ABSTRACT

Background: Serious, major meniscal fractures are the most common knee injuries. In the management of meniscal tears, physical therapy has shown positive results, and additional medication is required to reduce the effects of meniscal tears. This study aimed to evaluate the feasibility of the mulligan squeeze procedure in combination with conventional pain relief therapy and to increase the range of movement and functional ability of meniscal tear patients. The study aims at reviving pain, increasing ROM and stability, and improving the quality of their lives.

Methods: In this randomized controlled trial, 40 patients were chosen and randomly assigned to two groups, A and B, clinically diagnosed with a meniscal tear. The Numeric Pain Rating Scale (NPRS), the Patient-Specific Functional Scale (PSFS), and knee range of motion were reported to determine the pain level and functional capability of the patients.

Results: During the 4th and 6th week, all classes showed a significant gap (P<0.05). At the end of the 6th week, the standard variance and the overall analysis team t-test values were higher than the control group.

Conclusion: The two teams showed significant progress for NRPS, ROM, and PSFS, but the experimental group showed more significant improvement in all the parameters.

Keywords: Meniscal tear, knee pain, NPRS, PSFS, ROM.
INTRODUCTION

One of humanity’s most common injuries during sports is an injury to the knee joint meniscus. This injury has been observed in various populations, and it could be due to traumatic out of which intense traumatic occur more often in youth[1] frequently during game competition and practice [2]. The incidence of meniscal tears, with a prevalence of 2 can be as high as 6 per 1000 population 2.5 to 4 times in males[3]. The most typical indication of a meniscal tear is joint line tenderness, loss of motion range, and a sense of knee joint locking and instability [4]. Different methods are used to diagnose meniscal tears, the most commonly employed being magnetic resonance imaging (MRI) with 76 percent precision, 96 percent specificity, and 88 percent predictive performance. However, the clinical diagnosis of meniscal tears is also indicative of a number of particular tests. It needs that of McMurray (precision 95%, responsiveness 21%) [5], Apley’s (Specificity 90%, Sensitivity 13%) [6] and Thessaly’s test (Specificity 97.7%, Sensitivity 90.3%) [7]. Lowery et al. (2006) [5] Developed a regular clinical research battery capable of generating superior clinical composite score (CCS) to MRI precision for identification of meniscal tears. The battery contains a history of knee trap or lock, passive terminal knee flexion pain, passive knee extension pain, tenderness to the joint base, and a good McMurray test. If all of these symptoms have been detected in patients, the incidence of meniscal tears is confirmed by a high predictive value of 92.3 percent, 99 percent specificity and 11.2 percent sensitivity. Therefore, medical experience, in conjunction with special testing, will achieve a diagnostic accuracy of 90 percent, which is marginally prevalent to the diagnostic accuracy of MRI alone [8]. Several reports are suggesting that patients with meniscal tears with exercise therapy will improve their functioning and activities [9]. Taking into the consideration and analysis of all the strategies and treatment of different articles, it is possible to cure patients by the conservative treatment provided the injury is diagnosed at an early stage by special tests during clinical practices [10].

Conventional meniscal tear care usually involves vigorous workouts that aim to increase the assortment of motion and muscle strength and strengthen discomfort, stability, and elasticity [11,12]. Generally, surgical therapy is considered the primary cure, whereas conservative therapy is considered the alternative because long-term care is provided, and poor results are made. Similar and conflicting findings are reported for both surgical and conservative therapies [13,12]. It requires further work on non-operational alternative treatment strategies to address the signs of meniscal tears, as there is substantial support for effective alternative non-operational therapy [14]. The manual treatment of Mulligan’s squeeze technique is utilized to treat localized joint line pain, restricted ROM and the symptoms which are shown in meniscal tear patients [15]. Our study was aimed to find out the effectiveness of the Mulligan squeeze technique along with conventional therapy in improving functional outcomes in patients with a meniscal tear.

METHODS

Approval from the Institutional ethical committee was taken, and subjects recruited from the orthopedic department of Nizam’s institute of medical sciences. Entire 90 participants were evaluated for eligibility criteria and 40 were excluded before randomization, and 50 subjects who met inclusion criteria were randomly allocated in group A (experimental group) and group B (conventional group) by simple random sampling using the lottery method. Twenty-three subjects received the intervention and two refused active participation after allocation in each group. Three subjects in each group were lost the follow-up due to personal reasons. Twenty subjects in each group received intervention thought the study.

The inclusion criteria of the study were subjects aged between 18-50, with no gender specificity, joint line tenderness, restricted ROM, pain with terminal Knee flexion and extension and rotations and feeling of locking and instability of knee joint. The subjects with knee contracture, fractures, dislocations, infections, tumors, rheumatoid arthritis, vascular injuries and any surgeries to the lower extremities were excluded from the study.

Detailed physical assessments and tests were performed after patients were encompassed in the study, and were arbitrarily assigned into two clusters by the principal investigator. Patients who met the requirements submitted the informed consent.

![Study flow chart](Image)
The outcome measure includes the Numerical pain rating scale (NPRS), Knee Range of Motion (KROM), Patient-specific functional score (PSFS). Based on this, the pre-treatment evaluation was done on day one as a baseline measurement, and post-treatment evaluation was done at 4th week. The final assessment was done on the 6th week using the parameters mentioned above.

**INTERVENTION TECHNIQUE**

**GROUP I:** Received MC "Squeeze" technique and conventional therapy.

1. The MC "Squeeze" technique was administered according to the principles of the Mulligan Concept. The patient is placed in supine with better access to the joint line, and the affected knee has been placed at 90 degrees of flexion or bent to the pain-free extent of the patient. The psychologist put the medial border of one thumb over the region of the tremendous joint line pain and swelling and reinforced the first with the other thumb to create an overlap grip spot. The patient then extends the knee to the maximum pain-free range, while the therapist should keep the hand position and grip on the joint line as the joint space is closed. After achieving the peak knee-length, the client voluntarily returned their knee to full flexion as the trainer raised the pressure toward the joint core with the rubbing thumb. For two seconds, the trainer continued to hold the pressure on the joint line, as the patient exerted extra pressure by raising the tibia with both hands to the center of the knee flexion [16].

2. **Conventional Therapy:** Subjects received exercises that included Static Quadriceps, Static Hamstrings and Vastus medialis obliques strengthening. Active hip, knee and ankle ROM exercises, multiple angle isometrics, AROM, and strengthening for the unaffected lower limb and after exercises gait training given on parallel bar in front of the mirror.

**DOSAGE:** Mulligan's squeeze technique was applied in 3 sets of 10 repetitions in one session. All exercises were repeated ten times with 10sec hold and relaxed each time.

**GROUP II:** Received conventional therapy. Subjects were in the supine position and received exercises, which include Active hip, knee and ankle ROM exercises, Static Quadriceps, Static Hamstrings and Vastus medialis obliques strengthening. In sitting position, multiple angle isometrics exercise for affected leg, and AROM and strengthening for the unaffected lower limb and after exercises gait training given on parallel bar in front of the mirror.

**DOSAGE:** All exercises were repeated ten times with 10sec hold and relaxed each time.

**RESULTS**

The intragroup analysis of NPRS, PSFS, and ROM was done with the “F” test (Friedman Test) and Inter-group analysis of NPRS and PSFS was done with the “Mann-Whitney Test,” and ROM was done with independent "t" test. The whole treatment was conducted for six weeks. The participants of the study were predominantly males (32 subjects, 80%). The mean age of all the patients was 28.87 ±7.09 years. The left knee injury was found to be higher (n=24) compared to the right knee injury (n=16). Before treatment, the mean level of pain on NPRS, the functional ability PSFS, and Knee Range of motion was determined by using Universal Goniometer. The statistical analysis proved that the study groups were found to be similar concerning baseline findings for all the parameters.

For ROM, the mean values were 99±18.5 for group A and 102.75±12.92 for group B (Fig 2), and it shows that after day 1 of ROM, there is no significant difference between Group A and Group B; however, the difference was significant between the groups at 4th and 6th week of ROM as from Table1.

![Figure2. Represents of ROM in Group A vs. Group B](image)

| Assessment       | T   | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference |
|------------------|-----|----|----------------|-----------------|-----------------------|
| ROM_day1         | -0.742 | 38 | 0.463          | -3.75           | 5.05333              |
| ROM_4w           | 3.376  | 38 | 0.002          | 6               | 1.77705              |
| ROM_6w           | 5.802  | 38 | 0              | 7.5             | 1.29269              |

**Table 1: Analysis of ROM for Groups A and B**

The mean PSFS for groups A and B was found as 3.39±1.18 and 3.89±0.81 for day1, 7.3300±.7767 and 6.0300±.9358 for 4thw and 8.4850±.6055 and 7.1100±.8391 for 6thw, respectively (Fig 3). From Table 2, the results suggest a significant difference between Group A and B in all three time periods. Intergroup analysis of PSFS was done with the "Mann-Whitney Test."

![Figure 3: Represents of PSFS in Group A vs. Group B](image)
The work was conducted to investigate the efficiency of Mulligan's 'squeeze' technique along with conventional therapy as an adjunct to traditional therapy alone in improving patient-oriented measures such as NPRS and PSFS [19]. The intragroup comparison revealed a clear trend toward improvement in all assessed parameters in both study groups. While the intergroup comparisons demonstrated a reduction in the pain intensity as NPRS was higher in the experimental group (A) compared to the control group (B). This could be due to the additional effect of the Mulligan squeeze technique in group A.

The application of the Mulligan concept to treat recreational dancers with patellofemoral pain syndrome shows positive results in improving patient-oriented measures such as NPRS and PSFS [19]. In our study, the results show a significant difference between Group A and Group B in the 4th and 6th weeks of PSFS (Z value is -4.498 and its p-value 0.0001). Better improvement is seen in the range of motion in the experimental group (A) compared to the control group (B).

The results of our research have shown a trend in the improvement of pain intensity over the six weeks in two groups. But significantly experimental group (A) shows better improvement in terms of pain when compared to the control group (B). This could be due to the additional effect of the Mulligan squeeze technique in group A.

Varghese Jibu George et al., (2019) recently conducted a study to examine the efficacy of mobilization of OA knee disability with activity. In this research, mobilization with movement for knee weakness is more successful because it shows better results for increasing the range of movement [18]. The results of our study showed a significant (t value is 5.802 and its p-value 0.0001) difference between Group A and Group B in 6weeks of ROM. The more significant improvement is seen in the range of motion in the experimental group (A) compared to the control group (B).

The pain was assessed on NPRS. An alternate approach for the treatment of meniscal pathologies according to Hudson et al. (2016): a case-series study of the Mulligan theory "squeeze" technique shows positive outcomes on NPRS pain [11]. The results of our research have shown a trend in the improvement of pain intensity over the six weeks in two groups. But significantly experimental group (A) shows better improvement in terms of pain when compared to the control group (B). This could be due to the additional effect of the Mulligan squeeze technique in group A.

The results of this randomized controlled study clearly show the significant difference between both groups. Still, the results suggest that group A has a more significant difference when comparing to group B according to the outcome measures.

We studied a total of 40 subjects were distributed in two teams of 20 each, equally and individually. Evaluation of pain (NPRS), knee ROM (Goniometer) and physical disability (PSFS) are done for both categories. All the parameters were measured at baseline day 1, 4th week and 6th week following the completion of intervention in both groups successfully.

Table 2: Mann-Whitney Test for PSFS, Statistics

|          | PSFS_day1 | PSFS_4w | PSFS_6w |
|----------|-----------|---------|---------|
| Mann-Whitney U | 124.000 | 56.000 | 34.000 |
| Wilcoxon W    | 334.000 | 266.000 | 244.000 |
| Z            | -2.060 | -3.911 | -4.498 |
| Asymp. Sig. (2-tailed) | 0.039 | 0.000 | 0.000 |
| Exact Sig. [2*(1-tailed Sig.)] | 0.040a | 0.000a | 0.000a |

Table 3: (Mann-Whitney) Test Statistics of NPRS.

|          | NPRS_day1 | NPRS_4w | NPRS_6w |
|----------|-----------|---------|---------|
| Mann-Whitney U | 185.000 | 67.000 | 277.000 |
| Wilcoxon W    | 395.000 | 3.688 | -4.826 |
| Z            | -0.418 | 0.000 | 0.000 |
| Asymp. Sig. (2-tailed) | 0.676 | 0.000a | 0.000a |
| Exact Sig. [2*(1-tailed Sig.)] | 0.698a | 0.000a | 0.000a |

Figure 4: Represents of NPRS in Group A vs. Group B.
CONCLUSION
Both the treatment groups, the Mulligan Squeeze technique along with conventional therapy (experimental group A) and conventional therapy (control group B) are useful in falling pain and improving knee joint range of movement and functional activities in early return to work. But, as per our results and statistical analysis, there is more significant improvement was observed among group A, showing that the application of Mulligan squeeze technique is more effective. It is therefore concluded from this study that the Mulligan squeeze technique is more effective in improving outcomes in meniscal tear patients.

LIMITATIONS
Short duration study (6 weeks) and the study population was limited to those who were able to attend the physiotherapy department. This excluded the patients who could not participate in treatment due to financial condition, transport, work or other reasons. A recommended activity (gym, lifting heavy objects) was not monitored at home despite the ergonomic recommendation.

FUTURE SCOPE
Studies with long term follow up and larger sample size is recommended for generalization of the result. The study was carried out on pain, ROM, functional activities, and outcomes after each treatment, the session can be recorded the findings. In future studies, evaluation of pain and outcomes after each treatment, the session can be recorded for more accuracy of results.

REFERENCES
[1] Rhinehart AJ. Effective treatment of an apparent meniscal injury using the Mulligan Concept. Journal of Sports Medicine and Allied Health Sciences: Official Journal of the Ohio Athletic Trainers Association. 2015; 2(1): 1-5.
[2] Yeh PC, Starkey C, Lombardo S, Vitti G, Kharrazi FD. Epidemiology of isolated meniscal injury and its effect on performance in athletes from the National Basketball Association. The American journal of sports medicine. 2012 Mar; 40: 589-594.
[3] Shiraev T, Anderson SE, Hope N. Meniscal tear: presentation, diagnosis and management. Australian family physician. 2012 Apr; 41: 182.
[4] Chivers MD, Howitt SD. Anatomy and physical examination of the knee menisci: a narrative review of the orthopedic literature. The journal of the canadian family physician. 2012 Apr; 41: 182.
[5] Lowery, Douglas J and Farley, Timothy D and Wing, David W and Sterrett, William I and Steadman, J Richard. A clinical composite score accurately detects meniscal pathology. Arthroscopy: The Journal of Arthroscopic & Related Surgery. 2006; 22(11): 1174-1179.
[6] Kurosaka, M and Yagi, M and Yoshiya, S and Muratsu, H and Mizuno, K. Efficacy of the axially loaded pivot shift test for the diagnosis of a meniscal tear. International orthopaedics. 1999; 23(5): 271-274.
[7] Harrison, Bradley K and Abell, Brian E and Gibson, T Whitney. The Thessaly test for detection of meniscal tears: validation of a new physical examination technique for primary care medicine. Clinical Journal of Sport Medicine. 2009; 19(1): 9-12.
[8] Udson, Robinetta and Richmond, Amy and Sanchez, Belinda and Stevenson, Valerie and Baker, Russell T and May, James and Naspanyan, Alan and Reordan, Don. An alternative approach to the treatment of meniscal pathologies: a case series analysis of the Mulligan Concept “Squeeze” technique. International journal of sports physical therapy. 2016; 11(4): 564.
[9] Kise, Nina Jullum and Risberg, May Arna and Stensrud, Silje and Ranstam, Jonas and Engebretsen, Lars and Roos, Ewa M. Exercise therapy versus arthroscopic partial meniscectomy for degenerative meniscal tear in middle aged patients: randomised controlled trial with two year follow-up. bmj. 2016 Jul 20;354:i3740. 2016 july; 354(3740).
[10] Sah, Roshan and Bin, Luike and Sah, Vijay Kumar and Dhami, Keshav Singh. Approach to Meniscal Tear by Clinical Examination and Its Management: A Review. Yangtzte Medicine. 2019; 3(3): 195-211.
[11] Mordecai, Simon C and Al-Hadithy, Nawfal and Ware, Howard E and Gupte, Chinmay M. Treatment of meniscal tears: an evidence based approach. World journal of orthopedics. 2014; 5(3): 233.
[12] Herrlin, Sylvia and H'allaander, Maria and Wange, Peter and Weidenhielm, Lars and Werner, Suzanne. Arthroscopic or conservative treatment of degenerative meniscal tears: a prospective randomised trial. Knee Surgery, Sports Traumatology, Arthroscopy. 2007; 15(4): 393-401.
[13] Katz, Jeffrey N and Brophy, Robert H and Chaisson, Christine E and De Chaves, Leigh and Cole, Brian J and Dahm, Diane L and Donnell-Fink, Laurel A and Guermazi, Ali. The pivot shift test for the diagnosis of a meniscal tear and osteoarthritis. New England Journal of Medicine. 2013; 368(18): 1675--1684.
[14] Hudson R, Richmond A, Sanchez B, Stevenson V, Baker RT, May J, Naspanya, Reordan D. Innovative treatment of clinically diagnosed meniscal tears: a randomized sham-controlled trial of the Mulligan concept ‘squeeze’technique. Journal of Manual & Manipulative Therapy. 2018 oct; 26(5): 254-263.
[15] Mulligan BR, Dalkilinc, Murat, Elbasan Bulent. Manual Therapy: Nags, Snags, MWMs. 6th ed. OPTP; 2010.
[16] Kumar, Dr.Deepak. Manual of Mulligan concept. 2nd ed.: capri 4 Physio; 2014.
[17] Konan S, Rayan F, Haddad FS. Do physical diagnostic tests accurately detect meniscal tears. Knee Surgery, Sports Traumatology, Arthroscopy. 2009 july; 17(7): 806-11.
[18] Varghese JG, Dilakshana S, Ganesh SD, Varshini L. A Study to Analyze the effectiveness of Mobilization with movement in OA knee Dysfunction: A Quasi Experimental Study. Research Journal of Pharmacy and Technology. 2019; 12(5): 2279-82.

[19] Krzyzanowicz R, Gargano F, May J, Nasypany A. Analysis of Patient Outcomes When Applying the Mulligan Concept to Treat Recreational Dancers with Patellofemoral Pain Syndrome. Phys Med Rehab Sc. 2019; 1(1):1-9.