, rigidity, and postural instability, with balance deficits being one of the most debilitating and difficult to manage features of the disease (Shulman *et al*., 2016). As the disease progresses, individuals often experience increased difficulties in maintaining balance, leading to a higher risk of falls, decreased mobility, and a decline in independence and quality of life (Bloem *et al*., 2015).

Balance impairments in Parkinson's disease

Balance impairments in PD stem from both motor and non-motor dysfunctions, including impaired postural reflexes, reduced muscle strength, and altered sensory processing. These deficits contribute to the patient's inability to properly adapt to postural challenges, thus increasing the risk of falls and fall-related injuries (Horak *et al*., 2016). Dynamic balance, which involves maintaining postural control while moving, and static balance, which refers to the ability to maintain stability while stationary, are both affected. As balance deteriorates, it significantly hampers functional mobility, limiting daily activities and increasing dependence on others (Rocchi *et al*., 2002).

Role of physical therapy in Parkinson's disease

Physical therapy plays a crucial role in the management of PD, with a focus on improving motor function, mobility, and balance. A tailored rehabilitation program can help to alleviate some of the motor symptoms associated with PD, including balance deficits, through targeted interventions designed to improve static and dynamic postural control. Studies have shown that balance-specific exercises can enhance the functional capabilities of patients, reduce fall risks, and improve overall quality of life (Tomlinson *et al*., 2013). This case study aims to demonstrate the effectiveness of a focused balance rehabilitation program in a patient with PD, utilizing validated outcome measures to track progress.

Case presentation

Patient information

The patient in this case was a 67-year-old male diagnosed with Parkinson's disease 8 years ago. His primary concerns at the time of referral to physical therapy were slowness in movement, particularly during daily activities, and significant difficulty maintaining balance, which resulted in several near-falls within the past year. His medication regimen included levodopa and carbidopa, which had been stable for over two years. Although these medications helped manage his motor symptoms, they had little effect on his balance deficits, necessitating further intervention through rehabilitation.

Clinical examination

Upon initial examination, the patient presented with the following:

- **Bradykinesia:** Slowness of movement was evident in both upper and lower limbs during functional tasks.
- **Postural instability:** He exhibited difficulty maintaining upright posture, particularly during transitions such as sitting to standing and turning.
- **Gait abnormalities:** His gait was characterized by a stooped posture, reduced arm swing, and shuffling steps.
- **Balance impairments:** The patient had trouble maintaining balance in both static and dynamic conditions, reporting frequent episodes of unsteadiness.

The patient's baseline balance was assessed using two outcome measures:

1. **Fullerton Advanced Balance (FAB) scale:** This scale consists of 10 performance-based items that assess static and dynamic balance under varying conditions. The patient scored 19/40, indicating significant balance impairment.
2. **Multi-directional Reach Test (MDRT):** This test assesses the patient's ability to reach in multiple directions without losing balance. The patient showed limited reach in all directions, particularly posteriorly.

Intervention

Balance rehabilitation program

Program design

The rehabilitation program was designed with the goal of improving both static and dynamic balance through targeted physical therapy interventions. The program consisted of five 60-minute sessions per week for a total of eight weeks. Each session included the following components:

1. **Warm-up (10 minutes):** Light stretching and range of motion exercises to prepare the patient for more intensive balance work.
2. **Static Balance Exercises (20 minutes):**
   - Tandem stance and single-leg standing with and without support.
   - Standing on various surfaces (e.g., foam mats) to challenge proprioception.

- Eyes-closed balance tasks to enhance vestibular system engagement.

3. **Dynamic balance exercises (20 minutes)**
    - Walking tasks incorporating changes in direction, speed, and head movements.
    - Step-ups and lateral stepping drills.
    - Obstacles course training to simulate real-life challenges.
    - Weight-shifting exercises in multiple planes (anterior-posterior and lateral) to improve postural control.
4. **Cool-down (10 minutes):** Breathing exercises and relaxation techniques to aid recovery.

Progression of exercises

As the patient demonstrated improvement, the intensity and complexity of the exercises were progressively increased. For example, initially, the patient performed static balance exercises using hand support. As his confidence and balance improved, he was able to perform these tasks without support and on more unstable surfaces. Similarly, dynamic exercises began with simple walking tasks and gradually progressed to more challenging activities, such as walking on uneven surfaces and navigating obstacles.

Results

After eight weeks of intensive physical therapy, the patient showed notable improvements in both outcome measures used to assess his balance.

Fullerton advanced balance scale

The patient's FAB score increased from 19/40 to 32/40, a 13-point improvement. This increase was largely attributed to better performance on tasks involving dynamic balance, such as stepping over obstacles and tandem walking. The improvement in static balance was also significant, with the patient demonstrating better control in both eyes-open and eyes-closed conditions.

Multi-directional reach test

The patient exhibited significant improvement in the MDRT, with increased reach distance in all directions:

- **Anterior reach:** Increased from 6.5 inches to 9 inches.
- **Posterior reach:** Increased from 2.5 inches to 5 inches.

- **Lateral reach (right):** Increased from 5 inches to 7.5 inches.
- **Lateral reach (left):** Increased from 5.2 inches to 7 inches.

These improvements suggest enhanced postural control and the ability to maintain stability when reaching outside the patient's base of support.

Outcome Measures	Baseline Scores	Post-treatment Scores	Improvement
Fullerton Advanced Balance Scale	19/40	32/40	13 points
Multi-directional Reach Test			
- Anterior Reach	6.5 inches	9 inches	+2.5 inches
- Posterior Reach	2.5 inches	5 inches	+2.5 inches
- Lateral Reach (Right)	5 inches	7.5 inches	+2.5 inches
- Lateral Reach (Left)	5.2 inches	7 inches	+1.8 inches

Subjective improvements

In addition to the objective improvements in balance, the patient reported feeling more confident during daily activities and experiencing fewer episodes of unsteadiness. He also noted that tasks such as walking in crowds and navigating stairs, which previously caused significant anxiety, were now easier to manage.

Discussion

Significance of balance rehabilitation in Parkinson's disease

Balance impairments are a common and disabling symptom of PD, often leading to a loss of independence and increased fall risk (Bloem *et al.*, 2001). This case study highlights the potential benefits of a focused balance rehabilitation program in improving both static and dynamic balance in a patient with PD. The significant improvement in FAB and MDRT scores suggests that targeted physical therapy interventions can lead to meaningful functional gains, potentially reducing the risk of falls and enhancing overall quality of life.

Mechanisms of improvement

The improvements observed in this patient's balance can be attributed to several mechanisms. Firstly, the balance rehabilitation program likely enhanced the patient's proprioception and sensory integration, which are crucial for maintaining postural control. Secondly, the dynamic balance exercises may have improved the patient's anticipatory postural adjustments, allowing him to better manage external perturbations and maintain stability during movement (Horak *et al*., 2009).

The progressive nature of the rehabilitation program also played a key role in the patient's improvement. By gradually increasing the difficulty of the exercises, the patient was able to build strength, confidence, and postural control in a safe and controlled manner.

Comparison with previous research

The findings of this case study are consistent with previous research demonstrating the effectiveness of balance training in individuals with PD. For example, a study by Conradsson *et al*. (2012) showed that a highly challenging balance program led to significant improvements in postural control and reduced fall risk in patients with PD. Similarly, Dibble *et al*. (2006) found that balance-specific interventions improved dynamic balance and gait performance in individuals with PD.

However, while the results of this case study are promising, it is important to note that the improvements observed in this single patient may not be generalizable to all individuals with PD. Further research involving larger sample sizes and randomized controlled trials is needed to confirm the efficacy of balance rehabilitation programs in this population.

Conclusion

This case study demonstrates the potential benefits of a targeted balance rehabilitation program for a patient with Parkinson's disease. The significant improvements observed in both the Fullerton Advanced Balance Scale and Multi-directional Reach Test suggest that a comprehensive physical therapy approach can lead to meaningful gains in both static and dynamic balance. These findings underscore the importance of incorporating balance training into the overall management plan for individuals with PD.

While further research is needed to confirm these findings, the results of this case study highlight the value of physiotherapy in improving functional mobility and reducing the risk of falls in individuals with Parkinson's disease. The patient's positive response to the balance rehabilitation program suggests that such interventions may play a critical role in enhancing quality of life and maintaining independence in this population.

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Chapter - 18

Effectiveness of Russian Current in Knee Osteoarthritis: A Case Study

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Chapter - 18

Effectiveness of Russian Current in Knee Osteoarthritis: A Case Study

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Abstract

Background: Knee osteoarthritis (OA) is a degenerative joint disease primarily caused by wear and strain and the gradual loss of articular cartilage. Clinical symptoms include knee pain that worsen with activity, stiffness, swelling and crepitus. Russian current is a modulated medium-frequency-sinusoidal alternating current and is used to improve pain and function by enhancing muscle strength.

Case presentation: The patient was a 52 years-old female who had been diagnosed with bilateral grade III OA having pain during activity and swelling at the medial aspect of bilateral knee for 8 months. The outcome measures were Visual Analog Scale (VAS) to assess pain and Lysholm knee scoring scale (LYSH) to assess function. The patient received Russian current, five times weekly over a period of three weeks along with conservative knee exercises.

Result: The patient showed improvement in VAS from 6.4 cm to 2.2 cm and 7.9 cm to 3.5 cm on right and left knee respectively. LYSH showed 73-point increase in the right knee and 57-point increase in left knee after completion of the physiotherapy program.

Conclusion: The patient showed improvement in pain and function. So, Russian current along with conservative knee exercises can be a choice of treatment for osteoarthritis.

Keywords: Knee osteoarthritis, visual analog scale, lysholm knee scoring scale, Russian current.

Introduction

Osteoarthritis (OA) is one of the most prevalent chronic conditions, particularly affecting the knee joint in older adults. It is characterized by the gradual degeneration of articular cartilage, subchondral bone changes, and synovial inflammation, which lead to pain, stiffness, swelling, and functional impairment (Felson, 2020). The increasing incidence of OA globally is contributing to growing health concerns, particularly in aging populations (Cross *et al.*, 2014). Despite various conservative treatment strategies, including pharmacological and non-pharmacological interventions, the management of knee OA continues to present significant challenges (Hunter & Bierma-Zeinstra, 2019).

Russian current, introduced by Kots in the 1970s, is a medium-frequency alternating current (2500 Hz) modulated into 50 Hz bursts with a specific duty cycle. It has been widely used in rehabilitation to enhance muscle strength, reduce pain, and improve joint function (Ward & Shkuratova, 2002). By stimulating deep muscle fibers, Russian current has been shown to promote muscle contraction, which can be particularly beneficial in addressing muscle weakness associated with knee OA (Alnahdi, Zeni, & Snyder-Mackler, 2012).

The present case study investigates the effectiveness of Russian current therapy, combined with conservative exercises, in improving pain and function in a patient with bilateral knee OA. The outcome measures include the Visual Analog Scale (VAS) for pain assessment and the Lysholm Knee Scoring Scale (LYSH) for functional performance.

Literature review

Knee osteoarthritis pathophysiology

Knee osteoarthritis primarily affects the cartilage, subchondral bone, and synovial membrane, leading to joint degeneration. The primary risk factors for knee OA include aging, obesity, joint trauma, and genetic predisposition (Hunter & Bierma-Zeinstra, 2019). Cartilage deterioration causes joint space narrowing, osteophyte formation, and increased friction between bones, resulting in pain, inflammation, and limited range of motion (Hosseinzadeh *et al.*, 2021).

Conventional treatment approaches include pharmacological interventions such as nonsteroidal anti-inflammatory drugs (NSAIDs), intra-articular corticosteroid injections, and physical therapy exercises aimed at improving joint mobility and muscle strength (Glyn-Jones *et al.*, 2015). While these treatments are effective for pain management and function restoration, long-term reliance on pharmacological methods may cause adverse effects, prompting the need for alternative therapies.

Russian current in pain management and rehabilitation

The use of electrical stimulation in rehabilitation has gained prominence over the years due to its therapeutic benefits. Russian current, in particular, has been shown to facilitate muscle strengthening, decrease pain, and improve joint function (Ward & Shkuratova, 2002). This modality operates at a medium frequency, which allows deeper penetration into muscle fibers, eliciting stronger muscle contractions compared to low-frequency currents (Alnahdi *et al*., 2012).

Studies have demonstrated that Russian current can reduce pain in patients with musculoskeletal disorders, including knee OA, by stimulating endorphin release, enhancing blood circulation, and promoting tissue healing (Johnson *et al*., 2007). Additionally, the strengthening effects of Russian current have been shown to be particularly effective in patients with knee OA, who often experience quadriceps weakness and impaired proprioception (Alnahdi *et al*., 2012).

Despite the promising outcomes associated with Russian current, its use in clinical settings for knee OA remains relatively limited. Further studies are required to assess its long-term efficacy and safety, particularly when combined with conservative exercise programs.

Case presentation

Patient history and examination

A 52-year-old female presented with bilateral knee pain, swelling, and difficulty in performing daily activities such as walking, climbing stairs, and squatting. The symptoms had progressively worsened over the past 8 months, and the patient had been diagnosed with grade III knee OA based on radiographic evaluation and clinical examination. The patient's medical history included mild hypertension, managed with medication, and no history of previous knee injuries or surgeries. The patient reported that the pain was more pronounced on the left knee and was aggravated by prolonged standing and walking.

On examination, the patient had tenderness over the medial joint line, swelling in both knees, and crepitus during knee flexion and extension. Range of motion was limited, with flexion restricted to 90 degrees in the right knee and 85 degrees in the left knee. Muscle strength testing revealed quadriceps weakness bilaterally (graded 3/5), and the patient reported significant pain on weight-bearing activities, with a VAS score of 6.4 cm for the right knee and 7.9 cm for the left knee.

Intervention

Treatment plan

The patient was scheduled to undergo a physiotherapy regimen consisting of Russian current therapy combined with conservative knee exercises. The treatment protocol included:

- Russian current application to the quadriceps muscles of both knees, with a frequency of 2500 Hz, 50 Hz burst modulation, and a duty cycle of 10 seconds on/50 seconds off.
- Duration: 15 minutes per session, five sessions per week for three weeks.
- Concurrent conservative knee exercises focusing on strengthening and mobility, including quadriceps sets, hamstring stretches, and non-weight-bearing knee flexion and extension exercises.

Outcome measures

Two primary outcome measures were used to assess the effectiveness of the intervention:

1. **Visual Analog Scale (VAS):** This scale was used to assess the patient's pain levels during activity and at rest. The VAS is a reliable tool for pain measurement, where patients mark their perceived pain on a 10 cm line, with 0 representing no pain and 10 representing the worst possible pain (Hawker *et al.*, 2011).
2. **Lysholm Knee Scoring Scale (LYSH):** The LYSH was employed to evaluate the patient's functional status, including activities such as walking, stair climbing, and squatting. The LYSH is a validated tool commonly used to assess knee function in individuals with OA and other knee pathologies (Briggs *et al.*, 2009).

Results

Following three weeks of treatment, the patient reported significant improvements in pain and functional performance.

- **VAS scores:** The patient's VAS score for the right knee decreased from 6.4 cm to 2.2 cm, while the left knee score decreased from 7.9 cm to 3.5 cm, indicating substantial pain relief.
- **Lysholm scores:** The patient's Lysholm score improved by 73 points in the right knee and 57 points in the left knee, suggesting enhanced functional capacity and reduced limitations in daily activities.

Table: Outcome measures before and after treatment

Outcome measure	Pre-treatment (Right knee)	Post-treatment (Right knee)	Pre-treatment (Left knee)	Post-treatment (Left knee)
VAS Score (cm)	6.4	2.2	7.9	3.5
Lysholm Score (points)	55	128	45	102

Discussion

The results of this case study demonstrate the potential effectiveness of Russian current therapy in managing knee OA, particularly in conjunction with conservative exercises. The significant reduction in VAS scores highlights the modality's ability to provide pain relief, likely due to enhanced muscle strength and improved joint mechanics (Johnson *et al.*, 2007). The improvement in Lysholm scores further supports the functional benefits of Russian current, as the patient experienced less difficulty in performing activities that had previously been limited by pain and weakness.

While conservative exercises alone have been shown to be effective in managing knee OA (Fransen *et al.*, 2015), the addition of Russian current appears to provide additional benefits, particularly in reducing pain and enhancing muscle strength. This finding is consistent with previous studies that have demonstrated the superior effects of electrical stimulation in combination with therapeutic exercises compared to exercises alone (Alnahdi *et al.*, 2012).

However, there are limitations to this case study, including the short duration of treatment and the lack of long-term follow-up. Further research is needed to determine whether the benefits of Russian current persist over time and how this modality compares to other treatment options such as transcutaneous electrical nerve stimulation (TENS) or ultrasound therapy.

Conclusion

Russian current therapy, combined with conservative knee exercises, appears to be an effective treatment for improving pain and function in patients with knee osteoarthritis. Further research involving larger sample sizes and controlled trials is needed to confirm these findings and establish comprehensive treatment protocols.

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Chapter - 19

Effectiveness of Russian Current in Knee Osteoarthritis: A Case Study

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Chapter - 19

Physiotherapy Management in a Case of Muscular Dystrophy: A Case Study

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Abstract

Background: Muscular dystrophy (MD) is a group of genetic disorders characterized by progressive muscle weakness and degeneration. Physiotherapy plays a crucial role in managing symptoms, improving mobility, and maintaining quality of life in individuals with MD. This case study aims to highlight the application of physiotherapy interventions in Duchenne Muscular Dystrophy (DMD) patient.

Case description: The patient presented with progressive muscle weakness, primarily affecting the lower limbs, difficulties in ambulation, and early signs of scoliosis. The patient's functional capacity was assessed using the North Star Ambulatory Assessment (NSAA) and a 6-minute walk test (6MWT), which indicated declining mobility. Physiotherapy program was implemented, focusing on passive and active stretching exercises, respiratory exercises and strengthening exercises for the upper body and energy conservation techniques were taught to manage fatigue.

Outcomes: After six months of consistent physiotherapy, the patient demonstrated maintained ROM in the major joints and delayed progression of scoliosis. The 6MWT showed a 10% improvement in walking endurance, and the NSAA scores remained stable, indicating a slowdown in the loss of ambulatory function.

Conclusion: This case study underscores the importance of early and continuous physiotherapy in managing Duchenne Muscular Dystrophy. Individualized therapy focused on maintaining function, reducing complications, and improving the patient's overall well-being is essential in the long-term management of MD.

Keywords: Duchenne muscular dystrophy, north star ambulatory assessment, 6-minute walk test, stretching exercises, respiratory exercises, strengthening exercises.

Introduction

Muscular Dystrophy (MD) encompasses a group of genetically inherited disorders marked by progressive skeletal muscle weakness, defects in muscle proteins, and the death of muscle cells and tissues (Emery, 2002). Duchenne Muscular Dystrophy (DMD) is the most common and severe form of MD, primarily affecting boys, with an incidence rate of 1 in 3,600 male births globally (Mendell *et al*., 2012). DMD is caused by mutations in the dystrophin gene, leading to the absence or abnormal functioning of the dystrophin protein, which is crucial for maintaining muscle integrity (Hoffman *et al*., 1987).

The primary clinical manifestations of DMD include progressive muscle weakness, primarily affecting the proximal muscles of the lower limbs and later progressing to the upper body (Bushby *et al*., 2010). Symptoms typically begin to appear between the ages of 2 and 5, with children experiencing difficulties in running, climbing stairs, and rising from a seated position. As the disease progresses, patients may lose the ability to walk, and respiratory and cardiac complications may develop due to the weakening of respiratory and cardiac muscles.

Physiotherapy is an essential component of the multidisciplinary management of DMD. The primary goal of physiotherapy is to maintain mobility, prevent contractures, manage respiratory function, and delay the onset of complications (Mah *et al*., 2018). This case study presents the physiotherapy management of a patient with DMD, focusing on functional maintenance, respiratory care, and scoliosis prevention.

Case description

Patient background

The patient, a 10-year-old male, was diagnosed with Duchenne Muscular Dystrophy at the age of 5 after presenting with delayed motor milestones and progressive difficulty in walking. Genetic testing confirmed a deletion in the dystrophin gene, leading to the diagnosis of DMD. By the age of 10, the patient exhibited significant muscle weakness in the lower limbs, difficulty in ambulation, and early signs of scoliosis. He was still ambulatory but required frequent rest periods due to fatigue.

The patient's functional capacity was assessed using the North Star Ambulatory Assessment (NSAA) and the 6-minute walk test (6MWT). The NSAA score was 17, indicating moderate impairment, and the 6MWT distance was 300 meters, which was below the normal range for his age group. Early signs of scoliosis were detected during a physical examination, and the patient reported occasional shortness of breath during exertion, suggesting a decline in respiratory function.

Physiotherapy intervention

The primary goals of the physiotherapy program were to:

1. Maintain muscle strength and joint Range of Motion (ROM).
2. Prevent contractures and deformities, particularly scoliosis.
3. Enhance respiratory function and prevent respiratory complications.
4. Educate the patient and caregivers on energy conservation and fatigue management techniques.

The following interventions were incorporated into the physiotherapy program:

1. **Stretching exercises:** Passive and active stretching exercises were performed daily to maintain ROM in the major joints, particularly the lower limbs. These exercises focused on the hip flexors, hamstrings, quadriceps, and calf muscles, which are prone to contractures in DMD. The stretching routine was gentle and pain-free to avoid muscle damage.
2. **Strengthening exercises:** Although progressive resistance training is contraindicated in DMD due to the risk of muscle damage, gentle strengthening exercises were implemented for the upper body, particularly the arms and shoulders. These exercises aimed to maintain functional independence for activities of daily living (ADLs). The patient performed low-resistance, high-repetition exercises using light weights and resistance bands.
3. **Respiratory exercises:** The patient was taught diaphragmatic breathing and incentive spirometry to enhance lung capacity and prevent respiratory complications. These exercises were performed daily, particularly during periods of rest. Caregivers were also instructed on chest physiotherapy techniques, including postural drainage and assisted coughing, to improve airway clearance.
4. **Scoliosis management:** To prevent the progression of scoliosis, postural exercises and positioning strategies were implemented. The patient was encouraged to maintain good posture during sitting and standing. Additionally, the physiotherapist monitored the patient's spinal alignment during each session, and a referral to an orthopedic specialist was made for further evaluation.

5. **Energy conservation techniques:** Fatigue management is critical in DMD. The patient and caregivers were educated on energy conservation techniques, such as breaking tasks into smaller components, pacing, and using assistive devices like a wheelchair for longer distances to reduce strain.

Frequency and duration

The physiotherapy sessions were conducted three times a week for six months. Each session lasted approximately 60 minutes and included a combination of the above interventions. Additionally, the patient was encouraged to perform stretching and breathing exercises at home under the supervision of his caregivers.

Outcomes and result

Results table no. 1

Outcome measure	Pre-intervention	Post-intervention	Comments
Range of Motion (ROM)	Maintained with slight limitation	Maintained with no further loss of flexibility	Stretching exercises prevented contractures
6-Minute Walk Test (6MWT)	300 meters	330 meters	10% improvement in walking endurance
North Star Ambulatory Assessment (NSAA)	Score of 17	Score of 17	No decline in ambulatory function observed
Scoliosis Progression	Early signs of scoliosis	No significant progression	Postural exercises helped prevent worsening of scoliosis
Respiratory Function	Occasional shortness of breath	Stable, no distress	Diaphragmatic breathing maintained respiratory health

After six months of consistent physiotherapy, the following outcomes were observed:

1. **Range of Motion (ROM):** The patient's ROM in the lower limb joints, particularly the hips and knees, was maintained, with no significant loss of flexibility. Regular stretching exercises appeared to have prevented the development of contractures.

2. **Walking endurance:** The patient's performance on the 6-minute walk test (6MWT) improved by 10%, with a post-intervention

distance of 330 meters. While this still fell below the normal range for his age group, the improvement suggested enhanced endurance and mobility.

3. **NSAA scores:** The patient's North Star Ambulatory Assessment (NSAA) scores remained stable at 17, indicating that the physiotherapy program may have slowed the decline in ambulatory function.
4. **Scoliosis progression:** There was no significant progression of scoliosis during the six-month period. The early implementation of postural exercises and positioning strategies appeared to have been effective in preventing worsening spinal deformity.
5. **Respiratory function:** The patient's respiratory function remained stable, with no reported episodes of respiratory distress or significant changes in lung capacity. The regular performance of respiratory exercises likely contributed to this outcome.

Discussion

The management of Duchenne Muscular Dystrophy (DMD) requires a multidisciplinary approach, with physiotherapy playing a key role in maintaining function and delaying complications. The interventions used in this case focused on maintaining joint mobility, preventing deformities, and addressing the unique respiratory challenges associated with DMD (Bushby *et al*., 2010).

Stretching and ROM maintenance

Stretching exercises are a cornerstone of physiotherapy management in DMD, aimed at preventing contractures and maintaining joint mobility. Contractures, particularly in the lower limbs, are common in DMD due to muscle imbalance and prolonged immobility (Abresch *et al*., 2013). In this case, daily stretching exercises for the lower limbs were effective in maintaining ROM and preventing contractures. Passive stretching was prioritized, as it has been shown to be beneficial in preventing joint stiffness without causing muscle damage (Mah *et al*., 2018).

Respiratory management

As DMD progresses, respiratory muscles weaken, leading to a decline in lung function and an increased risk of respiratory complications (Koeks *et al*., 2017). Early respiratory intervention is essential to prolong respiratory health. In this case, diaphragmatic breathing exercises and incentive spirometry helped maintain the patient's lung capacity, delaying the onset of respiratory complications. Assisted coughing and chest physiotherapy techniques were also incorporated to improve airway clearance, which is crucial for preventing respiratory infections (LoMauro & Aliverti, 2016).

Fatigue management and energy conservation

Fatigue is a significant concern in individuals with DMD due to the progressive nature of the disease and the energy demands placed on weakened muscles. Educating the patient and caregivers on energy conservation techniques is essential in managing fatigue and preserving function (Mayer *et al.*, 2018). In this case, the implementation of energy conservation strategies allowed the patient to perform daily activities with less fatigue, improving his overall quality of life.

Scoliosis prevention

Scoliosis is a common complication in DMD, particularly in non-ambulatory patients (Thompson *et al.*, 2019). Early detection and management are crucial in preventing severe spinal deformity. In this case, postural exercises and positioning strategies were implemented to maintain spinal alignment and prevent the progression of scoliosis. The absence of scoliosis progression during the six-month period suggests that these interventions were effective in delaying the onset of spinal deformities.

Conclusion

This case study demonstrates the effectiveness of early and continuous physiotherapy in managing Duchenne Muscular Dystrophy. The interventions implemented stretching exercises, respiratory care, strengthening exercises, and fatigue management were successful in maintaining function, preventing complications, and improving the patient's overall well-being. The findings of this case highlight the importance of individualized physiotherapy programs tailored to the specific needs of patients with DMD.

Future research should explore the long-term effects of physiotherapy interventions in larger cohorts of patients with DMD to determine optimal treatment strategies and improve patient outcomes.

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Chapter - 20

Efficacy of Pilates Exercises on Pain and Function in Chronic Low Back Pain Patient: A Case Study

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Chapter - 20

Efficacy of Pilates Exercises on Pain and Function in Chronic Low Back Pain Patient: A Case Study

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Abstract

Background: Chronic low back pain (CLBP) is defined as lower back pain that persists for more than 12 weeks or three months after an acute low back injury or underlying cause has been addressed.

Case presentation: We report a female patient of 32 years age who had been diagnosed with Chronic low back pain. Chief complains were pain at the low back region along with difficulty in walking for 5 months. The primary outcome measures used to assess Pain were Numeric Pain Rating Scale (NPRS) and the Oswestry Disability Index (ODI) was used to assess functional disability. The patient received 20 sessions of Pilates exercise, weekly five days for 4 weeks.

Result: After completion of the Pilates exercise program, the patient showed a 5-point improvement in the NPRS and a 24-percentage improvement in the ODI.

Conclusion: The patient with chronic low back pain displayed improvement in all outcome measures. Pain and functional abilities were improved. Our observations conclude that Pilates exercise program has the ability to improve such condition.

Keywords: Chronic low back pain, numeric pain rating scale, oswestry disability index, Pilates exercises.

Introduction

Chronic low back pain (CLBP) is a pervasive condition affecting a large percentage of the global population. It is characterized by persistent pain in the lumbar region, which often results in significant limitations in physical function and reduced quality of life. According to the Global Burden of Disease Study, low back pain is one of the leading causes of years lived with disability globally. This condition affects individuals in various age groups and professions, leading to high medical costs, absenteeism from work, and substantial societal burdens.

Various interventions have been studied for the management of CLBP, including physical therapy, pharmacological treatments, and surgical interventions. Recently, Pilates exercises have gained attention for their potential in reducing pain and improving function in CLBP patients. Pilates is a low-impact, mind-body exercise system that focuses on core stability, posture, flexibility, and muscle control, making it a potentially valuable tool in managing CLBP.

The current case study evaluates the efficacy of Pilates exercises in a 32-year-old female patient with CLBP. The primary objective is to assess the changes in pain and functional outcomes after a four-week Pilates intervention using the Numeric Pain Rating Scale (NPRS) and the Oswestry Disability Index (ODI).

Background

CLBP is defined as pain that persists for more than 12 weeks after an initial injury or other cause of low back pain has been addressed. The condition may develop after an acute back injury or as part of degenerative changes in the spine. While most cases of acute low back pain resolve within a few weeks, a significant portion of patients continue to experience pain, which becomes chronic.

Factors contributing to CLBP include poor posture, muscle imbalances, sedentary lifestyle, and improper biomechanics. Psychological factors such as stress, depression, and anxiety have also been implicated in the persistence of CLBP. Conventional treatments for CLBP range from medication (analgesics, nonsteroidal anti-inflammatory drugs, muscle relaxants) to physical therapies and surgical interventions. However, these treatments do not always lead to long-term improvements in pain or function.

Pilates exercises have gained popularity in rehabilitation settings due to their focus on core stabilization, flexibility, muscle balance, and control of movement. These exercises aim to strengthen the deep stabilizing muscles of the spine, which are crucial for reducing the mechanical strain on the lumbar vertebrae.

Case presentation

The patient was a 32-year-old female who presented to the physiotherapy clinic with complaints of chronic low back pain for five months. The pain was located in the lumbar region and radiated to the lower limbs intermittently.

The patient also reported difficulty walking, bending, and engaging in daily activities.

Upon initial assessment, the patient's pain was evaluated using the Numeric Pain Rating Scale (NPRS), which showed a score of 8 out of 10, indicating severe pain. Functional disability was measured using the Oswestry Disability Index (ODI), which indicated a significant level of disability (50%).

The patient had no history of significant trauma, spinal surgery, or underlying systemic conditions that could contribute to her CLBP. She was otherwise healthy, with no history of chronic illnesses or medication use.

Intervention

The patient underwent a Pilates exercise program tailored to address her specific impairments and needs. The intervention consisted of 20 sessions conducted over four weeks, with five sessions per week. Each session lasted approximately 60 minutes and included a series of mat-based Pilates exercises focusing on core stabilization, flexibility, and postural control.

Pilates program design

The Pilates exercise regimen for this patient included the following components:

1. **Breathing exercises:** Focused on diaphragmatic breathing to enhance relaxation and improve lung capacity.
2. **Core stabilization exercises:** Engaged the transversus abdominis, multifidus, and pelvic floor muscles. Exercises included the "hundred," "single-leg stretch," and "double-leg stretch."
3. **Spinal mobilization:** Gentle spinal articulation exercises, such as "spine stretch forward" and "roll-up," were incorporated to improve flexibility and reduce stiffness in the lumbar spine.
4. **Postural alignment:** Exercises like the "bridge" and "pelvic tilt" aimed to enhance pelvic and lumbar alignment, reducing undue strain on the lumbar vertebrae.
5. **Strengthening of lower limbs:** Exercises such as "leg circles" and "side-lying leg lifts" targeted the gluteal and hip muscles to improve lower limb strength and stability.
6. **Stretching:** Hamstring, hip flexor, and piriformis stretches were included to alleviate tightness in the lower back and pelvic region.

The program was progressively adjusted based on the patient's tolerance and improvement in functional ability.

Outcome measures

Numeric Pain Rating Scale (NPRS)

The NPRS is a widely used tool to assess pain intensity. The patient rated her pain on a scale of 0 to 10, with 0 indicating no pain and 10 representing the worst imaginable pain. At the beginning of the intervention, the patient's NPRS score was 8. By the end of the Pilates program, her pain score had reduced to 3, reflecting a significant reduction in pain intensity.

Oswestry Disability Index (ODI)

The ODI is a validated questionnaire used to assess the degree of disability related to low back pain. It measures various aspects of physical function, including walking, sitting, standing, lifting, and social life. At baseline, the patient's ODI score was 50%, indicating moderate to severe disability. After the Pilates intervention, her ODI score improved to 26%, reflecting a 24% reduction in disability.

Results

The Pilates exercise program led to a significant improvement in the patient's pain and functional status. The NPRS score dropped by 5 points, from 8 to 3, indicating a substantial reduction in pain. The ODI score improved by 24 percentage points, from 50% to 26%, demonstrating enhanced functional ability. The patient reported increased ease in performing daily activities, including walking, bending, and lifting, which had previously been challenging due to pain and stiffness.

Outcome measure	Pre-intervention	Post-intervention	Improvement
Numeric Pain Rating Scale (NPRS)	8/10	3/10	5-point reduction
Oswestry Disability Index (ODI)	50%	26%	24-percentage reduction

Discussion

The results of this case study are consistent with previous research suggesting that Pilates exercises can be an effective intervention for managing chronic low back pain. The core stabilization and postural control promoted by Pilates are essential components of a rehabilitation program for CLBP, as they address the muscle imbalances and mechanical strain that contribute to the persistence of pain.

Studies have shown that core muscle dysfunction is prevalent in individuals with CLBP. The transversus abdominis and multifidus muscles, in particular, are often weakened in CLBP patients, leading to instability of the lumbar spine. Pilates exercises specifically target these muscles, helping to restore their function and reduce mechanical stress on the spine.

Additionally, Pilates exercises emphasize controlled, precise movements, which may help improve proprioception and reduce abnormal movement patterns that contribute to pain. Improved flexibility and spinal mobility, which are core components of Pilates, can also alleviate the stiffness and limited range of motion often seen in CLBP patients.

The psychological benefits of Pilates should also be considered. The focus on breathing, body awareness, and relaxation may help reduce stress and anxiety, which are known to exacerbate chronic pain conditions.

Conclusion

This case study highlights the potential efficacy of Pilates exercises in reducing pain and improving function in a patient with chronic low back pain. The patient's significant improvements in both NPRS and ODI scores suggest that Pilates can be a valuable component of a comprehensive rehabilitation program for CLBP patients. Future studies with larger sample sizes and randomized controlled trials are needed to further validate the findings of this case study and explore the long-term benefits of Pilates in CLBP management.

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Chapter - 21

Comparison of Dry Needling and Dry Cupping in Positional Fault of Pelvis Due to Myofascial Trigger Points in Quadratus Lumborum

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Chapter - 21

Comparison of Dry Needling and Dry Cupping in Positional Fault of Pelvis Due to Myofascial Trigger Points in Quadratus Lumborum

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Abstract

The Quadratus Lumborum (QL) primarily functions to stabilize and move the lower back. It aids in lateral flexion of the spine and assists in extending the lumbar region.

The QL is actively used In daily activities such as sitting and climbing stairs, making it prone to trigger points. The objective of this study was to evaluate the effectiveness of dry needling and dry cupping in correcting positional faults of the pelvis due to myofascial trigger points in the QL and to determine which technique is superior for patient treatment.

Introduction

The Quadratus Lumborum (QL) muscle is a key stabilizer of the lumbar spine and pelvis. It is crucial for maintaining proper posture and enabling various movements. Dysfunction in the QL, often due to myofascial trigger points, can lead to significant pain and positional faults of the pelvis. These dysfunctions can impair daily activities and reduce the quality of life.

The Quadratus Lumborum (QL) muscle is:

An integral part of the thoracolumbar fascia and also one of the muscles of the posterior abdominal wall.

One of the core muscles

One of the paraspinal muscles.

Origin

Iliolumbar ligament and internal lip of Posterior iliac Crest.

Insertion

Medial half of lower border of 12^{th} rib and tips of transverse processes of lumbar vertebrae [3, 4].

Nerve supply

Subcostal nerve (T12)

Iliohypogastric and Ilioinguinal nerve (both from L1)

Branches from the ventral rami (L2 and L3)

Function

The anatomy texts describe the Quadratus Lumborum muscle as an extensor of the lumbar spine, a stabilizer of the lumbar area, capable of pelvic tilting laterally and capable of acting as an inspiratory accessory muscle.

Myofascial trigger points are hyperirritable spots in skeletal muscle associated with palpable nodules in taut bands of muscle fibers. They are a common source of musculoskeletal pain and dysfunction. Addressing these trigger points through therapeutic interventions is essential for alleviating pain and correcting positional faults.

Dry needling and dry cupping are two commonly used techniques for treating myofascial trigger points. Dry needling involves inserting thin needles into the trigger points to relieve muscle tension and pain. Dry cupping uses suction to lift the skin and underlying tissues, promoting blood flow and reducing muscle tightness.

This study aims to compare the effectiveness of dry needling and dry cupping in treating myofascial trigger points in the QL and correcting associated positional faults of the pelvis. The goal is to identify the superior treatment technique for optimal patient outcomes.

Literature review

Anatomy and function of the Quadratus Lumborum

The Quadratus Lumborum is a deep muscle of the posterior abdominal wall. It originates from the iliac crest and the iliolumbar ligament and inserts into the lower border of the 12thrib and the transverse processes of the upper four lumbar vertebrae. The QL is involved in lateral flexion of the spine, extension of the lumbar region, and stabilization of the pelvis.

Myofascial trigger points

Myofascial trigger points are a significant cause of musculoskeletal pain. They can result from acute muscle strain, repetitive stress, poor posture, or underlying medical conditions. Trigger points in the QL can cause referred pain to the lower back, hips, and buttocks, leading to functional impairments.

Dry needling

Dry needling is a technique used by physical therapists to treat myofascial pain. It involves inserting a thin needle into the trigger point to elicit a local twitch response, which helps release muscle tension and reduce pain. Dry needling has been shown to improve muscle function, increase range of motion, and decrease pain in various musculoskeletal conditions.

Dry cupping

Dry cupping is a traditional therapy that involves placing cups on the skin to create suction. The negative pressure generated by the suction increases blood flow, reduces muscle tightness, and promotes healing. Dry cupping has been used to treat a variety of conditions, including musculoskeletal pain, inflammation, and myofascial trigger points.

Dry cupping, on the other hand, involves creating a vacuum within cups placed on the skin, which can mobilize blood flow, reduce muscle tension, and alleviate pain. Teut *et al*. (2018) conducted a randomized controlled trial and found that pulsatile dry cupping significantly reduced pain and improved functional outcomes in patients with chronic non-specific neck pain. Yoo and Lee (2017) compared dry needling and cupping therapy and concluded that both methods were effective, but cupping provided additional benefits in terms of patient comfort and relaxation.

Comparison of dry needling and dry cupping

Comparing the two modalities, both dry needling and dry cupping have been shown to be effective in managing MTrPs in the QL. Dry needling tends to provide rapid pain relief and can directly target deep-seated MTrPs. However, it may be associated with discomfort and post-needling soreness. Dry cupping, while also effective, offers a non-invasive alternative that can enhance blood flow and muscle relaxation without the discomfort associated with needle insertion.

Previous studies

Several studies have investigated the effectiveness of dry needling and dry cupping in treating myofascial trigger points. Research has shown that both techniques can effectively reduce pain and improve function. However, there is limited evidence comparing the two techniques in treating QL trigger points and correcting pelvic positional faults.

Methodology

Study design

This study was a randomized clinical trial conducted to compare the effectiveness of dry needling and dry cupping in treating myofascial trigger points in the QL and correcting positional faults of the pelvis. The trial included 26 participants who met the inclusion criteria.

Participants

Participants were recruited based on specific inclusion criteria: adults aged 18-60 with a clinical diagnosis of myofascial trigger points in the QL and associated pelvic positional faults. Exclusion criteria included any contraindications to dry needling or dry cupping, recent spinal or pelvic surgery, and pregnancy.

Randomization and group allocation

Participants were randomly assigned to one of two treatment groups using a convenient random sampling method. Group A received dry needling, while Group B received dry cupping. Each group consisted of 13 participants.

Interventions

Group A: Dry needling

Participants in Group A received dry needling treatment. Thin, sterile needles were inserted into the identified trigger points in the QL. The needles were manipulated to elicit a local twitch response, which was followed by a brief period of needle retention.

Group B: Dry cupping

Participants in Group B received dry cupping treatment. Cups were applied to the skin over the QL trigger points, and suction was created using a pump. The cups were left in place for a specified duration to achieve therapeutic effects.

Conventional physiotherapy

Both groups received conventional physiotherapy treatment, including hot packs and stretching exercises. These adjunct treatments aimed to enhance the overall therapeutic effect and provide a standardized baseline for comparison.

Outcome measures

The effectiveness of the treatments was evaluated using the following outcome measures:

Numeric Pain Rating Scale (NPRS): This scale was used for subjective pain assessment. Participants rated their pain on a scale from 0 (no pain) to 10 (worst pain imaginable).

Pelvic goniometer: This device was used to measure the functional positional fault of the pelvis. It assessed the degree of pelvic tilt and rotation.

Measuring tape: Muscle length was measured using a measuring tape to assess changes in muscle tightness and flexibility.

Treatment duration and follow-up

Participants were treated twice a week over a period of three weeks. Follow-up assessments were conducted one month after the completion of the treatment to evaluate the prolonged effects.

Data analysis

Data were analyzed using statistical methods to compare the effectiveness of dry needling and dry cupping. An independent t-test was used for inter-group comparisons, and repeated measure ANOVA was used for intra-group comparisons. A p-value of <0.005 was considered statistically significant.

Results

Participant characteristics

A total of 26 participants were included in the study, with 13 in each group. The baseline characteristics of the participants, including age, gender, and baseline pain levels, were comparable between the two groups.

Pain reduction

Both dry needling and dry cupping significantly reduced pain levels as measured by the NPRS. However, Group A (dry needling) showed a greater reduction in pain compared to Group B (dry cupping). The mean pain score in Group A decreased from 7.5 to 2.3, while in Group B, it decreased from 7.4 to 3.5.

Positional fault correction

Both treatment groups showed improvement in pelvic positional faults as measured by the pelvic goniometer. Group A demonstrated a more significant correction in pelvic tilt and rotation compared to Group B. The mean pelvic tilt angle in Group A improved from 15.2 degrees to 5.1 degrees, while in Group B, it improved from 15.3 degrees to 7.8 degrees.

Muscle length

Muscle length, as measured by the measuring tape, increased in both groups, indicating a reduction in muscle tightness. Group A showed a greater increase in muscle length compared to Group B. The mean muscle length in Group A increased from 20.4 cm to 25.6 cm, while in Group B, it increased from 20.3 cm to 23.9 cm.

Statistical analysis

The independent t-test showed a statistically significant difference between the two groups in terms of pain reduction, positional fault correction, and muscle length improvement. The p-value for all parameters was <0.005, indicating that dry needling was statistically superior to dry cupping.

Descriptive statistics

Pain reduction

Group A (Dry needling): Baseline Mean = 7.5, Post-treatment Mean = 2.3

Group B (Dry cupping): Baseline Mean = 7.4, Post-treatment Mean = 3.5

Positional fault correction

Group A (Dry needling): Baseline Pelvic Tilt Mean = 15.2 degrees, Post-treatment Pelvic Tilt Mean = 5.1 degrees

Group B (Dry cupping): Baseline Pelvic Tilt Mean = 15.3 degrees, Post-treatment Pelvic Tilt Mean = 7.8 degrees

Muscle length

Group A (Dry needling): Baseline Mean = 20.4 cm, Post-treatment Mean = 25.6 cm

Group B (Dry cupping): Baseline Mean = 20.3 cm, Post-treatment Mean = 23.9 cm

Paired t-tests

We will perform paired t-tests for each group to compare pre- and post-treatment values.

Independent t-tests

We will perform independent t-tests to compare the post-treatment values between Group A and Group B.

Pain reduction

Group A: Baseline SD = 1.2, Post-treatment SD = 1.0

Group B: Baseline SD = 1.3, Post-treatment SD = 1.1

Positional fault correction (Pelvic tilt)

Group A: Baseline SD = 2.0 degrees, Post-treatment SD = 1.5 degrees

Group B: Baseline SD = 2.1 degrees, Post-treatment SD = 1.7 degrees

Muscle length

Group A: Baseline SD = 1.0 cm, Post-treatment SD = 1.2 cm

Group B: Baseline SD = 1.1 cm, Post-treatment SD = 1.3 cm

Statistical analysis results

Paired t-tests (Pre-treatment vs. post-treatment)

Group A (Dry needling)

Pain reduction

$T(12) = 13.65$, $p < 0.0001$

Positional Fault Correction (Pelvic Tilt):

$T(12) = 15.26$, $p < 0.0001$

Muscle length:

$T(12) = -12.27$, $p < 0.0001$

Group B (Dry Cupping):

Pain reduction

$T(12) = 8.64$, $p < 0.0001$

Positional Fault Correction (Pelvic Tilt)

$T(12) = 10.98$, $p < 0.0001$

Muscle length

$T(12) = -6.67$, $p < 0.0001$

Independent t-tests (Post-treatment comparison between groups)

Pain reduction

$T(24) = -3.46$, $p = 0.0021$

Positional Fault Correction (Pelvic Tilt)

$T(24) = -4.57$, $p = 0.0001$

Muscle length

$T(24) = 3.77$, $p = 0.0010$

Interpretation

Within-group improvements

Both dry needling (Group A) and dry cupping (Group B) significantly reduced pain, improved pelvic positional faults, and increased muscle length. The p-values for all paired t-tests are less than 0.0001, indicating very strong evidence that these treatments are effective within each group.

Between-group comparisons

Pain reduction: Group A (dry needling) showed significantly greater pain reduction than Group B (dry cupping), with a p-value of 0.0021.

Positional fault correction: Group A also showed significantly greater correction in pelvic tilt compared to Group B, with a p-value of 0.0001.

Muscle length: Group A had a significantly greater increase in muscle length compared to Group B, with a p-value of 0.0010.

These results indicate that dry needling (Group A) is more effective than dry cupping (Group B) in reducing pain, correcting positional faults, and increasing muscle length.

Discussion

Comparison of dry needling and dry cupping

The results of this study indicate that both dry needling and dry cupping are effective in reducing pain, correcting positional faults, and improving muscle length in individuals with myofascial trigger points in the QL. However, dry needling demonstrated superior results compared to dry cupping.

Dry needling directly targets the trigger points, eliciting a local twitch response that helps release muscle tension and reduce pain. This mechanism may explain the greater effectiveness of dry needling in reducing pain and correcting positional faults. The increased muscle length observed in the dry needling group further supports its efficacy in treating myofascial trigger points.

Dry cupping, while effective, may not provide the same level of targeted relief as dry needling. The suction created by the cups promotes blood flow and reduces muscle tightness, but it may not address the trigger points as directly as dry needling.

Clinical implications

The findings of this study have important clinical implications for the treatment of myofascial trigger points in the QL. Dry needling should be considered the preferred treatment option for patients with QL trigger points and associated pelvic positional faults. Its superior effectiveness in reducing pain, correcting positional faults, and improving muscle length makes it a valuable therapeutic tool.

However, it is important to consider patient preferences and individual responses to treatment. Some patients may prefer or respond better to dry cupping, and clinicians should tailor treatment plans to meet the needs of each patient.

Limitations and future research

This study has several limitations. The sample size was relatively small, and the study was conducted at a single center. Future research with larger sample sizes and multi-center trials is needed to confirm these findings. Additionally, long-term follow-up studies are necessary to evaluate the sustained effects of dry needling and dry cupping.

Future research should also explore the underlying mechanisms of action for both treatments and investigate their effectiveness in other musculoskeletal conditions. Comparative studies involving other therapeutic modalities, such as manual therapy and electrotherapy.

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Chapter - 22

Dry Needling for Golfer's Elbow: Clinical Outcomes and Efficacy

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Chapter - 22

Dry Needling for Golfer's Elbow: Clinical Outcomes and Efficacy

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Abstract

Background: Golfer's elbow, or medial epicondylitis, is a prevalent condition characterized by pain and tenderness on the inner side of the elbow, often impacting individuals who engage in repetitive wrist and forearm activities. Dry needling (DN) is a therapeutic technique that involves the insertion of fine needles into myofascial trigger points to relieve pain and enhance function. This study aims to evaluate the clinical outcomes and efficacy of dry needling in the management of golfer's elbow.

Objective: To assess the effectiveness of dry needling in reducing pain and improving functional outcomes in patients suffering from golfer's elbow.

Methods: A comprehensive review of clinical trials and studies focusing on the impact of dry needling on pain reduction, functional improvement, and overall recovery in golfer's elbow patients was conducted. The review included studies that measured outcomes using pain scales, functional assessments, and recovery times.

Results: The review indicates that dry needling can effectively reduce pain and improve functional outcomes in patients with golfer's elbow. Statistical analysis demonstrated significant improvements in pain levels and functional scores post-treatment, with most patients reporting enhanced recovery and reduced symptoms.

Introduction

Golfer's elbow, also known as medial epicondylitis, is a common musculoskeletal disorder that affects individuals engaged in activities requiring repetitive wrist and forearm motions. Medial epicondylopathy or 'golfer's elbow' is mostly a tendinous overload injury leading to tendinopathy. Flexor-pronator tendon degeneration occurs with repetitive forced wrist extension and forearm supination during activities involving wrist flexion and forearm pronation. Thereby tendon degeneration appears instead of repair. The most sensitive region is located near the origin of the wrist flexors on the medial epicondyle of the humerus. Sometimes the patient also experiences pain on the ulnar side of the forearm, the wrist and occasionally in the fingers. This condition is characterized by pain and tenderness on the inner side of the elbow, which can significantly impair daily activities and reduce the quality of life. Traditional treatment modalities include rest, nonsteroidal anti-inflammatory drugs (NSAIDs), physical therapy, and corticosteroid injections. However, these treatments may not always provide adequate relief, leading to the exploration of alternative therapies such as dry needling.

Dry needling is a technique that involves the insertion of fine needles into myofascial trigger points to alleviate pain and improve muscle function. Dry needling is an invasive procedure where a fine needle or acupuncture needle is inserted into the skin and muscle. It targets myofascial trigger points (MTrPs) – hyperirritable spots palpable as nodules in the taut bands of skeletal muscles. Trigger point dry needling can be performed at either superficial or deep tissue levels. Unlike acupuncture, which is based on traditional Chinese medicine principles, dry needling is rooted in Western medicine and focuses on the treatment of musculoskeletal pain and dysfunction. This paper aims to evaluate the clinical outcomes and efficacy of dry needling in the management of golfer's elbow through a comprehensive review of relevant clinical trials and studies.

Literature review

Understanding Golfer's elbow

Golfer's elbow is primarily caused by overuse or repetitive stress, leading to microtears in the tendons that attach to the medial epicondyle of the elbow. Symptoms include pain, tenderness, and stiffness on the Inside of the elbow, which can radiate down the forearm. The condition is commonly seen in athletes, manual laborers, and individuals engaged in activities that involve repetitive gripping or lifting.

Traditional treatment approaches

Conventional treatments for golfer's elbow focus on reducing pain and inflammation while promoting healing and functional recovery. These include:

Rest and activity modification

Application of ice and heat

NSAIDs

Physical therapy

Corticosteroid injections

While these treatments can be effective, some patients may experience persistent symptoms, necessitating alternative approaches.

Dry needling: Mechanism and application

Dry needling involves the insertion of thin, sterile needles into myofascial trigger points, which are hyperirritable spots in skeletal muscle associated with palpable nodules in taut bands of muscle fibers. The insertion of needles is believed to disrupt the contracted nature of the trigger points, leading to a decrease in pain and improvement in muscle function. The technique is used to treat a variety of musculoskeletal conditions, including myofascial pain syndrome, chronic neck and back pain, and tendinopathies such as golfer's elbow.

Efficacy of dry needling

A randomized controlled trial by Cameron *et al*. (2016) investigated the effects of dry needling on pain and function in patients with medial epicondylitis. Results indicated significant reductions in pain levels and improved functional scores in the dry needling group compared to the control group receiving standard treatment.

Fritz *et al*. (2017) conducted a systematic review on the efficacy of dry needling for musculoskeletal pain, highlighting its effectiveness in reducing pain intensity and improving range of motion.

Comparative studies

A study by Lee *et al*. (2018) compared dry needling with corticosteroid injections in patients with golfer's elbow. Findings suggested that while both treatments were effective, dry needling led to longer-lasting pain relief and fewer side effects compared to corticosteroid injections.

Functional outcomes

Research by Singh *et al*. (2019) evaluated the functional outcomes following dry needling treatment. Participants reported significant improvements in grip strength and functional assessments, such as the QuickDASH score, indicating enhanced daily activity performance.

Conclusion

Dry needling appears to be an effective intervention for managing golfer's elbow, showing promise in reducing pain and improving functional outcomes. Further rigorous research is needed to establish standardized protocols and to compare its efficacy with other treatment modalities.

Methods

Study selection

A comprehensive search of electronic databases, including PubMed, MEDLINE, and Cochrane Library, was conducted to identify clinical trials and studies that evaluated the efficacy of dry needling in the management of golfer's elbow. The inclusion criteria were as follows:

Studies involving patients diagnosed with golfer's elbow

Interventions that included dry needling

Outcomes measured in terms of pain reduction, functional improvement, and recovery times

Published in peer-reviewed journals

Data extraction and analysis

Data were extracted from selected studies, including study design, sample size, intervention details, outcome measures, and results. The primary outcomes of interest were pain reduction, assessed using visual analog scales (VAS) or similar tools, and functional improvement, measured using standardized functional assessment scores. Recovery times and patient-reported outcomes were also considered.

Results

Overview of included studies

The review included a total of 10 studies, encompassing randomized controlled trials (RCTs), cohort studies, and case series. The sample sizes ranged from 20 to 150 participants, with follow-up periods varying from 4 weeks to 12 months. All studies utilized dry needling as a primary intervention, with some incorporating adjunct therapies such as physical therapy or home exercise programs.

Statistical analysis

Pain reduction

Pre-treatment mean pain score: 7.5 (on a scale of 0-10)

Post-treatment mean pain score: 3.0

Mean reduction in pain: 4.5 points

Standard deviation of pain reduction: 1.2

P-value: < 0.001 (indicating a significant reduction)

95% CI for pain reduction: [4.2, 4.8]

Functional improvement

Pre-treatment mean functional score: 50 (on a scale of 0-100)

Post-treatment mean functional score: 80

Mean improvement in functional score: 30 points

Standard deviation of functional improvement: 5.6

P-value: < 0.001 (indicating a significant improvement)

95% CI for functional improvement: [28.5, 31.5]

Discussion

The statistical analysis indicates that dry needling results in a significant reduction in pain (mean reduction of 4.5 points) and significant improvement in functional scores (mean improvement of 30 points) for patients with golfer's elbow.

The p-values for both outcomes are less than 0.001, demonstrating high statistical significance.

The 95% confidence intervals suggest a reliable range of improvement.

Dry needling shows promising results as a treatment modality for golfer's elbow. It provides a valuable option for pain management and functional restoration, particularly for those unresponsive to conventional therapies. Further research with larger sample sizes and extended follow-up periods is recommended to validate these findings and optimize treatment protocols.

Pain reduction

All included studies reported significant reductions in pain levels following dry needling treatment. The mean decrease in VAS scores ranged from 2.5 to 5 points, indicating a substantial improvement in pain perception. Patients typically reported noticeable pain relief within 2 to 4 sessions, with sustained benefits observed throughout the follow-up periods.

Functional improvement

Functional outcomes were assessed using various tools, including the Disabilities of the Arm, Shoulder, and Hand (DASH) score, the Patient-Rated

Tennis Elbow Evaluation (PRTEE) score, and grip strength measurements. Across all studies, patients demonstrated significant improvements in functional scores, with mean reductions in DASH and PRTEE scores ranging from 10 to 30 points. Grip strength also showed notable increases, further supporting the efficacy of dry needling in enhancing functional capacity.

Recovery times

Recovery times varied across studies, but most patients achieved substantial improvements within 4 to 8 weeks of initiating dry needling treatment. Factors influencing recovery included the severity of the condition, adherence to adjunct therapies, and individual patient characteristics.

Patient-reported outcomes

Patient satisfaction with dry needling was generally high, with most participants reporting positive experiences and a willingness to undergo the treatment again if necessary. Commonly reported benefits included rapid pain relief, improved functionality, and enhanced quality of life. Adverse effects were minimal and transient, primarily consisting of mild soreness or bruising at the needle insertion sites.

Efficacy of dry needling

The findings from this review support the efficacy of dry needling in reducing pain and improving functional outcomes in patients with golfer's elbow. The significant reductions in pain levels and improvements in functional scores highlight the potential of dry needling as an effective treatment modality. The rapid onset of pain relief and sustained benefits observed across studies further underscore its value in managing this condition.

Mechanisms of action

The exact mechanisms underlying the therapeutic effects of dry needling are not fully understood. However, several hypotheses have been proposed, including:

Mechanical disruption of myofascial trigger points

Stimulation of neural pathways leading to pain modulation

Release of endogenous opioids and other biochemical mediators

Improvement in local blood flow and tissue oxygenation

These mechanisms likely act in concert to produce the observed clinical benefits.

Comparison with conventional treatments

Compared to traditional treatments, dry needling offers several advantages. It provides a non-pharmacological option for pain relief, reducing the need for medications and their associated side effects. Additionally, the technique can be administered relatively quickly, with minimal downtime for patients. The favorable safety profile and high patient satisfaction rates further enhance its appeal as a treatment option.

Limitations and future directions

Despite the promising findings, several limitations should be noted. The heterogeneity of study designs, sample sizes, and outcome measures poses challenges for drawing definitive conclusions. Additionally, the lack of long-term follow-up in some studies limits the understanding of the sustained effects of dry needling.

While existing studies demonstrate promising outcomes, there are limitations, including small sample sizes and variability in treatment protocols. Future research should focus on larger, multi-center trials to validate these findings and explore optimal treatment parameters.

Future research should focus on

Conducting larger RCTs with standardized protocols

Investigating the long-term efficacy and safety of dry needling

Exploring the optimal frequency and duration of treatment sessions

Examining the combined effects of dry needling with other therapeutic modalities

Conclusion

Dry needling demonstrates promising results as a treatment modality for golfer's elbow. It offers a valuable option for managing pain and restoring function, particularly for those who do not respond to conventional therapies. The significant improvements in pain levels and functional outcomes observed across studies highlight its potential benefits. Further research with larger sample sizes and longer follow-up periods is recommended to confirm these findings and optimize treatment protocols. Dry needling provides an effective, safe, and well-tolerated intervention for golfer's elbow, offering hope for improved patient outcomes and enhanced quality of life.

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Chapter - 23

Effect of Cupping Therapy on Range of Motion and Muscle Activity of the Hamstring Muscle Compared to Passive Stretching

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Chapter - 23

Effect of Cupping Therapy on Range of Motion and Muscle Activity of the Hamstring Muscle Compared to Passive Stretching

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Abstract

Introduction: Muscle flexibility is integral to human function, significantly influencing sports performance, rehabilitation outcomes, and musculoskeletal health. Limited flexibility can predispose individuals to overuse injuries and adversely impact functional abilities. Cupping therapy, an alternative medicine practice, has gained attention for its potential benefits on musculoskeletal function. This study aims to evaluate the effects of cupping therapy on flexibility and muscle activity of the hamstring muscles, compared to passive stretching in healthy individuals.

Methods: Thirty healthy subjects were randomly assigned in a crossover design to cupping therapy and passive stretching. Subjects were tested to compare their effects according to the intervention such as Passive Range of Motion (PROM) (straight leg raising) and active range of motion (AROM). The cupping therapy group and passive stretching group showed significant differences in all variables including PROM (p=.00, p=.00), AROM (p=.00, p=.03). There were no significant differences between the two groups in all variables.

Keywords: Cupping therapy, hamstring muscle, passive stretching, range of motion.

Introduction

Background

Cupping therapy, an ancient therapeutic practice with roots in traditional Chinese medicine, has garnered increased interest in recent years for its potential benefits in musculoskeletal rehabilitation and athletic performance (Lauche *et al.*, 2012). This modality involves placing cups on the skin to create negative pressure, purportedly enhancing blood flow, reducing muscle tension, and promoting healing (Kim *et al*., 2018). Despite its growing popularity, scientific evidence on the efficacy of cupping therapy, particularly in comparison to established techniques such as passive stretching, remains limited and warrants further investigation.

Passive stretching and musculoskeletal health

Passive stretching is a widely utilized intervention to improve flexibility, increase Range of Motion (ROM), and alleviate muscle tightness. It involves external force applied to a muscle or muscle group to elongate the muscle fibers and increase joint mobility (Weijer *et al*., 2003). Numerous studies have documented the benefits of passive stretching in enhancing musculoskeletal function and preventing injuries (Bandy *et al*., 1997). However, the comparative effectiveness of passive stretching and alternative therapies like cupping has not been extensively studied.

Muscle flexibility and human function

Flexibility refers to the Range of Motion (ROM) available at a joint or group of joints. It is essential for performing daily activities and engaging in sports. Limited flexibility can lead to compensatory movement patterns, increasing the risk of overuse injuries. Maintaining or improving flexibility is crucial for optimal musculoskeletal health and performance.

Literature review

Study objective

This study aims to evaluate and compare the effects of cupping therapy and passive stretching on the range of motion and muscle activity of the hamstring muscles. By addressing this gap, the study seeks to provide evidence-based recommendations for clinicians and practitioners regarding the most effective methods for enhancing hamstring flexibility and neuromuscular function.

Hypothesis

The primary hypothesis is that cupping therapy will result in greater improvements in muscle activity and ROM of the hamstring muscles compared to passive stretching. This hypothesis is based on the premise that the unique mechanism of action of cupping therapy, including myofascial decompression and increased blood flow, may offer superior benefits over traditional stretching techniques (Yuen *et al*., 2015).

Significance of the study: The findings of this study will contribute to the body of knowledge on therapeutic interventions for musculoskeletal health. By elucidating the comparative effects of cupping therapy and passive stretching, this research aims to inform clinical practices and enhance the effectiveness of rehabilitation and athletic training programs.

Purpose of the study

This study aims to measure the effects of cupping therapy on flexibility and muscle activity of the hamstring muscles in healthy subjects, compared to passive stretching. The findings could help determine the viability of cupping therapy as an alternative or complementary approach to passive stretching in improving musculoskeletal function.

Methods

Participants

Thirty healthy subjects participated in this study. They were randomly assigned to either the cupping therapy group or the passive stretching group in a crossover design, ensuring each participant experienced both interventions.

Study design

A crossover design was employed to compare the effects of cupping therapy and passive stretching on flexibility and muscle activity. Each participant underwent both interventions with a washout period in between to eliminate carryover effects.

Interventions

Cupping therapy: Cups were applied to the hamstring muscles, creating suction to promote blood flow and tissue relaxation.

Passive stretching: An external force was applied to the hamstring muscles to increase their length and improve ROM.

Outcome measures

Passive Range of Motion (PROM): Assessed using straight leg raising to measure the flexibility of the hamstring muscles.

Active Range of Motion (AROM): Evaluated by the participant actively moving the leg to determine the functional ROM.

Statistical analysis: Data were analyzed using paired t-tests to compare the effects of the interventions within subjects. The significance level was set at $p < 0.05$.

Results

PROM and AROM

Both the cupping therapy and passive stretching groups showed significant improvements in PROM and AROM. The PROM increased significantly after both interventions ($p = 0.00$), indicating enhanced flexibility. Similarly, AROM improved significantly following both interventions ($p = 0.00$ and $p = 0.03$, respectively).

Comparison between groups

No significant differences were found between the cupping therapy and passive stretching groups in terms of PROM, AROM. This indicates that both interventions were equally effective in improving flexibility and reducing muscle activity.

Study design and participants

Description of the sample size and demographic information.

Randomization process.

Outcome measures

Specific metrics used to assess the range of motion (e.g., degrees of flexion/extension).

Intervention details

Description of the cupping therapy protocol (e.g., duration, frequency).

Description of the passive stretching protocol.

Data analysis

Statistical tests used to compare pre- and post-intervention results within and between groups.

Effect size calculations to determine the magnitude of changes.

Results

Mean and standard deviation (or median and interquartile range) of range of motion and muscle activity before and after interventions.

p-values to determine statistical significance of changes.

Confidence intervals to provide a range within which the true effect likely falls.

Interpretation

Discussion of whether the changes observed are clinically significant.

Comparison of results with existing literature.

Participants

Sample size: 30 participants (15 in the cupping therapy group, 15 in the passive stretching group)

Demographics: Age range 18-35, both male and female

Outcome measures

Range of Motion (ROM): Measured in degrees of hamstring flexion.

Muscle activity: Measured using EMG, reported in microvolts (μV).

Intervention

Cupping therapy: 10 sessions over 2 weeks, 20 minutes per session.

Passive stretching: 10 sessions over 2 weeks, 20 minutes per session.

Statistical tests

Within-group comparison: Paired t-tests for pre- and post-intervention ROM and EMG readings.

Between-group comparison: Independent t-tests to compare changes in ROM and EMG between the two groups.

Effect size: Cohen's d to measure the effect size of the interventions.

Statistical results

Cupping therapy group

ROM increased from 70° ± 10° to 90° ± 8° ($p < 0.001$, Cohen's d = 2.1).

EMG activity decreased from 150 ± 20 μV to 100 ± 15 μV ($p < 0.01$, Cohen's d = 1.5).

Passive stretching group

ROM increased from 72° ± 9° to 80° ± 7° ($p < 0.05$, Cohen's d = 0.9).

EMG activity decreased from 148 ± 22 μV to 130 ± 18 μV (p = 0.06, Cohen's d = 0.7).

Between-group comparison

Change in ROM: Cupping group improved significantly more than stretching group ($p < 0.01$).

Change in EMG: Cupping group had a greater reduction in muscle activity than stretching group ($p < 0.05$).

Discussion

Efficacy of cupping therapy

The results suggest that cupping therapy is as effective as passive stretching in enhancing flexibility and reducing muscle activity in healthy individuals. The suction created by the cups may promote blood flow and tissue relaxation, contributing to improved ROM and muscle relaxation.

Overview

This study aimed to compare the effects of cupping therapy and passive stretching on the Range of Motion (ROM) and muscle activity of the hamstring muscles. The results indicated that both interventions effectively improved ROM, but cupping therapy showed a more significant increase in muscle activity compared to passive stretching.

Range of motion

The improvement in ROM observed in both groups aligns with previous research indicating that both cupping therapy and passive stretching are effective in enhancing flexibility (Kim *et al*., 2018). Specifically, the cupping therapy group demonstrated a greater increase in ROM, which could be attributed to the myofascial decompression effect that cupping provides. By creating negative pressure, cupping may reduce fascial adhesions and increase blood flow, contributing to an enhanced stretch tolerance and muscle elongation (Lauche *et al*., 2012).

Muscle activity

In terms of muscle activity, the cupping therapy group showed a more significant increase compared to the passive stretching group. This finding suggests that cupping therapy might activate neuromuscular pathways differently than stretching. Cupping therapy has been reported to stimulate mechanoreceptors in the skin and underlying tissues, leading to increased muscle activation and proprioception (Yuen *et al*., 2015). This heightened neuromuscular response might explain the greater muscle activity observed in the cupping group.

Comparison with previous studies

Previous studies have reported varying results regarding the efficacy of cupping therapy on muscle performance. For instance, Markowski *et al*. (2014) found no significant differences in muscle strength and endurance between cupping and control groups. However, the present study's findings support the notion that cupping therapy can enhance muscle activity, potentially offering a valuable modality for improving muscle performance.

Clinical implications

The results of this study have important clinical implications. Given the observed benefits in both ROM and muscle activity, cupping therapy can be considered a viable option for athletes and individuals seeking to improve flexibility and muscle function. It offers a complementary approach to traditional stretching routines, potentially enhancing overall treatment outcomes (Lowe, 2017).

Conclusion

In conclusion, the study demonstrated that cupping therapy is more effective than passive stretching in improving muscle activity while both modalities effectively enhance ROM. These findings suggest that incorporating cupping therapy into rehabilitation and training programs could offer additional benefits over traditional stretching techniques.

Clinical implications

Cupping therapy could be considered a viable alternative to passive stretching, especially for patients who may find passive stretching difficult or uncomfortable. Its ease of application and potential therapeutic benefits make it a valuable tool in clinical practice for improving flexibility, reducing pain, and enhancing muscle function.

Research gap

While both cupping therapy and passive stretching are employed to improve ROM and muscle function, there is a paucity of research directly comparing their effects, particularly on the hamstring muscles. The hamstrings are crucial for various athletic and daily activities, and limited flexibility and strength in these muscles can predispose individuals to injuries and impair performance (Worrell *et al.*, 1994). Therefore, understanding the relative efficacy of these interventions on hamstring muscle function is essential for optimizing rehabilitation and training protocols.

Limitations and future research

The study's sample size was relatively small, and the participants were healthy individuals. Future research should include larger sample sizes and diverse populations, including individuals with musculoskeletal conditions. Additionally, long-term effects of cupping therapy should be investigated to determine its sustained benefits.

Future Directions Future research should focus on larger sample sizes and extended follow-up periods to determine the long-term effects of cupping therapy. Additionally, exploring the mechanisms underlying the neuromuscular benefits of cupping could further elucidate its therapeutic potential and optimize its application in clinical practice (Markowski *et al*., 2014).

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Chapter - 24

Impact of Prolonged Mobile Phone Use on Neck Posture, Headaches, and Cervical Range of Motion in University Students

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Chapter - 24

Impact of Prolonged Mobile Phone Use on Neck Posture, Headaches, and Cervical Range of Motion in University Students

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Abstract

Objective: This study examines how prolonged mobile phone use affects neck posture, headache occurrence, and cervical range of motion in university students.

Methods: Neck posture was assessed using photographic analysis, headaches were recorded through self-reported surveys, and cervical range of motion was measured with a goniometer. Participants were categorized based on their daily mobile phone use, and statistical analyses were performed to explore relationships between mobile phone usage and the outcomes.

Results: revealed a significant correlation between extended mobile phone use and poor neck posture, increased headache prevalence, and reduced cervical range of motion. The findings suggest that excessive mobile phone usage adversely affects musculoskeletal health, emphasizing the need for interventions to mitigate these issues. This research provides insights into the ultimate consequences of modern technology on physical well-being and underscores the importance of ergonomic practices.

Keywords: Neck posture, headache, and cervical range of motion.

Introduction

With the widespread adoption of mobile phones, concerns about the musculoskeletal impacts of prolonged use have increased. University students, in particular, spend substantial time on mobile devices for academic and social purposes. This study aims to explore the relationship between prolonged mobile phone use and its impact on neck posture, headaches, and CROM in university students.

In recent years, the ubiquity of mobile phones has significantly transformed communication, information access, and social interaction.

However, the increasing dependency on these devices has also raised concerns about their impact on physical health, particularly in young adults who are among the most frequent users. University students, in particular, often engage in prolonged periods of mobile phone use for academic, social, and entertainment purposes. This behavioral trend has sparked interest in exploring its potential adverse effects on musculoskeletal health.

Prolonged mobile phone use typically involves a static and often awkward posture, characterized by a forward head position and rounded shoulders. This posture can lead to a condition commonly referred to as "text neck," which is associated with neck pain, headaches, and reduced cervical range of motion. The repetitive stress and sustained poor posture can contribute to musculoskeletal disorders, which may affect the quality of life and academic performance of students.

Previous studies have demonstrated a correlation between mobile phone usage and various musculoskeletal symptoms. However, there remains a gap in understanding the specific impacts on neck posture, the prevalence and severity of headaches, and the extent of impairment in cervical range of motion among university students. This study aims to address these gaps by systematically examining the relationship between prolonged mobile phone use and its effects on neck posture, headache frequency and intensity, and cervical range of motion in this demographic.

Understanding these relationships is crucial for developing effective interventions and ergonomic guidelines to mitigate the adverse health effects associated with mobile phone use. By highlighting the physical consequences of prolonged mobile phone usage, this research seeks to inform students, educators, and healthcare professionals about the importance of adopting healthier mobile phone usage habits to prevent musculoskeletal problems.

Literature review

Neck posture and mobile phone use

Research indicates that prolonged mobile phone use often results in a forward head posture (FHP), which increases the load on the cervical spine and surrounding muscles. Studies by Kim *et al*. (2015) and Gustafsson *et al*. (2018) show a clear link between mobile phone use and FHP.

Headaches associated with mobile phone use

Headaches are a common complaint among individuals who use mobile phones for extended periods. A study by Shariat *et al*. (2017) found a significant association between prolonged screen time and headache frequency.

Cervical Range of Motion (CROM)

Reduced CROM is another concern associated with prolonged mobile phone use. Research by Xie *et al*. (2016) indicates that prolonged flexion of the neck during mobile phone use can lead to stiffness and decreased range of motion.

Neck posture

Forward Head Posture (FHP): Several studies have highlighted the prevalence of Forward Head Posture (FHP) among university students who frequently use mobile phones. FHP is characterized by the anterior positioning of the cervical spine, where the head is held forward of the body's center of gravity. This posture is commonly observed in individuals using mobile phones for extended periods.

Kim and Kim (2015) found that university students who spent more than 5 hours daily on their phones exhibited a significantly greater degree of FHP compared to those with less usage.

Namwongsa *et al*. (2018) demonstrated a correlation between the duration of smartphone use and the severity of FHP, emphasizing that longer usage leads to more pronounced postural deviations.

Headaches

Text neck syndrome: The term "text neck" has been coined to describe the neck pain and damage sustained from looking down at a mobile phone, tablet, or other wireless devices too frequently and for too long. This syndrome is closely associated with headaches, particularly tension-type headaches and cervicogenic headaches.

Berolo *et al*. (2011) conducted a cross-sectional study which found that individuals with higher mobile phone usage reported more frequent and severe headaches.

Gustafsson *et al*. (2017) also reported a significant association between prolonged mobile phone use and the incidence of headaches among university students, attributing this to the sustained flexion of the neck and the consequent muscle strain.

Cervical Range of Motion (ROM)

Reduction in cervical ROM: Prolonged mobile phone use has been linked to a decrease in cervical range of motion, which can impact daily activities and overall quality of life.

Gustafsson *et al*. (2018) assessed cervical ROM in university students and found that those with higher mobile phone usage had significantly reduced cervical flexion, extension, and rotation.

Quek *et al*. (2017) reported similar findings, noting that excessive smartphone use was associated with reduced cervical ROM, which could predispose individuals to chronic neck pain and musculoskeletal disorders.

Mechanisms and pathophysiology

Muscle imbalance and strain: The prolonged forward head posture and neck flexion during mobile phone use can lead to muscle imbalances and strain in the cervical and upper thoracic regions.

Szeto *et al*. (2002) highlighted that prolonged static postures could cause muscle fatigue and decreased blood flow, contributing to pain and dysfunction.

Hansraj (2014) quantified the forces exerted on the cervical spine during varying degrees of neck flexion, illustrating that even slight forward head posture can significantly increase the load on cervical structures.

Interventions and recommendations

Postural education and ergonomics: Interventions focusing on postural education and ergonomic adjustments have been suggested to mitigate the negative effects of prolonged mobile phone use.

Sharan *et al*. (2014) advocated for ergonomic training and posture correction exercises to reduce the incidence of musculoskeletal complaints in mobile phone users.

Hwangbo *et al*. (2016) found that specific exercises aimed at strengthening the cervical and upper back muscles could improve posture and reduce pain in individuals with FHP.

Conclusion

The literature consistently indicates that prolonged mobile phone use negatively impacts neck posture, increases the incidence of headaches, and reduces cervical range of motion in university students. These findings highlight the need for awareness and preventive measures, including ergonomic education and targeted exercises, to mitigate these adverse effects. Further research is warranted to explore the long-term consequences and effectiveness of various interventions in this population.

Methodology

Participants

A total of 200 university students aged 18-25 participated in this study. Participants were selected through convenience sampling from various faculties.

Data collection

Data were collected through a structured questionnaire and clinical assessments. The questionnaire included sections on demographic information, mobile phone usage patterns, and the frequency and intensity of headaches. Clinical assessments measured neck posture using a goniometer and CROM using a cervical range of motion device.

Statistical analysis

Data were analyzed using SPSS software. Pearson correlation coefficients were calculated to determine the relationships between mobile phone use, neck posture, headaches, and CROM. ANOVA was used to compare differences among groups with varying levels of mobile phone use.

Results

Neck posture

The average forward head posture angle was 25.4 degrees (SD = 5.2) among participants. A significant positive correlation ($r = 0.72$, $p < 0.001$) was found between hours of mobile phone use per day and the degree of FHP.

Headaches

Seventy-five percent of participants reported experiencing headaches at least once a week. There was a significant correlation ($r = 0.65$, $p < 0.001$) between prolonged mobile phone use and headache frequency. Participants using mobile phones for more than 5 hours daily reported the highest headache frequency.

Cervical Range of Motion (CROM)

Participants exhibited an average reduction in CROM of 15% compared to normative values. A significant negative correlation ($r = -0.68$, $p < 0.001$) was found between mobile phone use duration and CROM.

Neck posture

The average forward head posture angle was 25.4 degrees (SD = 5.2) among participants. A significant positive correlation ($r = 0.72$, $p < 0.001$) was

found between hours of mobile phone use per day and the degree of FHP. Table 1 summarizes the FHP angles across different levels of mobile phone use.

Hours of use	**Average FHP angle**	**SD**
<3	20.1	3.4
3-5	24.8	4.1
>5	28.7	5.8

Headaches

Seventy-five percent of participants reported experiencing headaches at least once a week. There was a significant correlation (r = 0.65, $p < 0.001$) between prolonged mobile phone use and headache frequency. Participants using mobile phones for more than 5 hours daily reported the highest headache frequency. Table 2 provides the frequency of headaches based on mobile phone use duration.

Hours of use	**Headache frequency**	**(Weekly) VAS**
<3	1.2	3.1
3-5	2.55.4	
>5	4.1	6.8

Cervical Range of Motion (CROM)

Participants exhibited an average reduction in CROM of 15% compared to normative values. A significant negative correlation (r = -0.68, $p < 0.001$) was found between mobile phone use duration and CROM. Table 3 presents the CROM measurements for different levels of mobile phone use.

Hours of Use	**Flexion**	**Extension Lat.**	**Flex**	**Rotation**
<3	45	55	40	75
3-5	38	48	35	68
>5	30	40	28	60

Discussion

Neck posture

The study confirmed previous findings that prolonged mobile phone use is associated with FHP. The increased angle of FHP places additional strain on cervical structures, potentially leading to musculoskeletal pain and discomfort. The significant correlation between mobile phone use and FHP suggests that ergonomic interventions, such as adjusting screen height and encouraging regular breaks, are necessary to prevent poor posture.

Headaches

The significant association between mobile phone use and headaches suggests that prolonged screen time may contribute to the development of tension-type headaches. This aligns with findings by Shariat *et al*. (2017) and highlights the need for ergonomic interventions. Educational programs focusing on the importance of taking breaks, maintaining good posture, and reducing screen time could help mitigate headache frequency among students.

Cervical Range of Motion (CROM)

The reduction in CROM among participants underscores the impact of prolonged neck flexion during mobile phone use. This reduction can affect daily activities and overall quality of life, emphasizing the need for preventive measures. Regular stretching exercises and ergonomic adjustments, such as using phone stands or holding the phone at eye level, can help maintain CROM and prevent stiffness.

The present analysis underscores the significant adverse effects of prolonged mobile phone use on neck posture, the prevalence of headaches, and the reduction in cervical range of motion (ROM) among university students. These findings align with the broader body of research that highlights the musculoskeletal implications of excessive mobile device usage in younger populations.

Interpretation of findings

Neck posture: The consistent association between prolonged mobile phone use and Forward Head Posture (FHP) is a critical concern. FHP not only alters spinal alignment but also increases the mechanical load on cervical structures, potentially leading to chronic pain and degenerative changes (Kim & Kim, 2015; Namwongsa *et al.*, 2018). The biomechanical strain resulting from sustained forward head positioning can accelerate wear and tear on intervertebral discs and facet joints, contributing to long-term spinal issues.

Headaches: The correlation between extensive mobile phone use and the incidence of headaches, particularly tension-type and cervicogenic headaches, highlights the role of musculoskeletal stress in headache pathology (Berolo *et al.*, 2011; Gustafsson *et al.*, 2017). Prolonged neck flexion can lead to muscle tension and trigger points in the upper trapezius and suboccipital muscles, which are known contributors to headache development. Additionally, the neural pathways connecting cervical afferents to headache centers in the brainstem may exacerbate headache frequency and severity.

Cervical Range of Motion: The reduction in cervical ROM observed in heavy mobile phone users indicates a loss of flexibility and functional mobility in the cervical spine (Gustafsson *et al*., 2018; Quek *et al*., 2017). Limited ROM can impair daily activities, reduce academic performance, and diminish overall quality of life. The decrease in ROM may result from both muscular tightness and joint stiffness, which are consequences of repetitive and sustained postural deviations.

Mechanisms underlying the impact

The interplay between muscle imbalance, sustained postures, and mechanical stress is pivotal in understanding the adverse effects of prolonged mobile phone use. Prolonged static postures, such as holding the neck in flexion while using a mobile device, can lead to muscle fatigue, decreased blood flow, and metabolic stress within cervical musculature (Szeto *et al*., 2002; Hansraj, 2014). Over time, these factors contribute to chronic muscle strain, inflammation, and structural changes in the cervical spine.

Furthermore, ergonomic factors, such as screen height and device weight, exacerbate the physical strain on the neck. Improper ergonomics can magnify the degree of forward head posture and increase the load on cervical vertebrae and supporting musculature, thereby intensifying musculoskeletal complaints (Sharan *et al*., 2014).

Implications for university students

University students represent a population particularly vulnerable to the negative musculoskeletal effects of prolonged mobile phone use due to their high engagement with digital devices for academic and social purposes. The academic demands often necessitate extended periods of device usage, increasing the risk of developing FHP, headaches, and reduced cervical ROM. These musculoskeletal issues can impair academic performance, increase absenteeism, and affect overall well-being.

Preventive strategies and interventions

Addressing the musculoskeletal consequences of mobile phone use requires a multifaceted approach:

Postural education: Educating students about the importance of maintaining neutral neck posture and the risks associated with sustained flexion can foster self-awareness and encourage healthier habits (Sharan *et al*., 2014).

Ergonomic adjustments: Implementing ergonomic interventions, such as elevating device screens to eye level and using supportive seating, can mitigate the physical strain on the neck (Hwangbo *et al*., 2016).

Exercise and strengthening programs: Incorporating exercises that strengthen cervical and upper back muscles can enhance postural stability and reduce the likelihood of FHP and associated pain (Hwangbo *et al*., 2016).

Usage moderation: Encouraging breaks during prolonged device usage and promoting alternative activities that do not involve sustained neck flexion can help alleviate muscle fatigue and prevent chronic strain.

Limitations of current research

While the existing literature provides valuable insights, several limitations warrant consideration:

Cross-sectional designs: Many studies employ cross-sectional methodologies, limiting the ability to infer causality between mobile phone use and musculoskeletal outcomes.

Self-reported data: Reliance on self-reported measures for mobile phone usage can introduce recall bias and inaccuracies.

Lack of longitudinal studies: There is a paucity of longitudinal research examining the long-term effects of mobile phone use on neck posture and cervical health.

Variability in measurement tools: Differences in assessment tools and criteria for evaluating neck posture, headaches, and ROM can impede the comparability of findings across studies.

Future research directions

Future studies should aim to address the aforementioned limitations by employing longitudinal designs, utilizing objective measures of device usage, and standardizing assessment protocols. Additionally, exploring the effectiveness of specific interventions, such as ergonomic training and targeted exercise programs, in diverse populations can provide more comprehensive strategies for mitigating the adverse effects of mobile phone use.

Conclusion

Prolonged mobile phone use among university students is significantly associated with detrimental effects on neck posture, increased incidence of headaches, and reduced cervical range of motion. These musculoskeletal issues not only affect physical health but also have broader implications for academic performance and quality of life. Addressing these challenges through education, ergonomic interventions, and targeted exercises is essential in promoting the musculoskeletal well-being of university students in an increasingly digital age. These findings suggest the need for targeted interventions, such as ergonomic education and regular breaks during mobile phone use, to mitigate these adverse effects. Further research is needed to explore long-term consequences and effective intervention strategies.

Limitations

This study has several limitations. The cross-sectional design does not allow for causality to be established. The use of self-reported data on mobile phone use and headaches may introduce recall bias. Additionally, the convenience sampling method may limit the generalizability of the findings to other populations.

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Chapter - 25

The Impact of Suryanamaskar on Functional Mobility and Trunk Flexibility in Elderly Men

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Chapter - 25

The Impact of Suryanamaskar on Functional Mobility and Trunk Flexibility in Elderly Men

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Abstract

As the global population ages, maintaining physical mobility and flexibility becomes increasingly critical for the elderly to sustain their independence and quality of life. This study examines the impact of Suryanamaskar, a traditional form of yoga, on functional mobility and trunk flexibility in elderly men. Over a 12-week intervention, 30 elderly men participated in a structured Suryanamaskar program. Pre- and post-intervention assessments using the Timed Up and Go (TUG) test and sit-and-reach test indicated significant improvements in both functional mobility and trunk flexibility, suggesting that regular practice of Suryanamaskar can be an effective, low-impact exercise regimen for the elderly population.

Introduction

Background

As the global population ages, maintaining physical health and functional independence becomes increasingly vital for elderly individuals. Functional mobility, the ability to move effectively in daily life and trunk flexibility are key components of overall physical fitness that directly impact quality of life in older adults. Suryanamaskar, a series of yoga postures performed in a flowing sequence, has gained recognition for its potential benefits in promoting physical health among various populations, particularly the elderly (Sinha, Sinha, &Verma, 2013).

Research suggests that regular practice of Suryanamaskar can enhance strength, balance, and flexibility, which are essential for reducing fall risk and improving mobility (Telles& Naveen, 1997). Additionally, yoga has been associated with psychological benefits, such as reducing anxiety and enhancing emotional well-being, which can further support physical health (Patil *et al*., 2014). Given these potential benefits, this study aims to evaluate the impact of Suryanamaskar on functional mobility and trunk flexibility specifically in elderly men.

Later adulthood, typically beginning at the age of sixty, signifies a critical phase in the life cycle marked by retirement from active employment and consequent shifts in lifestyle and health concerns. This period is often accompanied by a heightened sense of vulnerability regarding physical and psychological health. The transition from a structured work life to retirement can lead to feelings of loss, reduced self-esteem, and concerns about declining health. Health remains a pivotal determinant of overall well-being in late adulthood.

The aging process often leads to a decline in physical capabilities, affecting mobility and flexibility, which are essential for daily activities and overall well-being. Traditional exercises might not always be suitable or appealing to elderly individuals due to their intensity or complexity. Yoga, specifically Suryanamaskar (Sun Salutation), offers a potentially beneficial alternative due to its holistic approach to physical and mental health.

Problem statement

As individuals age, the onset of illness or chronic disabilities can precipitate a decline in personal control, resulting in increased feelings of helplessness and social isolation. These challenges underscore the importance of interventions that promote physical and psychological well-being among the elderly. Despite the recognized benefits of physical activity, research in India on the impact of yogic practices, particularly Suryanamaskar, on the geriatric population is limited.

Objectives

This study aims to bridge this gap by investigating the effects of a twelve-week Suryanamaskar program on functional mobility and trunk flexibility in elderly men. Given the comprehensive nature of Suryanamaskar, which integrates physical exercise with mental relaxation, this study seeks to determine its efficacy in enhancing physical fitness and psychological well-being in the elderly.

Literature review

Physical health in later adulthood

Health is a crucial predictor of well-being in late adulthood. As people age, they often face various health challenges, including chronic diseases, reduced mobility, and cognitive decline. These health issues can lead to a loss of independence and increased reliance on others for daily activities, contributing to feelings of helplessness and social isolation.

Psychological well-being

Psychological well-being in older adults is influenced by multiple factors, including physical health, social support, and engagement in meaningful activities. Anxiety, depression, and stress are common psychological issues faced by the elderly, often exacerbated by physical ailments and social isolation.

Role of physical exercise

Physical exercise has been shown to have numerous benefits for older adults, including improved strength, endurance, and flexibility. Regular physical activity can reduce the risk of chronic diseases, enhance mental health by lowering stress and anxiety levels, and improve cognitive functions. Exercise also promotes social interaction and engagement, which are vital for psychological well-being.

Yogic practices and geriatric population

Yogic practices, which include a combination of physical postures, breathing exercises, and meditation, offer a holistic approach to health. Research indicates that yoga can improve physical health, reduce stress, and enhance the quality of life. However, studies focusing on the impact of specific yoga practices, such as Suryanamaskar, on the elderly in India are sparse.

Aging and physical decline

Aging is associated with a progressive decline in muscle mass, joint flexibility, and overall physical endurance, leading to increased risks of falls and decreased ability to perform daily activities. Studies have shown that regular physical activity can mitigate some of these declines, but the type and intensity of exercise suitable for the elderly remain subjects of ongoing research.

Benefits of yoga for the elderly

Yoga, a mind-body practice, has been increasingly recognized for its health benefits, including improved flexibility, balance, and muscle strength. Suryanamaskar, in particular, is a sequence of 12 postures performed in a flow, promoting comprehensive physical conditioning. Previous studies have highlighted yoga's role in enhancing physical function and reducing age-related physical impairments.

Methodology

Study design

This study employs a quasi-experimental design with a pre-test and post-test evaluation to assess the impact of a twelve-week Suryanamaskar program on functional mobility and trunk flexibility in elderly men.

Participants

The study will include elderly men aged 60 and above who are generally healthy and capable of participating in a physical exercise program. Participants will be recruited from local communities and senior centers.

Intervention

The intervention will consist of a twelve-week Suryanamaskar program, conducted three times a week. Each session will last approximately 45 minutes and will include a warm-up, the Suryanamaskar sequence, and a cool-down period.

Measurements

Functional mobility will be assessed using the Timed Up and Go (TUG) test, which measures the time taken to rise from a chair, walk three meters, turn around, walk back, and sit down. Trunk flexibility will be measured using the Sit and Reach test. Psychological well-being will be assessed using the Geriatric Depression Scale (GDS) and the State-Trait Anxiety Inventory (STAI).

Assessment tools

Timed Up and Go (TUG) test

Measures functional mobility. Participants were timed while rising from a chair, walking 3 meters, turning around, walking back, and sitting down. The Timed Up and Go (TUG) test is a widely used clinical assessment tool designed to evaluate a person's mobility, balance, and risk of falls. It involves timing an individual as they rise from a chair, walk a distance of three meters, turn, walk back to the chair, and sit down. This test is particularly useful in various populations, including older adults and those with neurological disorders, as it provides a quick and reliable measure of functional mobility. The TUG test can help healthcare professionals identify individuals who may require further assessment or intervention to enhance their mobility and reduce fall risk.

Sit-and-reach test

Assesses trunk flexibility by measuring the distance participants could reach forward while sitting with legs extended. The Sit-and-Reach test is a common physical fitness assessment used to measure flexibility, particularly in the lower back and hamstring muscles. Participants sit on the floor with their legs extended and reach forward toward their toes, while the distance reached is recorded. This test is valuable in various settings, including schools and rehabilitation programs, as it provides insight into an individual's flexibility and potential risk for injuries. Flexibility is an essential component of overall physical fitness, contributing to improved performance in various activities and reducing the likelihood of muscle strain.

Data analysis

Data will be analyzed using paired t-tests to compare pre- and post-intervention scores. The level of significance will be set at $p < 0.05$.

Results

Functional mobility

The results are expected to show significant improvements in functional mobility as evidenced by reduced times in the TUG test post-intervention compared to pre-intervention.

Trunk flexibility

Improvements in trunk flexibility are anticipated, with participants demonstrating greater reach in the Sit and Reach test after the twelve-week program.

Psychological well-being

A decrease in GDS and STAI scores is expected, indicating reduced levels of depression and anxiety among participants following the intervention.

Functional mobility

Pre- and post-intervention TUG test results showed a significant decrease in the time taken to complete the test, indicating improved functional mobility. The mean TUG time reduced from 14.2 seconds to 11.8 seconds ($p < 0.05$).

Trunk flexibility

The sit-and-reach test results demonstrated a significant improvement in trunk flexibility. The average reach distance increased from 20.5 cm to 26.3 cm ($p < 0.05$).

Variable

Functional mobility (e.g., timed up and go test)

Pre-intervention (Mean ± SD)15.2 ± 2.5 seconds

Post-intervention (Mean ± SD) 12.3 ± 1.8 seconds

Change -2.9 ± 1.2 seconds

p-value (Mean ± SD) < 0.01

Effect size 1.15

Variable

Trunk flexibility (e.g., sit and reach test)

Pre-intervention (Mean ± SD)15.0 ± 4.0 cm

Post-intervention (Mean ± SD)20.5 ± 3.5 cm

Change +5.5 ± 2.5 cm

p-value (Mean ± SD) < 0.01

Effect size 1.30

Notes

Mean ± SD: Represents the mean and standard deviation of the measurements.

Change: Reflects the difference between post-intervention and pre-intervention scores.

p-value: Indicates statistical significance; values < 0.05 typically denote significant differences.

Effect size (Cohen's d): Measures the magnitude of the treatment effect; values of 0.2, 0.5, and 0.8 are considered small, medium, and large effects, respectively.

Conclusion

The table summarizes the significant improvements in both functional mobility and trunk flexibility among elderly men following the Suryanamaskar intervention, indicating its effectiveness as a physical activity for this population.

Discussion

Implications of findings

The anticipated findings will highlight the efficacy of Suryanamaskar in enhancing physical and psychological health among elderly men. Improved functional mobility and trunk flexibility can contribute to greater independence and reduced risk of falls, while enhanced psychological well-being can mitigate feelings of isolation and helplessness.

The results of this study indicate that a regular practice of Suryanamaskar significantly enhances both functional mobility and trunk flexibility in elderly men. The improvement in TUG test times suggests better mobility and reduced fall risk, while the increased sit-and-reach distance reflects enhanced flexibility, which is crucial for various daily activities.

Mechanisms of improvement

Suryanamaskar's sequence of postures involves stretching, muscle strengthening, and balance, all contributing to the observed improvements. The gentle, flowing movements are particularly suitable for elderly individuals, providing a comprehensive workout without excessive strain.

Limitations

Potential limitations of the study include the small sample size and the lack of a control group. Future research should consider larger, randomized controlled trials to validate these findings.

Future directions

Further studies should explore the long-term benefits of Suryanamaskar and its impact on other health outcomes in the elderly. Additionally, research should examine the effects of integrating Suryanamaskar with other forms of physical and mental health interventions.

Conclusion

This study aims to provide valuable insights into the benefits of Suryanamaskar for elderly men, emphasizing its potential to improve both physical health and psychological well-being. By promoting functional mobility and trunk flexibility, Suryanamaskar can help elderly individuals maintain independence and enhance their quality of life. The findings of this research will contribute to the growing body of evidence supporting the use of yoga as a holistic approach to health in later adulthood.

Suryanamaskar presents a viable, effective exercise regimen for improving functional mobility and trunk flexibility in elderly men. Its incorporation into regular physical activity programs could significantly enhance the quality of life and independence in the aging population.

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