

Original articles

Effectiveness of Short Wave Diathermy and Maitland Mobilization on Functional outcomes in Patients with knee osteoarthritis: A Pre-Post Interventional study.Ranaweera A.G^{1*}, Karunanayake A.L²¹Department of physical medicine, Teaching Hospital Ratnapura²Faculty of Medicine, University of Kelaniya, RagamaCorresponding author: agranaweera84@gmail.com**Abstract**

Introduction: Knee osteoarthritis is a common degenerative joint disease causing pain, stiffness and disability. This study evaluated the effectiveness of combining Short Wave Diathermy and Maitland mobilization in improving the functional outcomes of patients affected with knee osteoarthritis.

Methods: A pre-post interventional study was conducted in teaching hospital Ratnapura among 30 patients with unilateral knee OA in the age range 40 -65 years. The patients were subjected to a weekly intervention of 20 minutes of SWD and Maitland mobilization which provided 120/min graded oscillations of five sets. The intervention duration lasted for eight weeks. Patients were assessed using the WOMAC Index at baseline and soon after the eight-week intervention. WOMAC index measures the pain, stiffness and physical function. Paired T test or Wilcoxon Signed Rank test was used to compare the baseline and post intervention values. Shapiro Wilkins test was used to assess the normality of the data.

Results: Pain scores reduced from 10.40 ± 3.38 to 4.43 ± 3.32 , stiffness reduced from 2.83 ± 1.12 to 1.13 ± 1.20 , physical function limitation reduced from 32.40 ± 9.27 to 11.07 ± 9.97 , and total WOMAC score reduced from 45.63 ± 12.64 to 16.63 ± 13.63 . This difference in WOMAC score was statistically significant ($Z = -4.734$, $p < 0.001$).

Discussion: The combined intervention produced clinically and statistically significant improvements consistent with previous literature.

Conclusion: SWD combined with Maitland mobilization is an effective physiotherapy intervention for treating patients with knee osteoarthritis.

Keywords: Knee pain, Maitland mobilization, Osteoarthritis, Short wave diathermy

Introduction

Osteoarthritis (OA) of the knee is the most prevalent form of arthritis and the primary cause of impairment affecting the elderly and middle-aged globally [1]. According to Hsu and Siwiec (2020), the burden on society due to OA (both in terms of individual suffering and health resource utilization) is anticipated to rise in tandem with the community's aging [2] and the rising incidence of obesity [3]

Clinical features of OA include joint pain with activity, transient stiffness in the morning or after rest, reduced range of motion, joint crepitus or periarticular tenderness and swelling [2]. Osteoarthritis can significantly limit a person's capacity to do activities of daily living, depending on the disease's stage. The pain due to this disease impairs one's ability to move freely, lowers physical capability and reduces engaging in social activities and performance at work [4].

The diagnosis of osteoarthritis is usually made clinically with relevant history and associated signs and symptoms, and then it is confirmed by radiography. Plain radiographs with advanced disease show narrowing of joint space, osteophytes, and sometimes changes in the subchondral bone [5]

The exact etiology of knee OA remains unclear. Modifiable risk factors of Knee Articular damage include prolonged standing, repetitive knee bending, muscular weakness, obesity and health-metabolic syndrome [3]. Non-modifiable risk factors of Knee OA are gender (females more common than males), increasing age and genetics [2]

Analgesics, physical therapy, wedged insoles, unloaded braces, intra-articular injections, patient education, activity modification, and weight loss are nonsurgical treatment options that are currently available for management of knee OA [6]. These treatments are crucial in reducing joint pain and postponing surgical intervention [2]. The most recommended nonsurgical and non-pharmacological treatment for patients with knee OA includes physical therapy which includes using of electrotherapy modalities, muscle strengthening and range of motion exercises, aerobic exercises, kinesio taping and soft tissue mobilization and patient education. This type of treatment has shown to be effective in reducing levels of pain and improving physical functioning [2; 7]

Shortwave diathermy (SWD) is an electrotherapy modality that produces heat by converting electromagnetic energy into thermal energy. Shortwave Diathermy uses electromagnetic energy to produce heat in the tissues, which helps increase blood flow, reduce muscle spasms, relieve pain, and promote the healing of tissues. This thermal effect can enhance the flexibility and extensibility of the soft tissues surrounding the knee joint, potentially preparing the joint for mobilization [6]. However, it is challenging to draw firm conclusions about the elements influencing the efficacy of SWD treatment due to the variation in treatment procedures [6].

Maitland's Mobilization is a hands-on therapy that focuses on joint movement and is aimed at restoring mobility and reducing pain [1]. According to Maitland's classification, Grade I and Grade II joint mobilizations are performed primarily to decrease joint pain and Grade III and Grade IV joint mobilizations are performed to increase joint range

of motion (ROM). This type of mobilization includes low-velocity passive movements within or at the limit of the joint range of motion [8, 9]

Combining both modalities may address a wider range of symptoms and functional limitations associated with knee osteoarthritis. This can potentially lead to improved functional outcomes as patients may experience both immediate relief from pain and long-term improvement in joint function. Both SWD and Maitland mobilization are frequently employed isolated in clinical practice in Sri Lanka to treat patients with knee OA. Even though they are often used, little is known about their combined functional effects in Sri Lankan clinical settings. Hence this study hopes to evaluate the efficacy of Maitland mobilization in conjunction with short-wave diathermy in enhancing functional results in patients with osteoarthritis in the knee.

Objectives

The aim of this study is to assess the effect of combination of SWD and Maitland mobilization, to analyze the functional outcome of patients with knee osteoarthritis with regard to reducing pain, stiffness and physical function.

Methods

This experimental study was conducted in an outpatient physiotherapy clinic in Teaching Hospital Ratnapura, Sri Lanka for a period of four months. The study population included male and female patients affected with unilateral knee OA in the age range 40-65 years.

Sample size

The sample size for this study was determined by means approximation method, where 30 patients were selected. This sample size was approximated because there was no available hospital-level data. Hence it was decided to use the approximation method of 30 patients for this study, by following the reliable and valid minimum number of patients needed for any research activity that has been mentioned as 30 in common statistical procedures [10]. A commonly accepted minimum sample size for an experimental study design research is typically considered to be around 30 participants per group. This is often used as a rule of thumb because it aligns with the point where the Central Limit Theorem

begins to apply, providing more reliable statistical analysis [10].

Patients with RA and other inflammatory arthritic conditions, significant knee injuries, bilateral knee OA, malignant conditions, previous knee surgeries were excluded.

The functional outcome was measured using the Western Ontario and McMaster University (WOMAC) osteoarthritis index [11]. It is a validated tool for assessing activities of daily living (ADL), functional mobility, gait, general health, and quality of life in patients with knee OA. It has a total of 24 items and three subscales, namely pain (5 items), stiffness (2 items), and function (17 items) scored on a five-point scale. A higher WOMAC score indicates worse pain, stiffness, and functional limitation. The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) is a widely used and validated scale for assessing pain, stiffness, and physical function in patients with osteoarthritis (OA) of the knee. [11]

Data collection procedure

This study followed a pre-test and post-test design to assess the effectiveness of combined shortwave therapy and Maitland mobilization for patients with unilateral knee OA. Data collection was commenced after obtaining ethical approval from ethics committee Faculty of Medicine, University of Kelaniya and permission from the Director of Teaching hospital, Ratnapura, Sri Lanka. A Pre-test was assessed using an independent physiotherapist – administered questionnaire which was designed to collect demographic data and information on functional disabilities (based on WOMAC OA Index) prior to the interventions.

Intervention

The intervention consisted of a combination of SWD and the Maitland mobilization technique.

SWD at a frequency of 27.12MHz was administered for 20 minutes, in continuous mode to provide thermal effects. Participants were positioned in a sitting position in a comfortable chair with a backrest. The affected knee with OA was placed in a 90-90 position with a foot resting on a low stool. Electrodes were placed in a contra planar method (one electrode closer to the medial aspect of the knee joint and the other electrode closer to the lateral

aspect of the knee joint) [12]. Intensity was adjusted according to the warmth felt by the participant. The participant's tolerance to the increase temperature were monitored during the treatment.

Maitland mobilization include tibio-femoral distraction, tibio-femoral anterior glide, and tibio-femoral posterior glide. Each Maitland mobilization technique was performed in 5 sets with a frequency of 120 oscillations per minute [8,9]. This mobilization was performed while the patient was positioned on a treatment bed with the knee flexed to ninety degrees. Treatment was administered by the same physiotherapist for all the patients.

This combined intervention was administered once a week for a total duration of 8 weeks. Pre and Post-intervention assessments were conducted using the same questionnaire by an independent therapist. This questionnaire was used to assess the changes in pain, stiffness, and physical function following combination of SWD and the Maitland mobilization technique.

Data analysis

To compare the baseline values with post-intervention values Paired T-test was carried out when the data was normally distributed. When data was not normally distributed Mann Whitney U test was carried out. Shapiro-Wilk test was carried out to see whether the data is normally distributed. SPSS Version 25 was used for data analysis

Results

A total of 30 patients were assessed. The mean age of the patients were 55 ± 4.8 years. Majority (63.3%) were females.

Descriptive statistics of the individual components of WOMAC score indicated an overall improvement in pain, stiffness, and physical function following the intervention. The main improvement happened in the limitation in physical function score. The limitation in physical function score decreased from 32.40 ± 9.27 in the pre-intervention phase to 11.07 ± 9.97 post-intervention (Table 1).

Table 1. Comparison of Pre and post intervention WOMAC domain scores

Variable	Pre Mean $\pm$ SD	Post Mean $\pm$ SD
Pain	10.40 $\pm$ 3.38	4.43 $\pm$ 3.32
Stiffness	2.83 $\pm$ 1.12	1.13 $\pm$ 1.20
Physical Function limitation	32.40 $\pm$ 9.27	11.07 $\pm$ 9.97
Total WOMAC score	45.63 $\pm$ 12.64	16.63 $\pm$ 13.63

The total WOMAC score was analyzed to assess the overall change in pain, stiffness, and physical function following the intervention among the participants. The results demonstrated improvements in WOMAC score in 29 patients and worsening of WOMAC score in 1 patient only. The mean total WOMAC score decreased from 45.63 ± 12.64 in the pre-intervention phase to 16.63 ± 13.63 in the post-intervention phase. This substantial reduction in the total WOMAC score indicates an overall improvement in symptoms and functional status after the intervention). This difference in Total WOMAC score was statistically significant ($Z = -4.73$, $P = <0.001$).

Discussion

This chapter discusses the results of this study based on the primary aim to evaluate the effectiveness of Shortwave Diathermy (SWD) combined with Maitland mobilization techniques in reducing pain, stiffness, and improving physical function in patients with knee osteoarthritis.

In the present study the mean age of the participants was 55 ± 4 years. The age distribution of our study participants is consistent with the published epidemiological data that shows the prevalence of osteoarthritis rises with age, especially in the population over 50 years may be due to degenerative joint changes that occur with increase in age [13]. In our study females accounted for 63% of the sample, which is in line with the fact that women are more likely than men to have knee OA. Hormonal impacts, variations in biomechanics and joint structure, as

well as lifestyle-related factors, have all been linked to this gender gap [14]. It is critical to comprehend these demographic traits since age and gender might affect the severity of a disease and how well a treatment works.

The present study found a substantial reduction in mean pain scores from 10.40 ± 3.38 pre-intervention to 4.43 ± 3.32 post-intervention, which reflects a clinically meaningful improvement. Pain is the most common symptom of knee OA and significantly impacts daily functioning and quality of life. The observed pain reduction aligns with previous studies that demonstrate the analgesic effect of SWD and manual therapy techniques [6].

SWD produces deep tissue heating via electromagnetic energy, which can increase local blood flow, reducing joint stiffness and facilitate muscle relaxation. Increased tissue temperature may also reduce pain by enhancing metabolic activity and decreasing sensitivity of the nociceptors [15]. However according to some literature, shortwave diathermy shows weak evidence. A meta-analysis of seven studies by Laufer and Dar found only small, significant effects on pain when thermal sensation was induced, with no functional performance improvements [15]. According to the study by Laufer et al., 2005 [16], pulsed SWD produced no significant differences versus placebo in 103 patients. Similar findings were reported in a RCT which mentions that SWD had no significant benefits compared to physical exercise on women affected with osteoarthritis [17]

Meanwhile, Maitland mobilization involves graded passive movements of the joint to improve range of motion, decrease pain, and reduce capsular tightness. Mobilization has been shown to modulate pain through neurophysiological mechanisms, including stimulation of mechanoreceptors and inhibition of nociceptive input at the spinal level [18]. Samal et al, found Maitland mobilization produced more significant improvements than conventional treatment alone in 72 patients [8]. POZSGAI et al. (2021) reported that Maitland mobilization exercises combined with conservative therapy outperformed conservative therapy alone across 30 patients on pain and functional measures [9].

According to some studies, the combination of mobilization techniques and electrotherapy modalities are likely to provide a synergistic effect,

resulting in the marked pain reduction. Studies by Yesil et al. (2017) [19] and Koca et al (2015) [20] demonstrated that combined electrotherapeutic and manual therapy interventions produced significant pain relief in knee OA patients. Also evidence suggest that when combined with exercise, SWD showed modest additive effects [21]. According to the same authors Maitland mobilization remains the more evidence- supported intervention for functional outcomes. These results highlight the potential superiority of multimodal physiotherapy techniques over single therapies for managing pain in OA. Our study findings support the study findings of Yesil et al. (2017) [19] and Koca et al. (2015) [20].

Knee OA is characterized by stiffness, especially in the morning or after periods of inactivity. The mean stiffness score in this study dropped from 2.83 ± 1.12 to 1.13 ± 1.20 after the intervention. Findings of our study concur with earlier studies that demonstrate that manual treatment approaches can lessen joint stiffness by increasing capsular flexibility and fostering synovial fluid circulation which helps to increase joint mobility [22].

SWD may help in facilitating joint movement, using it's heating effect. As noted by Brosseau et al. (2003), these heat modalities contribute to decreasing stiffness in OA by reducing periarticular connective tissue viscosity, thereby facilitating the joint movement [23]. This further highlights that the combined effect of SWD and Maitland mobilization thus appears to address both structural and functional components of stiffness, explaining the significant post-intervention improvements.

OA-related disability primarily manifests as impaired mobility and reduced ability to perform activities of daily living (ADLs). Physical function, which was assessed using the WOMAC functional domain, shows a significant improvement with the mean scores decreasing from 32.40 ± 9.27 to 11.07 ± 9.97 . Our study findings are consistent with findings from other interventional studies using manual therapy and electrotherapeutic modalities. According to Deyle et al (2000) reported that patients receiving manual therapy and supervised exercise demonstrated superior improvements in function compared to those receiving exercise alone [24]. Similarly, Tragord et al (2013) found that integrating physical modalities with joint mobilization led to better functional outcomes in knee OA patients [25]. The improvements in physical function may also be

attributed to pain reduction, as decreased pain facilitates greater willingness and ability to move the affected joint that enhances functional capacity.

In the present study, the total WOMAC score, which provides a measure of pain, stiffness, and physical function, decreased significantly from 45.63 ± 12.64 to 16.63 ± 13.63 post-intervention. This difference was statistically significant. The results of our study provide some important insights into that the present intervention was not only effective in reducing individual symptoms but also led to a substantial overall improvement in patients' functional status and quality of life.

The findings of this study brings some significant implications. First, the combination of SWD and Maitland mobilization can be considered an effective non-pharmacological strategy for managing knee OA, particularly for patients who may not tolerate long-term pharmacotherapy due to adverse effects. Second, the intervention demonstrated measurable improvements in pain, stiffness, and function within a short duration, suggesting that it can be incorporated into routine physiotherapy practice for rapid symptom relief. Finally, the results support the importance of individualized, multimodal treatment plans that address both symptomatic relief and functional recovery, consistent with current OA management guidelines [26].

Our findings significantly align with the principle of multimodal rehabilitation in OA management, which emphasizes addressing multiple aspects of the effects of the disease simultaneously. Concur to our study findings, Zhang et al (2010) indicates, interventions that combine physical therapy techniques targeting pain relief, joint mobility, and muscle strength are more likely to produce comprehensive benefits compared to single-modality treatment [12].

Conclusions

Overall, the findings of this study suggest that the combination of Short Wave Diathermy and Maitland mobilization is an effective physiotherapy intervention for patients with knee osteoarthritis. This combined intervention significantly reduced symptoms and improved functional outcomes within the study sample. However, several limitations qualify these findings. First, the small sample size and absence of a control group may restrict the generalizability of the results. Consequently, future research should utilize larger sample sizes,

randomized controlled trial designs, and extended follow-up periods to validate these outcomes and assess long-term efficacy.

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