INSIGHTS-IJHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

ORIGINAL RESEARCH

Volume 4 | Issue 2 | 2026
ISSN: 3007-2948

The effect of mobilization with movement versus paraffin wax bath therapy in patients with post-traumatic stiffness of Knee joint: A Randomized Controlled Trial

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CONFLICT OF INTEREST
None declared.

GRANT SUPPORT
None declared.

ARTICLE TYPE
Original Research

ABSTRACT

BACKGROUND: Knee traumas termed as any injury or damage to the knee's joint which is caused by different factors like sports injury, accidents and by fall .Knee stiffness is a common complication of femoral and tibia fracture and injuries to the extensor mechanism of the knee.

AIM: To determine the effect of mobilization with movement versus paraffin wax bath therapy in patients with post-traumatic stiffness of Knee joint to improve pain intensity , functional ability and knee range of motion.

METHODOLOGY: The researcher employs a randomized controlled trial methodology. Participants are divided into two groups: one receiving Mobilization with Movement (MWM), and the other receiving Paraffin wax bath therapy. Outcomes are assessed over 8 weeks period, focusing on pain levels by visual analogue scale (VAS), mobility by goniometer and stiffness by the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) scale. Data will be analyzed using SPSS-23.

RESULTS: Parametric test were applied. Paired sample t test (within group analysis) and independent t test for (between group analysis). In Paraffin Wax Bath therapy group VAS mean difference was 1.486. WOMAC mean difference was 12.048. Mean score of knee joint ROM of before the treatment was 36.38±8.4 for flexion, -8.14±1.19 for extension and after the treatment was 118.24±11.3 for flexion, -2.43±1.43 for extension. In Mobilization with Movement group mean difference of VAS of was -1.6. WOMAC mean difference was -8.143. Mean score of knee joint range of motion before treatment was 30.14± 6.9 for flexion, -6.57±1.6 for extension, after the treatment was 100.1±10.4,-4.10±1.7, flexion, extension respectively. P value is less than 0.05.

CONCLUSION: Group B shows significant variations. Both interventions were effective in improving patient outcomes but Paraffin Wax Bath Therapy group is more effective in improving pain intensity, knee functional ability, stiffness and mobility.

REGESTRATION NO: NCT06913439

KEYWORDS Paraffin wax, Movement with Mobilization, Pain, Trauma, Stiffness

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ISSN: 3007-2948

INTRODUCTION

Knee traumas termed as any injury or damage to the knee's joint which is caused by different factors like sports injury, accidents and by fall .Knee stiffness is a common complication of femoral and tibia fractures and injuries to the extensor mechanism of the knee (1). The reported rate of significance knee stiffness after various injuries and procedure around the knee is as high as 11% in the western literature but may be much higher in underdeveloped countries. Severely restricted knee motion is a recognized complication of trauma around the knee (2).

Loss of motion following fracture is multifactorial; stiffness can be followed by prolonged immobilization, traction intra-articular and extra articular fractures fixation. Stiffness applies more severely to the knee than to any other joint of the lower limb (3). An anterior Cruciate Ligament (ACL) tear is a knee trauma which leads to instability and painful condition in the knee joint. Posterior Cruciate Ligament (PCL) tears is a knee trauma contribute pain and instability in the knee joint. (4)

In cases of limited extension (flexion deformity), one must look for anterior impingement (e.g. mal union of the intercondylar eminence), contracture of anterior cruciate ligament (ACL) and posterior cruciate ligament (PCL) (retraction of the PCL, which is taut during flexion, primarily limits flexion, unless the PCL insertions were brought closer together due to mal union, in which case, the PCL will also limit extension) and contracture of the posterior joint capsule over the condyles (13).

Patient faces a complication named as stiff knee gait in knee stiffness. Normally, the knee goes in flexion during the early stage of swing phase to clear the foot from the ground. But if the knee is stiff during the swing phase, the patient has to raise the affected side pelvis to clear the foot from the ground and swing sideways with circumduction of the limb to propel it forward to reach the heel strike(14).

Paraffin Wax bath is a type of deep heating therapy which use paraffin oil and wax to reduce pain of hand, feet, sore joints and muscles. Temperature of paraffin wax is 42-52°C. Melting point is 51-54.4°C. Heat transfer during paraffin wax bath therapy through conduction from the layer of solid paraffin wax into the skin. Warm paraffin wax is applied to the skin leads to vasodilation to improve the circulation, boost healing and remove toxins out of the skin(15). Paraffin wax bath therapy involves soaking targeted area in a warm paraffin wax bath pour pour hot liquid form wax on target area. The warm wax decrease pain and stiffness in treated part of body. The heat from the wax increase blood circulation in the affected areas. This technique relaxes the stiff muscles and reduces stress by boosting healing process. This technique will hydrate and moisturize the underlying skin of specific treated body part. (16)

Mobilization with Movement (MWM) is a type manual therapy technique includes combination of joint mobilization with movement to improve joint mobility, decrease pain and improve functional ability. MWM play a role of application of joint mobilization and active movement simultaneously. Patients perform the movement while the therapists apply the mobilization technique.(17)

This technique target specific joints and movement patterns to reduce pain, stiffness and improve mobility. Lumbar rolls, thoracic extensions and cervical rotations techniques are used to increase spinal mobility. Shoulder rotations, elbow extensions and knee flexions techniques are used to enhance flexibility in peripheral joints. Muscle energy technique and soft tissue mobilization are used to reduce soft tissue restrictions. MWM can increase joint range of motion, reducing stiffness and limited functional mobility. MWM promote patient-generated movement; encourage patients to play an active role in their treatment. MWM used to reduce musculoskeletal traumas such as sprains, strains and tendinopathies. MWM used to decrease chronic painful conditions like osteoarthritis and fibromyalgia.(18)

The basic goal of this study is to the development of evidence-based therapeutic protocols for post traumatic knee joint stiffness to improve functional disability, range of motion and reduce pain. It is essential to form such effective therapeutic regimes. These two regimes Mobilization with movement and Paraffin wax bath therapy are commonly follows in patients with post-traumatic knee joint stiffness. But there is less evidence on the comparative effects of these two regimes in improving functional disability, range of motion and reduction of pain in patients with post-traumatic knee joint stiffness.

METHODOLOGY

This study was a single blinded randomized controlled trial. Sample size calculated from G Power. Sample size is n=42. Add estimated 10% drop out was 46.(30) Non probability, Purposive Sampling technique was used. Data was collected from Shoukat Ismail Medical Complex. Study duration was 10 months. Inclusion Criteria: Age 18-40 years. (31) ,Both Male and female(6) ,Fracture of unilateral knee joint and around the knee managed with conservative treatment only.(32), Subjects with post traumatic stiffness of knee joint having a minimum of 70º knee flexion.(33) ,Able to walk independently or with minimal assistance.(34), Administer patient in study after 12 weeks of knee injury.(35) Exclusion Criteria: Any deformity of hip and knee. (36) Implant at fracture and around fracture site. (37) Subject having polyarthritis, bleeding disorders, tumors, local infection, peripheral vascular disease, leg-length discrepancy of more than one-half inch.(38) History of knee replacement or other knee surgeries within the last six months.(37) Presence of neurological conditions (e.g., stroke, multiple sclerosis) affecting gait or knee mobility.(39) Known allergy or intolerance to paraffin wax therapy or other study interventions.(40)

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Volume 4 | Issue 2 | 2026
ISSN: 3007-2948

Treatment Approach :Each participant was randomized into either the A group or B group. One mediator and one assessor participated in this study. In addition, the assessor was unsure of in which category the subjects were chosen. Pain, Rom and functional ability were evaluated by the examiner before and after treatment. Baseline Treatment: Participants of both group warmed up by ultrasound therapy for 5 minutes. The evaluator, who was blinded to intervention given to each group, measured the ROM, functional ability and pain intensity around one minute after this warm up. Group A (Mobilization with movement (MWM) Technique) :In group A, the mobilization with movement (MWM) technique was implemented with three sets of ten repetitions on each treatment occasion for a period of 3 days/ week for 8 weeks. In this group, the adjustable couch was used to treat the patients effectively. During MWM, position of the patients was prone lying and high sitting position with swinging bilateral leg out of the couch at available various range of motion of affected knee joint. In prone lying position, the therapist was stand just behind the patient towards the affected knee joint. The mulligan belt placed at proximal tibia ends which already wrapped with the lower back of the therapist. In high or couch sitting position, the therapist was sitting on rest chair. The method using of mulligan belt was same as in prone lying position. After stabilization, the mobilization with movement (MWM) started in order with the therapist mobilized the knee joint followed by active movement of knee joint performed by the patients (24). Group B (Paraffin Wax Bath Therapy) :Group B will receive Paraffin Wax Bath Therapy in combination with standard care exercises. In this treatment, the affected knee joint will be immersed in warm paraffin wax to deliver thermotherapy, which helps reduce joint stiffness, improve circulation, and enhance joint mobility. Each paraffin wax session will last 15–20 minutes. Following the thermotherapy, participants will perform standard care exercises targeting knee mobility, flexibility, and strength. These sessions will also occur 3 times per week over a period of 8 weeks.

RESULTS

Table shows mean comparison of VAS, WOMAC and Knee joint ROMS for both Mobilization with Movement group and Paraffin Wax Bath therapy group. Mean score of VAS Mobilization with Movement group before the treatment was 6.23 ±1.6 and after the treatment was 4.15±1.7.mean difference of VAS of was -1.6 .this table shows mean score of VAS of Paraffin Wax Bath therapy group before treatment was 7.83±1.4 after the treatment was 2.67±1.3.while the mean difference was 1.486. p value is less than 0.05 that shows there is significant difference between Mobilization with Movement group and Paraffin Wax Bath therapy group but Paraffin Wax Bath therapy group shows greater improvement in pain relief.

This table shows mean score of Womac of VAS Mobilization with Movement group before the treatment was 66.52±13.2 and after the treatment was 33.24±5.56.mean difference Mobilization with Movement group was -8.143. This table shows mean score of Womac of Paraffin Wax Bath therapy group before the treatment was 74.67 ±10.2 and after the treatment was 21.19±4.45.mean difference Womac of Paraffin Wax Bath therapy group was 12.048. p value is less than 0.05 that shows there is significant difference between Mobilization with Movement group and Paraffin Wax Bath therapy group but Paraffin Wax Bath therapy group shows greater improvement in knee joint functional ability. This tables also shows mean score of knee joint range of motion of Mobilization with Movement group before treatment was 30.14± 6.9 for flexion, -6.57±1.6 for extension , after the treatment was 100.1±10.4 ,-4.10±1.7, flexion, extension respectively.

This table shows mean score of knee joint ROM of Paraffin Wax Bath therapy group before the treatment was 36.38±8.4 for flexion, -8.14±1.19 for extension and after the treatment was 118.24±11.3 for flexion, -2.43±1.43 for extension. There is greater increase in Knee range of motion Paraffin Wax Bath therapy group than Mobilization with Movement group. P value is less than 0.05 that shows there is significant difference between Mobilization with Movement group and Paraffin Wax Bath therapy group but Paraffin Wax Bath therapy group shows greater improvement in knee joint range of motion.

WITHIN-GROUPS ANALYSIS	Mean	Mean Difference	Std. Deviation	P-Value
PRE_VAS	7.03	3.623	1.735	.000
POST_VAS	3.41		1.714	
PRE_WOMAC	70.60	43.381	12.370	.000
POST_WOMAC	27.21		7.873	
PRE_KNEE_FLEXION	33.26	-75.905	8.288	.000
POST_KNEE_FLEXION	109.17		14.176	
PRE_KNEE_EXTENSION	-7.36	-4.095	1.620	

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ISSN: 3007-2948

POST_KNEE_EXTENSION		-3.26		1.809	.000
BERWEEN-GROUPS ANALYSIS		Mean Difference	Mean	Std. Deviation	P-Value
PRE_VAS	A	-1.601	6.23	1.633	.002
	B		7.83	1.470	
POST_VAS	A	1.486	4.15	1.764	.004
	B		2.67	1.323	
PRE_WOMAC	A	-8.143	66.52	13.224	.031
	B		74.67	10.200	
POST_WOMAC	A	12.048	33.24	5.567	.000
	B		21.19	4.457	
PRE_KNEE_FLEXION	A	-6.238	30.14	6.952	.013
	B		36.38	8.488	
POST_KNEE_FLEXION	A	-18.143	100.10	10.454	.000
	B		118.24	11.397	
PRE_KNEE_EXTENSION	A	1.571	-6.57	1.630	.001
	B		-8.14	1.195	
POST_KNEE_EXTENSION	A	-1.667	-4.10	1.786	.002
	B		-2.43	1.434	

DISSCUSSION

The purpose of our study was to compare the effect of mobilization with movement versus paraffin wax bath therapy to reduce pain, improve functional disability and range of motion in patients with post-traumatic stiffness of knee joint .For this purpose VAS and Western Ontario and McMaster Universities Arthritis Index (WOMAC) and knee range of motions(-ROM) scales was used. Mobilization with movement versus paraffin wax bath therapy was applied.

In addition subjects completed post intervention questionnaire to determine the difference between patient's levels of comfort between the groups. The results of this study have shown that the group had significant difference in Mobilization with movement versus paraffin post treatment values of pain intensity, Western Ontario and McMaster Universities Arthritis Index (WOMAC) and knee range of motions(-ROM) Paired T test was applied for within group analysis. The mean values indicate that there is increase in knee range of motion and decrease for both pain and McMaster Universities Arthritis Index (WOMAC) after the treatment session. The result of this study reveals that there is a significant difference between post treatment values of pain intensity, WOMAC and knee range of motions(ROM) (p- value<0.05) across the group analysis. An important goal of improving knee functional ability and prevention of any knee contracture.

This study focused on two types of interventions used to improve pain intensity, WOMAC and knee range of motions (ROM). The results of the current study suggested that Paraffin Wax Bath Therapy group is more effective than Mobilization with movement. Mean comparison of VAS, WOMAC and Knee joint ROM before treatment and after treatment. The pre-treatment value of VAS test was 7.03±1.7 and post treatment was 3.41 ±1.71.mean difference was 3.623 that shows significant difference in VAS values shows significant difference and suggest decrease of pain. Mean comparison of WOMAC. The pre-treatment value was 70.60±12.3 and post treatment value was 27.21± 7.87.mean differences was 43.38 that shows significant difference WOMAC values and greater decrease in post treatment values suggest less disability. Mean comparison of Knee joint ROM. The pre-treatment value was knee flexion 33.26±8.2 and post treatment value was 109.17 ±14.1.mean differences was 75.905. The pre-treatment value knee extension

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Volume 4 | Issue 2 | 2026
ISSN: 3007-2948

was -7.36 ±1.6 and post treatment value was -3.26 ±1.8 .mean differences was -4.095. P value is less than 0.05 that shows there is significant difference within group analysis.

In Paraffin Wax Bath therapy group at 1st day mean score of VAS before treatment was 7.83±1.4 after the treatment was 2.67±1.3.while the mean difference was 1.486. Mean score of Womac of before the treatment was 74.67 ±10.2 and after the treatment was 21.19±4.45.mean difference Womac was 12.048. Mean score of knee joint ROM of Paraffin Wax Bath therapy group before the treatment was 36.38±8.4 for flexion, -8.14±1.19 for extension and after the treatment was 118.24±11.3 for flexion, -2.43±1.43 for extension. In Mobilization with Movement group at 1st day mean score of VAS before the treatment was 6.23 ±1.6 and after the treatment was 4.15±1.7.mean difference of VAS of was -1.6 . Mean score of Womac before the treatment was 66.52±13.2 and after the treatment was 33.24±5.56.mean difference was -8.143. Mean score of knee joint range of motion before treatment was 30.14±6.9 for flexion, -6.57±1.6 for extension, after the treatment was 100.1±10.4 ,- 4.10±1.7, flexion, extension respectively. P value is less than 0.05 that shows there is significant difference between Mobilization with Movement group and Paraffin Wax Bath therapy group but Paraffin Wax Bath therapy group shows greater improvement in pain intensity , knee functional ability and knee joint range of motion.

These results are consistent with the results of previous study in 2024 conducted by Buttagat et al. to investigate the efficacy of a new therapeutic approach cassava wax bath (CWB) compared with usual care paraffin wax bath: (PWB) in patients with knee pain. Forty patients with knee pain were recruited into the study. Patients in the CWB group received cassava wax bath and patients in the PWB group received usual care (PWB). The primary outcome was pain intensity (PI). The secondary outcomes were the pressure pain threshold (PPT), pain frequency (PFr), all outcomes were assessed before and after the five-week intervention, one month, and three months after the intervention period. After the intervention, statistically significant improvement was found in all outcomes after the intervention period and during the one month and three months follow-up study in both groups ($P < 0.05$). For all outcomes, no between-group differences were seen at any post-assessment time-point, except for PFr ($P < 0.05$). This study concluded that the findings of this study indicate that CWB was significantly superior to PWB in reducing PFr. For the other outcomes, CWB and PWB were both equally effective in reducing PI and increasing PPT. Therefore, PWB might be considered as a novel useful therapeutic option for patients (20)

Another RCT shows consistency with our results in 2023 by Kim et al. conducted a study to investigate the effectiveness of paraffin bath therapy for pain relief and functional improvement in knee pain. Eligible studies were selected based on the following criteria: patients with knee pain, comparison between paraffin bath therapy and no paraffin bath therapy; and sufficient data on changes in the visual analog scale (VAS). Forest plots were drawn to visualize the overall effect. Jadad scale score, I2 statistics, and subgroup analyses were used to assess the risk of bias. The results of this study showed that total of five studies included 153 patients who were treated and 142 who were not treated with paraffin bath therapy. The VAS were measured in all 295 patients included in the study, while the AUSCAN index was measured in the 105 patients with osteoarthritis. Paraffin bath therapy significantly reduced the VAS scores. In osteoarthritis, paraffin bath therapy significantly improved and reduced the VAS. This study concluded that Paraffin bath therapy is effective for alleviating pain and improving function in hand diseases, thereby improving quality of life.(21)

CONCLUSION:

Group B shows significant variations. Both interventions were effective in improving patient outcomes but Paraffin Wax Bath Therapy group is more effective in improving pain intensity, knee functional ability , stiffness and mobility.

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Volume 4 | Issue 2 | 2026
ISSN: 3007-2948

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