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EFFECTS OF DEEP STRIPPING VERSUS KNEADING ON PAIN, RANGE OF MOTION AND FUNCTIONAL ACTIVITY AMONG INDIVIDUALS WITH KNEE OSTEOARTHRITIS: A RANDOMIZED CONTROLLED TRIAL

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Abstract: Knee osteoarthritis is linked to progressive loss and deterioration of articular cartilage which affects individuals 45 years of age and older. The study aimed to compare the effects of soft tissue mobilization's techniques deep stripping versus kneading for osteoarthritis of knee joint. 44 individuals of 40 to 65 years of age with chronic knee osteoarthritis that meets Kellgren and Lawrence's criteria for grades two and three, pre-diagnosed by an orthopedic were included and the participants with any other lower limb musculoskeletal issue and taking any type of treatment were excluded. Participants were assigned into two groups randomly and provided deep longitudinal stripping and kneading. Outcome measures were pain, range of motion and functional activity collected at the baseline, 2nd week, and 4th week. Participants in the kneading and deep stripping groups had respective mean ages of 55.27 ± 9.38 and 55.86 ± 8.59 years. Pain, range of motion, and functional activity did not differ significantly between the two groups at baseline, the second week and the fourth week ($p<0.05$). As the p-value > 0.05, the between-group analysis had no statistically significant differences in pain, range of motion and functional activity. The study concluded that both the deep stripping and kneading techniques had equal effectiveness on individuals with knee osteoarthritis. Thus, both techniques can be used as an adjuvant treatment option for knee osteoarthritis.

Trial Registration: NCT05084014
Keywords: Massage, Knee joint, Osteoarthritis, Soft tissue, Therapy

Introduction:

Osteoarthritis (OA), a condition that is associated with the progressive loss and wear and tear of articular cartilage, also involves the underlying bone and joint. Osteoarthritis involves big joints of the body, out of all the joints most common form of arthritis is in the knee joint affecting people of forty- five years and above (Bettonville *et al.*, 2021).

According to a survey conducted in 2022, 10% of men and 18% of women aged 60 and over are thought to have symptomatic OA. Out of an estimated 240 million people worldwide and the prevalence will be expected to be increased (Allen *et al.*, 2022). The process of the pathophysiology of osteoarthritis begins in the collagen of the articular cartilage that covers the articular surfaces of the bone. This process bring changes in the pattern of collagen that leads to the loss of elasticity in the articular cartilage and ultimately to its erosion (Primorac *et al.*, 2020). Several factors contribute to the etiology and risk factors of knee osteoarthritis (KOA) that include high levels of body mass index, genetics, low levels of bone density, muscular weakness, biomechanical factors, female gender and previous injury to the knee joint that contributes to 3.86 times risk of KOA (Driban *et al.*, 2020; Ericsson *et al.*, 2021). The reduce range of motion, pain on movement especially after prolong sitting or lying, stiffness (commonly seen in the early morning), swelling and pain on palpation are the typical clinical characteristics of knee osteoarthritis (Moore *et al.*, 2020).

Knee osteoarthritis is classified into primary osteoarthritis which is idiopathic and secondary osteoarthritis which has known reason. The KOA is categorized into 5 grades according to the Kellgren-Lawrence classification system (Canzone *et al.*, 2024). Knee osteoarthritis is diagnosed by imaging (Radiographs, MRI, CT-scan) and by examines the individual's knee for swelling, tenderness, pain, range of motion, muscle weakness, and atrophy (Katz *et al.*, 2021). Knee osteoarthritis can be treated with a variety of pharmaceutical and non-pharmacological approaches. The pharmacological strategies are non-steroidal anti-inflammatory drugs, opioids, nutraceuticals, intra-articular injections, plasma-rich protein, and surgery (Dório *et al.*, 2021). For non- pharmacological; patient education, exercise (strengthening, stretching, and aerobic exercises), weight loss, adjunct therapies; thermal modalities, electrical stimulation, manual therapy techniques; joint and soft tissue mobilization are used (Uritani *et al.*, 2021).

The deliberate hand manipulation of soft tissue that has a good impact on healing, lowers stress, increases muscular relaxation, improves local circulation, and promotes a sense of well-being is known as soft tissue mobilization. Muscle adhesions and knots can be treated with thorough longitudinal stripping. Using the thumbs of the hands, elbows, and knuckles, the lengthening strokes are applied obliquely and parallel to the muscle fiber (Nafees *et al.*, 2023). As the name indicates it can target deep muscles, whereas, in the kneading technique the muscle is lifted, rolled, and squeezed. With the use of the fingers, kneading pulls the muscle in circular motions (Romanowski *et al.*, 2017).

There are several studies available on soft tissue mobilization effectiveness in knee osteoarthritis along with conventional physical therapy. Also, the effectiveness of deep stripping and kneading is evident from the literature (Ferreira *et al.*, 2024; Flynn, 2020; Karaborklu Argut *et al.*, 2021; A. Tsokanos *et al.*, 2021) but the comparison between the two techniques is not available. Therefore, this study evaluated the effectiveness between the deep stripping technique and kneading technique for KOA. This study also provided another treatment option along with conventional physical therapy hence increasing the treatment efficacy for KOA.

Methodology:

This controlled trial was conducted in the physiotherapy department of Surraya Azeem Surgical Hospital, Pattoki, Pakistan. Before the study, participants were explained about the research and the procedure that was being done and provided by the written informed consent declaring the volunteer participation in the study. The University of Lahore, Lahore, Pakistan's Institutional Review Board and Ethical Committee gave their approval to the study. Reference number: IRB-UOL-FAHS/819-I/2021.

The eligibility criteria for this randomized trial included both genders of age between 40-65 years, who had been suffering for unilateral and/or bilateral knee osteoarthritis of grade II or III (Kellgren and Lawrence classification) for more than three months. Individuals had any other lower limb and/or lumber spine dysfunction, had any acute inflammation, contracture, or knee joint surgery, had cognitive problems, or had received medications for pain, injections in their knee joint, or any rehabilitative therapy for the knee joint in the past three months were excluded from this trial. All the participants were pre-diagnosed by an orthopedic.

The pain was measured by the **Numeric Pain Rating Scale** (NPRS) (Euasobhon *et al.*, 2022), the **Universal Goniometer** was used to measure range of motion of knee joint (Alfredo *et al.*, 2020). For functional activity **Lower Extremity Functional Scale** was used (Turcotte *et al.*, 2022). A total of 78 participants were interested to take part in the study. Forty-four participants were assessed for eligibility (26 females and 18 males). Before the treatment, the readings for pain, range of motion (flexion and extension) of the knee joint and functional activity were recorded by a blind assessor. Selected participants were divided into two groups by the random allocation method (computer generated random numbers). All the participants also received conventional physical therapy that include patient education, stretching exercises, strengthening exercises, weight loss, thermal modalities, and electrotherapy (Dantas *et al.*, 2020). Both the deep stripping and kneading technique were applied on the quadriceps and hamstrings and around the affected knee joint.

Interventions:

Group A: twenty-two participants received the deep longitudinal stripping technique of soft tissue mobilization.

Deep Longitudinal Stripping for Quadriceps

The participants with the involved side exposed were in a supine position. The therapist was standing on the involved side and with help of his/her; knuckles/fingers/thumbs/hands apply pressure depending upon the participants' tolerance, longitudinally on the quadriceps muscle, thus covering the whole muscle. (figure 1)

Deep Longitudinal Stripping for Hamstring

The participants with the involved side exposed were in a prone position. The therapist was standing on the involved side and with help of his/her; knuckles/fingers/thumbs/hands apply pressure depending upon the participants' tolerance, longitudinally on the hamstring muscle, thus covering the whole muscle. (figure 2)

Group B: twenty-two participants received the kneading technique of soft tissue mobilization.

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Kneading for Quadriceps

The participants with the involved side exposed were in a supine position. The therapist was standing on the involved side and with help of his/her fingers, lift, rolled, and/or squeezed the muscle applying pressure depending upon the participants' tolerance on the whole quadriceps muscle.(figure 4)

Kneading for Hamstring

The participants with the involved side exposed were in a prone position. The therapist was standing on the involved side and with help of his/her fingers, lift, rolled, and/or squeezed the muscle applying pressure depending upon the participants' tolerance on the whole hamstring muscle. (figure 5)

CONSORT FLOW DIAGRAM

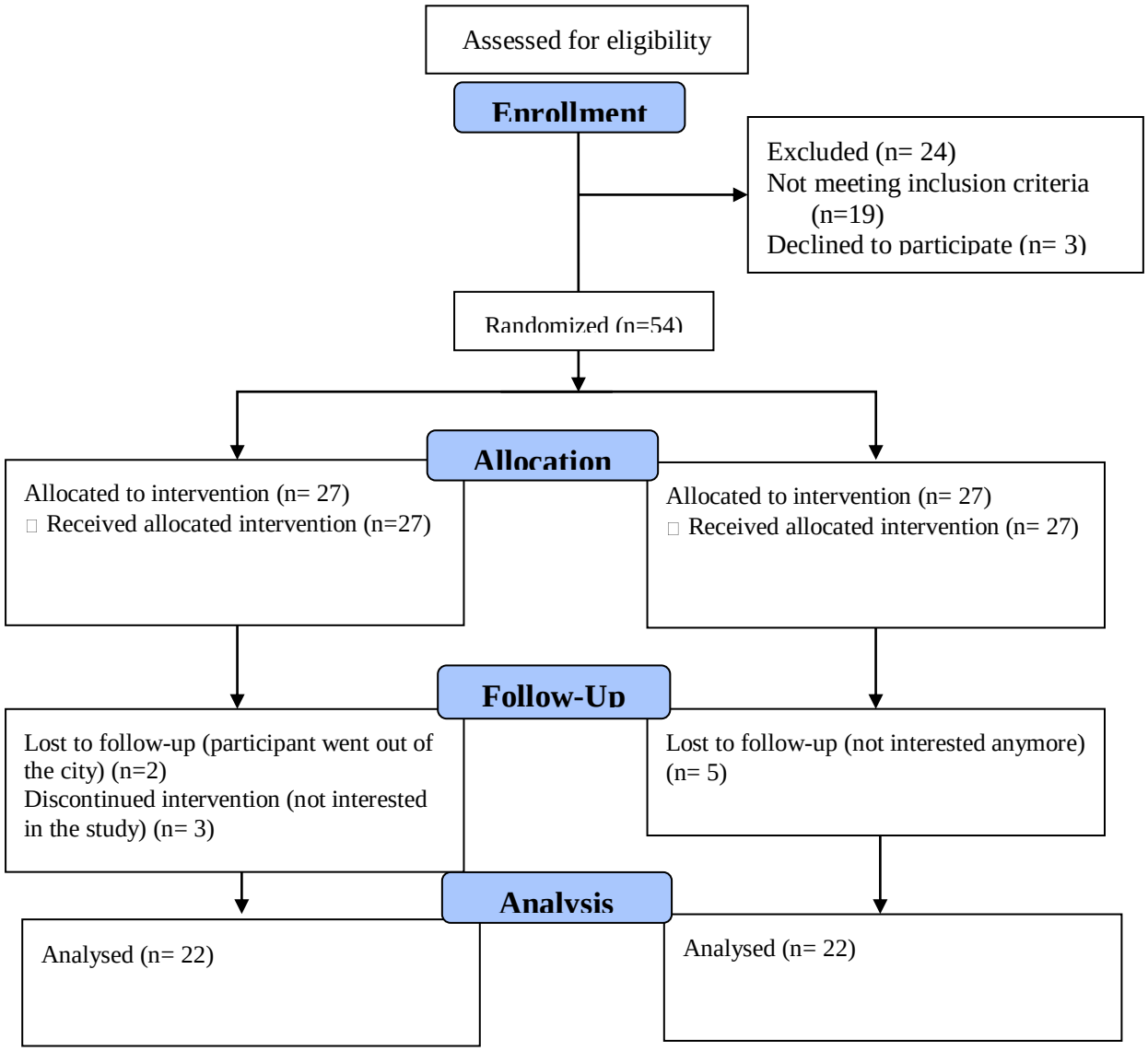

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Figure 1: Deep Stripping on Quadriceps Muscle

Figure 2: Deep Stripping on Hamstrings Muscle

Figure 3: Deep Striping around Knee Joint

Figure 4: Kneading on Quadriceps Muscle

Figure 5: Kneading on Hamstrings Muscle

Figure 6: Kneading around Knee Joint

Statistical Analysis:

The Statistical Package for the Social Sciences (SPSS) program for Windows (IBM Statistics, version 22) was used to do statistical analysis. Mean and standard deviation were used to display quantitative factors like age, while frequency and percentage were used to portray qualitative variables like gender. Data normality was assessed using the Shapiro-Wilk test. The Friedman test was used to evaluate NPRS, ROM, and LEFS within the group because the data were not normally distributed, and the Mann- Whitney U test was employed to compare groups. P-values below 0.05 were regarded as statistically significant.

Results:

A total of 78 participants were interested to take part in the study. Forty-four individuals (26 females and 18 males) participated in the study. The mean age for participants in the deep stripping group was 55.86 ± 8.59 years and 55.27 ± 9.38 years for the kneading group. (table1). Out of 22 participants, 15 were females and 7 were males in the deep stripping group and in the kneading group there were 11 females and 11 males. (table 2).

Non-parametric Friedman test was used for comparison within the deep stripping group and kneading group based on NPRS, ROM and LEFS. For the deep stripping group, there was a significant difference in NPRS, ROM, and LEFS at baseline, at 2nd week and at 4th week (p-value = 0.00). The within-group analysis among NPRS, ROM and LEFS at the baseline, at 2nd week and at 4th week for the kneading group showed a significant difference (p-value = 0.00). (table3)

Non-parametric Mann Whitney U test was applied for comparison between deep stripping and kneading based on NPRS. The baseline analysis of NPRS, p-value =0.317, at 2nd week p-value= 0.574 and at 4th week was 0.137(table 4).

The ROM, flexion at baseline had P-value =0.481 and extension had p-value =0.97. P-value of flexion at 2nd week was 0.33 and of the extension was 0.38 respectively. At the 4th week flexion had 0.16 and extension had 0.19 p value, indicating no significant difference as p-value> 0.05 (table 5).

For LEFS the p-value=0.20 at baseline, at 2nd week p-value= 0.148 and at 4th week was 0.733(table 6). According to the results, the deep stripping group and kneading group have equal effects in alleviating pain, increasing ROM and functional activity among individuals with knee osteoarthritis.

Table 1: Age of Participants

Group	**Mean±Std. Deviation**
Deep Stripping	55.86 ± 8.59
Kneading	55.27 ± 9.38

Table 2: Gender Distribution among Groups

Groups	Gender	Frequency
Deep Stripping	**Female**	15
	Male	7
Kneading	**Female**	11
	Male	11

Table 3: Within-group comparison using Friedman for Deep Stripping and Kneading Group

Groups	Variables	Mean Rank		p-value
Deep Stripping	**NPRS Baseline**	2.64		0.00
	NPRS 2nd Week	2.18		
	NPRS 4th Week	1.18		
	ROM Baseline	**Flexion**	4.23	0.00
		Extension	2.14	
	ROM 2nd Week	**Flexion**	5.23	
		Extension	2.00	
	ROM 4th Week	**Flexion**	5.55	
		Extension	1.86	
	LEFS Baseline	1.00		0.00
	LEFS 2nd Week	2.00		
	LEFS 4th Week	3.00		
Kneading	**NPRS Baseline**	2.66		0.00
	NPRS 2nd Week	1.91		
	NPRS 4th Week	1.43		
	ROM Baseline	**Flexion**	4.57	0.00
		Extension	2.16	

	ROM 2nd Week	**Flexion**	5.09	0.00
		Extension	2.16	
	ROM 4th Week	**Flexion**	5.34	0.00
		Extension	1.68	
	LEFS Baseline	1.20		0.00
	LEFS 2nd Week	1.93		
	LEFS 4th Week	2.86		

Table 4: Between Groups Comparison for NPRS using Mann Whitney Test

Variables	**Groups**	**Mean Rank**	**p-value**
NPRS Base line	Deep stripping	22.00	0.317
	Kneading	23.00	
NPRS 2ndWeek	Deep stripping	23.45	0.574
	Kneading	21.55	
NPRS 6th Week	Deep stripping	19.43	0.137
	Kneading	25.57	

Table 5: Between Groups Comparison for ROM using Mann Whitney Test

Variables	**Groups**		**Mean Rank**	**p-value**
ROM Base line	Flexion	Deep stripping	23.48	0.481
		Kneading	21.16	
	Extension	Deep stripping	20.07	0.97
		Kneading	24.93	
ROM 2nd Week	Flexion	Deep stripping	26.52	0.33
		Kneading	18.48	
	Extension	Deep stripping	19.45	0.38
		Kneading	25.55	
ROM 4thWeek	Flexion	Deep stripping	26.98	0.16
		Kneading	18.02	
	Extension	Deep stripping	20.00	0.19
		Kneading	25.00	

Table 6: Between Groups Comparison for LEFS using Mann Whitney Test

Variables	Groups	Mean Rank	p-value
LEFS Base line	Deep stripping	18.00	0.20
	Kneading	27.00	
LEFS2ndWeek	Deep stripping	19.70	0.148
	Kneading	25.30	
LEFS 4thWeek	Deep stripping	21.84	0.733
	Kneading	23.16	

Discussion:

This study compared the effectiveness of deep stripping and kneading on functional activity, range of motion, and intensity of pain among individuals with KOA. In this study, a statistically significant improvement was seen in pain, range of motion, and functional mobility of knee joints of individuals suffering from KOA after applying the STM but there was not any statistical difference found between the two techniques, both techniques can be used as an adjuvant treatment with conventional physical therapy for individuals with KOA.

There are many benefits of STM on KOA also discussed in other studies that are: STM can help to reduce muscle tension and tightness as due to pain and chronicity of the disease muscles became tight. It induces muscle relaxation by releasing the tight fascia, releasing tension and stress on the muscle. The local blood circulation is also enhanced by STM, and there is an increase in the lymphatic drainage thus improving the range of motion and functional activity in the individual with knee osteoarthritis (Hasanpour-Dehkordi *et al.*, 2021).

A Tsokanos et al. carried out a systematic review in 2021 to assess the effectiveness of manual techniques in treating osteoarthritis in the knee. The manual techniques include; passive joint movement, mobilization with movement, electrotherapy, exercises, soft tissues mobilization and manipulation. The study concluded that the manual therapy had positive effects among individuals with knee osteoarthritis but had short term effects (Alexios Tsokanos *et al.*, 2021). The current study also concluded the same that soft tissue mobilization found to be effective among knee osteoarthritis individuals.

However, the present study mentioned all the manual therapy techniques while the current study compared the two soft tissue mobilization techniques but the conclusion of both the studies were same.

In 2021, Jurecka et al. carried out a systematic evaluation to assess the efficacy of soft tissue therapy for a number of knee diseases and disorders, including knee joint osteoarthritis. The study concluded that the usefulness of soft tissue therapy as a significant therapeutic option for orthopedic patients with various knee joint dysfunctions is summed up in this review. Soft tissue therapy has been shown to have a particularly strong impact on pain reduction, regulating muscle flexibility, and enhancing knee joint mobility (Jurecka *et al.*, 2021). The recent study also indicated that soft tissue mobilization was beneficial for people with osteoarthritis of knee joint.

In the year 2020, a study conducted to evaluate physical therapy treatment efficacy for chronic pain of KOA, by Kim L Bennell. This review suggested that STM was effective in enhancing function and reducing pain in KOA patients; however, the impact of STM on knee joint range of motion in KOA patients was not addressed in this study (Bennell *et al.*, 2020). But the current study discussed pain, ROM and functional activity and found STM to be very effective on all these three factors related with KOA. The findings of this studies match with the finding of the current study as it also suggested that STM can be used as an adjuvant treatment therapy along with conventional physical therapy, as the STM can enhance the treatment efficacy for the participant with KOA.

Conclusion:

The study concluded that both the deep stripping technique and kneading technique were effective in alleviating pain, improving range of motion and functional mobility among individuals with knee osteoarthritis; there was not any difference between the efficacies of both the techniques. Thus, any soft tissue mobilization techniques can be used as an additional treatment with conventional physical therapy to increase the treatment efficacy.

Recommendations and Limitations:

- As knee osteoarthritis is a chronic disease so further studies should be performed to evaluate the long-term effects of soft tissue mobilization.
- Large sample size, taken into consideration for further studies.
- Systematic review and meta-analysis will also conduct in future.
- The fact that only one physiotherapist treated the individuals may have limited how the findings.
- Participants' declarations were simply accepted, and they were instructed not to use any medications during this trial.
- The research was single-blind. For additional research, double blindness ought to be advised.

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Conflict of Interest

- The authors declared no conflict of interest.

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