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Immediate effects of Mulligan mobilization and taping on pain and functional status in patients with knee osteoarthritis

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Abstract

Aim: The present study aimed to examine the immediate impact of a physical therapy in combined with mobilization on pain, functional restoration, and decreasing disability in individuals with knee osteoarthritis.

Materials and Methods: Pain intensity was evaluated by Visual Analog Scale (VAS), disability by WOMAC Osteoarthritis Index, and function by functional tests. The participants of the study were randomly divided into two groups. The control group received a single session of conventional physical therapy. In contrast, the study group received 3 sets of Mulligan mobilization technique (MWM), one set made up of 10 repetitions in combination to conventional physiotherapy. In the following step, internal rotation taping was applied to the study group. Outcome measurements were repeated after the treatment.

Results: A total of 40 patients with knee osteoarthritis were included the study. No significant differences were found between the study and control groups regarding demographic characteristics ($p>0.05$). Significant changes were observed in all measured parameters within both groups ($p<0.05$). The pain evaluation showed significant changes among the groups ($p=0.002$) whereas, no significant differences were identified in functional tests or disability measures ($p>0.05$).

Conclusion: Mulligan MWM technique and internal rotation taping in addition to conventional treatment were found to be more effective in reducing pain compared to the group treated with conventional treatment alone. Adding MWM technique and taping to the routine treatment of OA may increase the success of treatment.

Introduction

Osteoarthritis (OA) is a progressive joint disorder marked by the breakdown of articular cartilage, increased density in the underlying bone (subchondral sclerosis), and alterations in the biochemical and morphological aspects of the synovial membrane and joint capsule It results in pain, joint stiffness, stiffness, stiffness in joint motion, limitation in activities of daily living and eventually disability [1]. Patients with knee OA (KOA) have symptoms such as pain, movement limitation and loss of function due to biomechanical changes. Osteoarthritis Research Society International provides pharmacologic, non-pharmacologic and surgical treatment recommendations for the treatment of osteoarthritis [2].

Physical therapy modalities are frequently used in combination with other treatment options or alone in the treatment of OA in clinical practice [3]. Mobilization methods are also used in the treatment of OA in addition to physical therapy. Manual techniques used in KOA aim to reduce pain, increase range of motion, and improve function [4]. According to Adams et al., manual therapy exerts mechanical, neurophysiological, and physiological effects on tissues. Their findings indicated immediate pain relief, activation of pain-inhibitory mechanisms, a reduction in inflammatory markers in the bloodstream, and improved joint function following joint mobilization [5]. Similarly, Moss et al. observed a rapid decrease in pain after joint mobilization in individuals with knee osteoarthritis (KOA). This pain reduction was attributed to the stimulation of mechanoreceptors and the modulation of pain perception within the cortical system [4].

Mulligan mobilization is a type of joint mobilization developed by physiotherapist Brain Mulligan in New Zealand in 1980. This method that should be applied by trained physiotherapists, and it aims to correct movement limitation in the joint and to eliminate pain and restore the

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function of the joint [6]. However, there are no studies examining the effects of MWM and kinesio taping in addition to conventional physical therapy. The aim of this study was to investigate the immediate effects of MWM and kinesio taping applied in combination with a physical therapy program on pain, functionality and disability in patients with KOA.

Materials and Methods

The study received approval from the institutional review board (Fırat University Non-Interventional Clinical Research Ethics Committee, 2023/10-18) and followed the ethical guidelines outlined in the Declaration of Helsinki. Written informed consent was secured from all participants. To calculate the required sample size and ensure statistical power, the G*Power 3.1.9.4 software was employed. Using VAS mean scores reported by Kiran et al. [7], a power analysis indicated that at least 20 participants per group were needed to detect an effect size of 1.21, with an alpha level of 0.05 and a power of 0.95. Sixty-four female patients with KOA diagnosed using the American College of Rheumatology criteria, were included in this study. Eligible patients were aged 40-65 years and presented with Kellgren-Lawrence stage 1 or 2 osteoarthritis, and provided consent to participate. Exclusion criteria included pregnancy, malignancy, requirement for walking support, prior knee surgery, inflammatory arthritis, analgesic use on the day of treatment, and a history of knee trauma within the preceding six months. Pain was the primary outcome, with functional restoration and disability reduction serving as secondary outcomes.

Sixty-four female patients with KOA diagnosed using the American College of Rheumatology criteria, were included in this study. Eligible patients were aged 40-65 years and presented with Kellgren-Lawrence stage 1 or 2 osteoarthritis, and provided consent to participate. Exclusion criteria included pregnancy, malignancy, requirement for walking support, prior knee surgery, inflammatory arthritis, analgesic use on the day of treatment, and a history of knee trauma within the preceding six months. Pain was the primary outcome, with functional restoration and disability reduction serving as secondary outcomes.

Outcome measurements

Sociodemographic data, including age, height, weight, body mass index (BMI) and, current medications were recorded.

Pain assessment

Visual Analog Scale (VAS) was used to evaluate pain in functional tests before and after treatment [8].

Functional tests

Patient functional status was assessed using the pick-up, repeated sit-to-stand, socks, stair descent, stair climbing, and ten meters walk tests [9]. Patients received explanations of the tests and performed each test three times, with one-minute rest intervals between repetitions. The mean of the three scores obtained for each test was then calculated.

Disability assessment

The Western Ontario and McMaster Universities Arthritis Index (WOMAC) was utilized to assess disability. This tool consists of 24 items, categorized into three domains: pain (5 items), stiffness (2 items), and physical function (17 items) [10].

Treatment program

The patients included in the study were randomly divided into two groups using random.org. Patients in control group received combined physical therapy modalities (CPT); patients in study group received mobilization and Mulligan Concept internal rotation kinesiotaping, in addition to CPT. In the supine position, lateral, medial and rotational sliding forces were applied to the tibia, and anterior sliding force was applied to the proximal tibiofibular joint of the fibula head, to determine the sliding direction that reduced subjects pain. Three sets of 10 repetitions were performed, with 15-20 second rests between sets. After mobilization, kinesiotaping was applied using submaximal tension , adhering to the Mulligan Concept. During taping, subjects maintained 5-10 degrees of knee flexion while standing, and maximally externally rotated the hip while internally rotating the foot. The tape was then applied form the posterior aspect of the fibular head, diagonally across the anterior knee, and adhered to the posterior aspect of the medial condyle of the femur.

Hotpack (HP), TENS and ultrasound (US) were applied in CPT. Superficial heat application was applied on the knee for 30 minutes by wrapping two layers of towels on HPs. Conventional TENS with 4 electrodes for 30 minutes and Therapeutic US with 3 megahertz, 1 watt/cm2 treatment dosage for 5 minutes were applied to the knee of the patients.

Statistical analysis

All statistical analyses were performed using SPSS Version 22.0 for Windows. The normality of the data was evaluated using the Kolmogorov-Smirnov and Shapiro-Wilk tests. Based on the results, either parametric or nonparametric methods were selected for data analysis. Descriptive statistics were expressed as counts, percentages, ranges, and means ± standard deviations. Categorical variables were analyzed using the Pearson chi-square test, while continuous variables were examined using the Independent t-test and Mann-Whitney U test. For parametric comparisons, the Wilcoxon test (a nonparametric method for dependent groups) and Paired Sample tests were utilized. A p-value of less than 0.05 was considered statistically significant.

Results

Twenty-one patients did not meet inclusion criteria and three patients refused to participate. Therefore, this study was completed with 40 patients. The demographic characteristics of the patients were summarized in Table 1. There was no statistically significant difference between the demographic variables of the two groups ($p>0.05$).

When the efficacy of the treatments was analyzed, a statistically significant difference was found between all parameters evaluated for both groups ($p<0.05$) (Table 2). While

Table 1. Demographic variables in study and control groups.

Parameters	Study Group (n=20)	Control Group (n=20)	p
Age/years (Mean±SD)	51.05±4.65	50.90±5.08	0.923
Med. (Min.-Max.)	51.00 (43.00-59.00)	50.50 (41.00-59.99)	
Length/cm (Mean±SD)	159.60±6.90	160.40±5.25	0.870
Med. (Min.-Max.)	160.00 (146.00-170.00)	160.00 (150.00-172.00)	
Weight/kg (Mean±SD)	69.10±9.52	68.55±11.44 68.50	0.683
Med. (Min.-Max.)	69.00 (52.00-90.00)	(48.00-92.00)	
BMI/kg/cm^2(Mean±SD)	27.24±4.26	26.79±5.20	0.769
Med. (Min.-Max.)	26.94 (21.09-33.78)	26.28 (16.90-36.63)	

Abbreviations: cm: centimeters, kg: kilograms, BMI: Body Mass Index.

Table 2. Comparison of pain, function and disability before and after treatment of study and control groups.

Parameters	Study Group (n=20)			Control Group (n=20)		
	Before treatment	After treatment	p	Before treatment	After treatment	p
VAS (Mean±SD)	7.65±1.75	6.00±1.33	**0.001**	7.80±1.23	6.80±1.15	**0.002**
Med. (Min.-Max.)	8.00 (4.00-10.00)	6.00 (4.00-9.00)		8.00 (5.00-10.00)	7.00 (3.00-8.00)	
Picking up test (Mean±SD)	1.80±0.95	1.30±0.65	**0.008**	1.90±0.96	1.70±0.92	**0.046**
Med. (Min.-Max.)	2.00 (0.00-3.00)	1.00 (0.00-2.00)		2.00 (0.00-3.00)	2.00 (0.00-3.00)	
Repeated sit to stand test (Mean±SD)	16.50±2.81	15.45±2.94	**0.001**	16.80±4.03	16.25±4.24	**0.005**
Med. (Min.-Max.)	15.50 (13.00-24.00)	14.50 (11.00-22.00)		16.50 (10.00-25.00)	16.00 (10.00-25.0)	
Socks Test (Mean±SD)	1.95±0.68	1.15±0.58	**0.001**	1.90±0.85	1.45±1.09	**0.014**
Med. (Min.-Max.)	2.00 (1.00-3.00)	1.00 (0.00-2.00)		2.00 (0.00-3.00)	1.50 (0.00-3.00)	
Stair descent test (Mean±SD)	13.30±2.47	12.30±2.38	**0.001**	13.95±3.13	13.45±2.81	**0.014**
Med. (Min.-Max.)	14.00 (9.00-20.00)	12.00 (8.00-18.00)		14.50 (10.00-21.00)	13.50 (9.00-18.00)	
Stair climbing test (Mean±SD)	14.25±2.24	13.15±1.66	**0.001**	14.50±2.72	13.95±2.74	**0.009**
Med. (Min.-Max.)	14.00 (11.00-21.00)	14.00 (10.00-17.00)		14.00 (10.00-20.00)	14.00 (10.00-20.00)	
Ten meters walking test (Mean±SD)	14.35±2.32	13.20±2.37	**<0.001**	14.35±2.62	14.10±2.75	**0.037**
Med. (Min.-Max.)	15.00 (10.00-19.00)	13.50 (9.00-17.00)		14.50 (10.00-19.00)	14.50 (8.00-18.00)	
WOMAC-Pain (Mean±SD)	10.75±3.62	9.60±3.40	**0.002**	10.45±3.20	10.05±3.03	**0.011**
Med. (Min.-Max.)	11.50 (3.00-15.00)	11.00 (3.00-15.00)		10.00 (4.00-18.00)	10.00 (4.00-17.00)	
WOMAC- Stiffness (Mean±SD)	3.90±1.07	3.00±1.21	**0.002**	3.80±1.28	3.35±1.26	**0.024**
Med. (Min.-Max.)	4.00 (2.00-6.00)	3.00 (2.00-6.00)		4.00 (1.00-6.00)	3.00 (1.00-6.00)	
WOMAC-Function (Mean±SD)	30.10±6.71	28.85±6.50	**<0.001**	30.00±7.91	29.15±7.96	**<0.001**
Med. (Min.-Max.)	29.00 (18.00-44.00)	28.00 (17.00-43.00)		29.50 (19.00-46.00)	28.50 (18.00-46.00)	

Abbreviations: VAS: Visual Analog Scale, WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index.

there was a statistically significant difference between the groups in pain assessment (p=0.002), there was no significant difference in functional tests and disability assessment (p>0.05) (Table 3).

Discussion

Our study was designed to investigate the effects of Mulligan mobilization and taping with CPT on pain, functional status and disability in OA patients. The results of the study demonstrated that CPT and Mulligan MWM plus CPT were both effective on the parameters evaluated in these patients. In addition, it was concluded that CPT and Mulligan mobilization and taping application were more effective than CPT alone in improvement of all the evaluated parameters. However, a statistically significant difference was obtained on pain between the groups. These results indicated that Mulligan mobilization has acute effects on pain, function and disability in KOA patients and can be applied in addition to CPT.

Our results showed that the Mulligan MWM technique was found to be effective on pain, functional status, and disability. The Mulligan Concept helps to increase neuromuscular control by providing the experience of painless movement [11]. MWM application in the treatment of KOA may have reduced pain by regulating biomechanics. In additional, as a result of decreased pain, patients may gain their functions more rapidly. Furthermore, internal rotation taping may mainly contribute to the reduction of pain and improvement of function by maintaining the beneficial effects of the Mulligan MWM. A systematic review examining the effects of Mulligan mobilization in KOA patients concluded that this treatment was a promising alternative treatment method in reducing pain and improving disability [12]. Various other studies concluded that MWM technique was more effective in reducing pain than Maitland tecnique [7,13]. Bhagat et al concluded that MWM technique applied in KOA patients had acute effects on pain and balance [14]. The results of our study supported the results of the studies in the current literature.

Internal rotation taping was applied in addition to the

Table 3. Within group differences before and after the treatment.

Parameters	Before treatment			After treatment		
	Study Group (n=20)	Control Group (n=20)	p	Study Group (n=20)	Control Group (n=20)	p
VAS (Mean±SD)	7.65±1.75	7.80±1.23	0.879	6.00±1.33	6.80±1.15	**0.022**
Med. (Min.-Max.)	8.00 (4.00-10.00)	8.00 (5.00-10.00)		6.00 (4.00-9.00)	7.00 (3.00-8.00)	
Picking up test (Mean±SD)	1.80±0.95	1.90±0.96	0.711	1.30±0.65	1.70±0.92	0.080
Med. (Min.-Max.)	2.00 (0.00-3.00)	2.00 (0.00-3.00)		1.00 (0.00-2.00)	2.00 (0.00-3.00)	
Repeated sit to stand test (Mean±SD)	16.50±2.81	16.80±4.03	0.585	15.45±2.94	16.25±4.24	0.493
Med. (Min.-Max.)	15.50 (13.00-24.00)	16.50 (10.00-25.00)		14.50 (11.00-22.00)	16.00 (10.00-25.0)	
Socks Test (Mean±SD)	1.95±0.68	1.90±0.85	0.930	1.15±0.58	1.45±1.09	0.349
Med. (Min.-Max.)	2.00 (1.00-3.00)	2.00 (0.00-3.00)		1.00 (0.00-2.00)	1.50 (0.00-3.00)	
Stair descent test (Mean±SD)	13.30±2.47	13.95±3.13	0.426	12.30±2.38	13.45±2.81	0.172
Med. (Min.-Max.)	14.00 (9.00-20.00)	14.50 (10.00-21.00)		12.00 (8.00-18.00)	13.50 (9.00-18.00)	
Stair climbing test (Mean±SD)	14.25±2.24	14.50±2.72	0.753	13.15±1.66	13.95±2.74	0.385
Med. (Min.-Max.)	14.00 (11.00-21.00)	14.00 (10.00-20.00)		14.00 (10.00-17.00)	14.00 (10.00-20.00)	
Ten meters walking test (Mean±SD)	14.35±2.32	14.35±2.62	0.924	13.20±2.37	14.10±2.75	0.275
Med. (Min.-Max.)	15.00 (10.00-19.00)	14.50 (10.00-19.00)		13.50 (9.00-17.00)	14.50 (8.00-18.00)	
WOMAC-Pain (Mean±SD)	10.75±3.62	10.45±3.20	0.783	9.60±3.40	10.05±3.03	0.662
Med. (Min.-Max.)	11.50 (3.00-15.00)	10.00 (4.00-18.00)		11.00 (3.00-15.00)	10.00 (4.00-17.00)	
WOMAC- Stiffness (Mean±SD)	3.90±1.07	3.80±1.28	0.955	3.00±1.21	3.35±1.26	0.267
Med. (Min.-Max.)	4.00 (2.00-6.00)	4.00 (1.00-6.00)		3.00 (2.00-6.00)	3.00 (1.00-6.00)	
WOMAC-Function (Mean±SD)	30.10±6.71	30.00±7.91	0.966	28.85±6.50	29.15±7.96	0.897
Med. (Min.-Max.)	29.00 (18.00-44.00)	29.50 (19.00-46.00)		28.00 (17.00-43.00)	28.50 (18.00-46.00)	

Abbreviations: VAS: Visual Analog Scale, WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index.

MWM technique in our study. Internal rotation of the tibia occurs with flexion in the knee joint [15]. By applying the tape in the direction of internal rotation, the procedure supports and maintains the internal rotation movement that naturally occurs during knee flexion, in accordance with the Mulligan MWM. Research indicates that this internal rotation taping technique contributes to improved knee biomechanics, further enhancing the effectiveness of the Mulligan Concept [16,17]. The results of our study demonstrated that taping with MWM was effective in the reduction of pain, and disability, and improvement in function in patients with KOA.

In the present study, we found that CPT treatment had important effects on pain, functional status and disability in KOA patients in this study. Both groups received TENS, therapeutic US and hot pack, which are frequently used in OA treatment. TENS has been widely used in KOA patients for a long time and its efficacy is well known [18]. US is safe and effective in pain reduction and function improvement in patients with KOA [19]. Hochberg et al. [20]. recommended that hot pack should be used by physiotherapists in combination with exercise. Both our study and previous research have shown that conventional physical therapy (CPT) leads to significant improvements in pain, a reduction in disability, and enhanced functional status.

There was a statistically significant improvement in pain in the study group in which MWM and taping techniques were performed. Although both techniques have comparable outcomes, MWM technique and taping seem to be superior in reducing disability and improving function in patients with KOA. The results may be more prominent in long-term applications. The biomechanical structure of the joint is restored and positional error is corrected with MWM. Painless movement is perceived and learned with repetition [11]. One of the pain mechanisms in OA is the weakening of central inhibition mechanisms and decrease in pain threshold. MWM and taping may contribute to pain desensitization due to perception of painless movement. The Mulligan MWM and taping techniques potentially contribute to pain desensitization by promoting the perception of movement without pain. As pain decreased, patients likely experienced an increase in the speed of functional movements, leading to a reduction in disability [21]. Li et al. was reported that Mulligan MWM was effective in patients with KOA as parallel to our study [12].

Our study had some limitations. The fact that we did not examine the long-term results of the methods can be seen as a limitation. In addition, the fact that we did not evaluate the proprioception of the patients can be considered as a limitation.

Conclusion

In conclusion, both CPT alone and CPT combined with Mulligan MWM and taping were effective in improving pain, disability, and function in patients with KOA. Notably, the addition of MWM and internal rotation taping to CPT demonstrated superior pain reduction compared to CPT alone. While not statistically significant, this combined approach also showed trends towards improved function and disability status. These findings suggest that incorporating MWM and taping into routine KOA treatment may enhance treatment outcomes. Future research should investigate the long-term effects of the Mulligan technique.

Ethics Committee Approval

Ethical approval was obtained for this study from the Fırat University Non-Interventional Clinical Research Ethics Committee (2023/10-18).

Conflict of Interest

The authors declare that they have no conflict of interest.

Competing Interest

Not applicable.

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