Research Article

Effectiveness of Patellar Taping Techniques for Improving Pain in Patellofemoral Osteoarthritis: a Comparative Study

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Abstract

Background: Patellofemoral osteoarthritis (PFOA) is a progressive degenerative condition of the knee joint that primarily presents with anterior knee pain and functional limitation. Altered patellofemoral biomechanics, including abnormal patellar tracking and increased joint stress, are key contributors to pain development. Conservative management strategies such as patellar taping and isometric strengthening exercises are widely used to reduce pain; however, limited evidence exists comparing the effectiveness of medial, lateral, and neutral taping techniques in PFOA.

Objective: To compare the effect of medial, lateral, and neutral patellar taping combined with isometric strengthening exercises on pain in patients with patellofemoral osteoarthritis.

Material and Methods: An experimental randomized study was conducted on 60 female patients aged 45–60 years diagnosed with unilateral patellofemoral osteoarthritis. Participants were randomly allocated into three groups: Group A (medial patellar taping), Group B (lateral patellar taping), and Group C (neutral patellar taping), with 20 subjects in each group. All groups received standardized isometric strengthening exercises along with their respective taping intervention for a duration of 4 weeks. Pain intensity was measured using the Visual Analog Scale (VAS) before and after the intervention. Since data were non-normally distributed (Shapiro-Wilk $p < 0.001$), Wilcoxon signed-rank test was used for intragroup analysis and Kruskal-Wallis test followed by Dunn's post-hoc test was used for intergroup comparison.

Results: All three groups showed a statistically significant reduction in pain ($p < 0.001$). Group A demonstrated the greatest reduction in VAS scores from 7.5 to 2.5, followed by Group C from 7.0 to 4.0, and Group B from 7.5 to 5.0. Intergroup comparison revealed a significant difference among all groups ($\chi^2 = 49.13$, $p < 0.001$), with medial patellar taping showing superior pain reduction compared to lateral and neutral taping.

Conclusion: Medial patellar taping combined with isometric strengthening exercises is more effective in reducing pain than lateral and neutral taping in patients with patellofemoral osteoarthritis.

Keywords: Patellofemoral osteoarthritis, patellar taping, medial taping, lateral taping, neutral taping, Visual Analog Scale, isometric strengthening; knee pain.

INTRODUCTION

Patellofemoral osteoarthritis (PFOA) is a common degenerative condition of the knee joint and a major cause of anterior knee pain, particularly in middle-aged and older adults. It is characterized by progressive degeneration of articular cartilage within the patellofemoral joint, resulting in joint space narrowing, subchondral bone changes, and altered joint biomechanics. The condition significantly contributes to pain, functional limitations, and reduced quality of life in affected individuals.[1]

Anterior knee pain is the most prominent clinical symptom of PFOA and is typically aggravated by activities that increase patellofemoral joint loading, such as stair climbing, squatting, kneeling, and prolonged sitting. These activities increase compressive forces across the patellofemoral joint, thereby intensifying pain and functional impairment. The progression of symptoms is closely associated with biomechanical abnormalities, particularly altered patellar tracking and increased lateral patellofemoral joint stress.[2]

One of the key contributing factors in patellofemoral pain and osteoarthritis is abnormal patellar alignment, most commonly lateral patellar maltracking. This malalignment increases contact pressure on the lateral facet of the patella, resulting in uneven load distribution and progressive cartilage wear. This abnormal biomechanics is further influenced by quadriceps muscle imbalance, particularly delayed or reduced activation of the vastus medialis obliquus, resulting in poor patellar stabilization and increased joint stress.[3]

Conservative management is the first-line approach for patellofemoral osteoarthritis. Physiotherapy interventions focus on pain reduction, improvement of joint mechanics, and enhancement of muscular control. Among these, exercise therapy and patellar taping are widely used due to their non-invasive nature and immediate therapeutic effects. Exercise-based interventions, particularly isometric strengthening, are commonly prescribed because they allow muscle activation without joint movement, thereby minimizing joint stress while improving neuromuscular control and pain modulation.[4]

Isometric exercises have been shown to reduce pain through multiple mechanisms, including improved motor unit recruitment, enhanced muscle activation, and reduction of nociceptive input at the joint level.[5] In knee osteoarthritis, isometric strengthening of the quadriceps is particularly beneficial in improving joint stability and reducing patellofemoral loading during functional activities. Furthermore, these exercises are safe, simple, and well tolerated, making them suitable for early-stage rehabilitation programs.[6]

In addition to exercise therapy, patellar taping is widely used in clinical practice as an adjunct intervention for pain management in patellofemoral disorders. Patellar taping is believed to work by modifying patellar alignment, improving patellofemoral contact mechanics, reducing stress on irritated structures, and enhancing proprioceptive feedback. Different taping techniques such as medial, lateral, and neutral taping are used depending on the clinical presentation and therapeutic goal.[7]

Medial patellar taping is commonly applied to correct lateral patellar maltracking by facilitating medial glide of the patella, thereby reducing lateral facet compression and associated pain. Lateral patellar taping, although less commonly used for corrective purposes, provides sensory stimulation and may influence pain perception through neurophysiological mechanisms. Neutral taping, on the other hand, does not produce any directional correction but may offer placebo-like or proprioceptive benefits due to skin stimulation and compression effects.[8]

Despite widespread clinical use of these taping techniques, there remains limited comparative evidence regarding their relative effectiveness, particularly when combined with structured isometric strengthening programs. Previous studies have reported beneficial effects of patellar taping on pain and function; however, results vary depending on taping direction, technique, and patient-specific biomechanical factors. This variability highlights the need for further research comparing medial, lateral, and neutral taping approaches in a controlled clinical setting.

Therefore, the present study was undertaken to compare the effectiveness of medial, lateral, and neutral patellar taping combined with isometric strengthening exercises in reducing pain among patients with patellofemoral osteoarthritis.

MATERIALS AND METHODS

Study Design: Experimental randomized study.
Study Setting: Outpatient Department of Dasmesh College of Physiotherapy, Faridkot.
Sampling Technique: Simple random sampling.
Sample Size: 60 female patients with patellofemoral osteoarthritis.
Inclusion Criteria:

- Age group between 45-60 years.
- Patients of female gender only.
- Clinically diagnosed unilateral patellofemoral osteoarthritis.
- BMI between 25.0-34.9 kg/m².
- Pain on sufficient intensity (greater than 3 out of 10 on VAS).
- Pain aggravated by stair climbing, squatting, kneeling, or prolonged sitting.
- Pain and stiffness for at least 4 weeks or more.

Exclusion Criteria:

- Patients diagnosed with Primary chronic osteoarthritis of tibiofemoral joint.
- Inflammatory or rheumatoid arthritis.
- Prior knee surgery or recent trauma.
- Patients with clinically or radiologically confirmed fixed deformity of the knee joint.
- Hip or spinal pathology referring pain to knee.
- Skin allergy or infection over knee region.
- Fracture around knee.
- Recent local or systemic steroid injection to the knee.

INTERVENTIONS-

Participants were randomly divided into three groups:
Group A: Medial patellar taping + isometric strengthening exercises
Group B: Lateral patellar taping + isometric strengthening exercises
Group C: Neutral patellar taping + isometric strengthening exercises

The intervention was administered for a duration of 4 weeks. Informed consent was obtained from all participants. Subjects were instructed not to receive any additional pharmacological or physiotherapeutic treatment during the study period.

Taping Frequency: 3 sessions per week
Total 12 sessions over 4 weeks.[9]
Exercise Frequency: 6 days per week
Total 24 sessions.[10]

PROCEDURE

Group A – Medial Patellar Taping

The participant was positioned in supine lying with the knee maintained in extension and the quadriceps relaxed. After skin preparation, a hypoallergenic under-tape was applied. A medial glide was given to the patella, and then the Leukotape was applied maintaining the glide. Starting from the lateral border of patella, the patella was pulled in a medial direction with the help of the thumb, pushing the soft tissue on the medial aspect of knee towards the patella and anchoring over the medial femoral condyle, with enough medial force applied to shift the patella medially. To standardize the amount of medialization, the tape was pulled until a skin crease of greater than 2 cm wide was visible at the medial side of the knee. To assess the effect of taping, a pain provoking activity such as single or double squat was performed immediately prior to taping and repeated afterwards. If the tape is applied correctly, the post taping squat will be painless.[9]

Group B- Lateral Patellar Taping

The participant was positioned in long sitting with the knee maintained in a neutral position. Following skin preparation, a protective under-tape was applied. Rigid adhesive tape was anchored at the medial border of the patella and pulled laterally, with the soft tissues accommodated laterally and the tape secured along the lateral femoral condyle to produce a lateral glide of the patella.[11]

Group C – Neutral Patellar Taping

The participant was positioned in long sitting and the skin around the patella was cleaned and dried. A hypoallergenic under-tape was applied over the anterior aspect of the patella, followed by rigid adhesive tape placed directly across the centre of the patella without producing any medial or lateral glide. Neutral taping served as a control taping condition, providing tactile and proprioceptive input without altering patellar alignment.[8]

ISOMETRIC STRENGTHENING EXERCISES (ALL GROUPS)

The subjects performed the following sets of exercises for 4 weeks (6 days/week). Each exercise session lasted approximately 40 minutes. All exercises were performed for 2 sets of 10 repetitions with a 5-second rest interval between repetitions throughout the intervention period.

All groups performed identical exercises:

Isometric Quadriceps Exercise:

Participants were positioned in supine lying with a rolled towel placed beneath the knee to maintain approximately 15° of knee flexion.[12] Participants were instructed to pull the toes upward and press the knee downward against the towel roll to produce an isometric contraction of the quadriceps muscle without visible knee movement.[13] The contraction was maintained for 10 seconds, followed by a 5-second relaxation period.[14]

Straight Leg Raising (SLR) Exercise:

Participants were positioned in supine lying and instructed to raise the affected lower limb to approximately 30° of hip flexion while maintaining full knee extension. The exercise was performed against ankle-weight resistance equivalent to each participant's 10-repetition maximum (10-RM). The position was held for 10 seconds, followed by a controlled return to the starting position and a 5-second rest interval between repetitions.[14]

Isometric Hip Adduction Exercise:

Participants were positioned in long sitting with both knees flexed to approximately 90° and the feet placed flat on the supporting surface. A pillow was placed between the knees, and participants were instructed to perform an isometric hip adduction contraction by pressing the knees against the pillow.[15] The contraction was maintained for 7 seconds followed by a 5-second rest interval between repetitions.[16]

Isometric Knee Extension in High Sitting:

Participants were positioned in high sitting with the knee flexed to 90° and performed isometric knee extension against ankle-weight resistance equivalent to their individual 10-RM. The contraction was maintained for 10 seconds, followed by slow and controlled lowering of the lower limb to the starting position.[14]

Knee Extension Hold at 30° Flexion:

Participants were positioned in high sitting with the knee maintained at approximately 90° of flexion. Ankle-weight resistance equivalent to the participant's individual 10-RM was applied, and the knee was extended to approximately 30° of flexion. The position was maintained for 10 seconds.[14]

Knee Extension Hold at 60° Flexion: +++++

Participants were positioned in high sitting with the knee maintained at approximately 90° of flexion. Ankle-

weight resistance equivalent to the participant's individual 10-RM was applied, and the knee was extended to approximately 60° of flexion. The position was maintained for 10 seconds.[14]

Static Hamstring Exercise:

Participants were positioned in supine lying and instructed to press the heel downward against the supporting surface to produce an isometric contraction of the hamstring muscles. The contraction was maintained for 10 seconds before relaxation.[15]

Isometric Wall Squat:

Participants were positioned in standing with the back supported against a wall and feet placed shoulder-width apart. They were instructed to lower into a wall squat position to approximately 100° of knee flexion while maintaining proper lower-limb alignment.[17] The exercise was performed for 2 sets of 10 repetitions per session throughout the intervention period.[18]

STATISTICAL ANALYSIS

Data were analyzed using non-parametric tests due to non-normal distribution. Within-group comparisons were performed using the Wilcoxon signed-rank test. Between-group differences were analyzed using the Kruskal–Wallis test followed by Dunn's post-hoc test. Statistical significance was set at $p < 0.05$. Analysis was performed for pain outcome using the Visual Analog Scale (VAS).

RESULTS-

Baseline Comparison

At baseline, all three groups were statistically comparable with no significant difference in pain scores ($p > 0.05$), indicating homogeneity of participants prior to intervention.

Intragroup Analysis (VAS Scores)

All groups demonstrated statistically significant improvement in pain after 4 weeks of intervention ($p < 0.001$):

Group A (Medial taping):

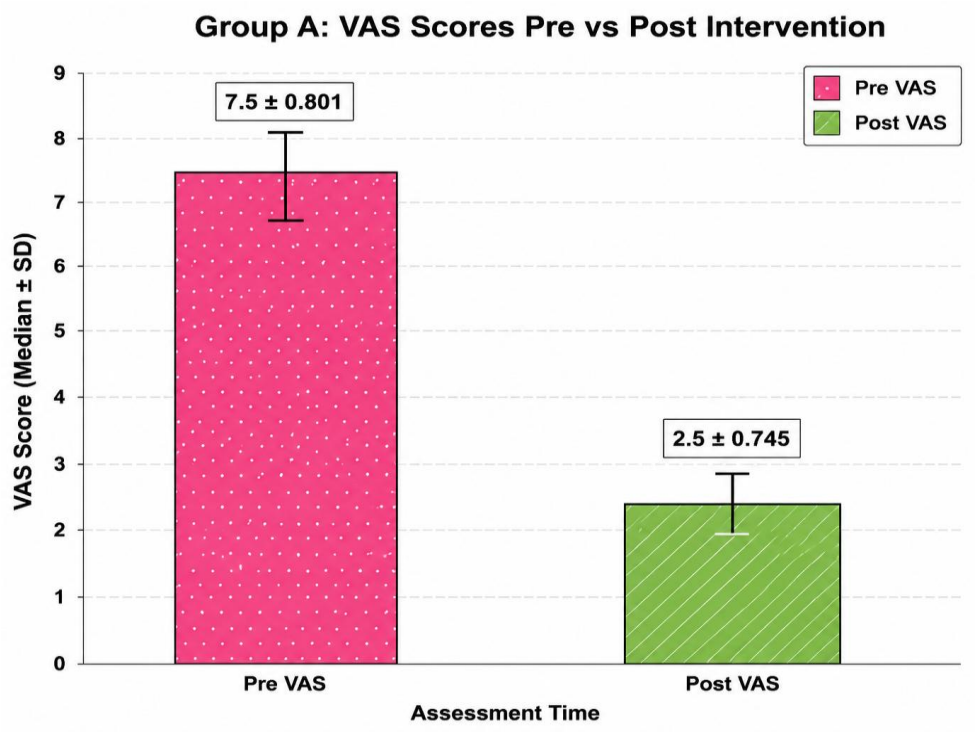


Figure 1: Intragroup comparison of VAS scores in Group C (medial patellar taping).

In Group A (medial patellar taping + isometric exercises), participants exhibited a marked reduction in VAS scores, with median values decreasing from 7.5 ± 0.801 pre-intervention to 2.5 ± 0.745 post-intervention ($p < 0.001$). This highly significant change indicates that medial patellar taping combined with isometric strengthening exercises was highly effective in alleviating knee pain in the study population.

Group B (Lateral Patellar Taping + Isometric Strengthening):

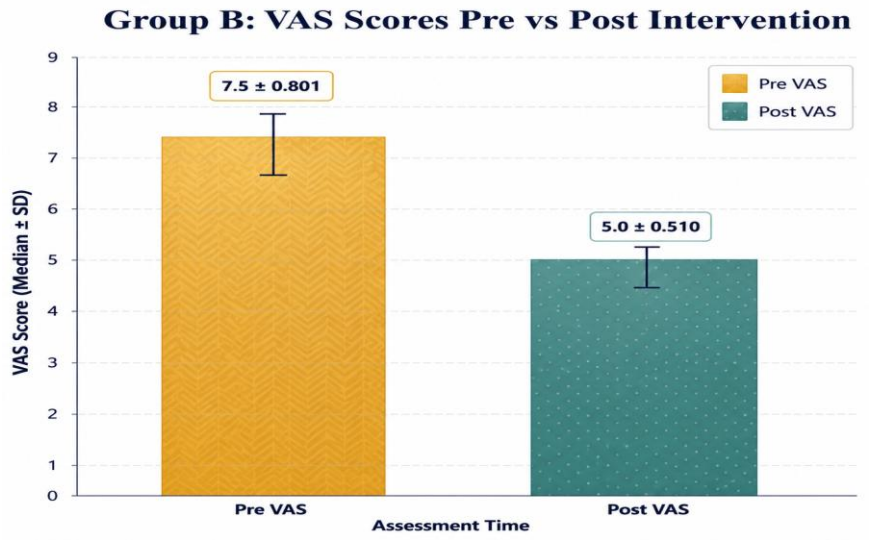


Figure 2: Intragroup comparison of VAS scores in Group B (lateral patellar taping).

In Group B (lateral patellar taping + isometric exercises), participants showed a moderate reduction in VAS scores, with median values decreasing from 7.5 ± 0.801 pre-intervention to 5.0 ± 0.510 post-intervention ($p < 0.001$). This highly significant change demonstrates that lateral patellar taping combined with isometric strengthening exercises effectively reduced knee pain, though to a lesser extent than medial taping

Group C (Neutral Patellar Taping + Isometric Strengthening):

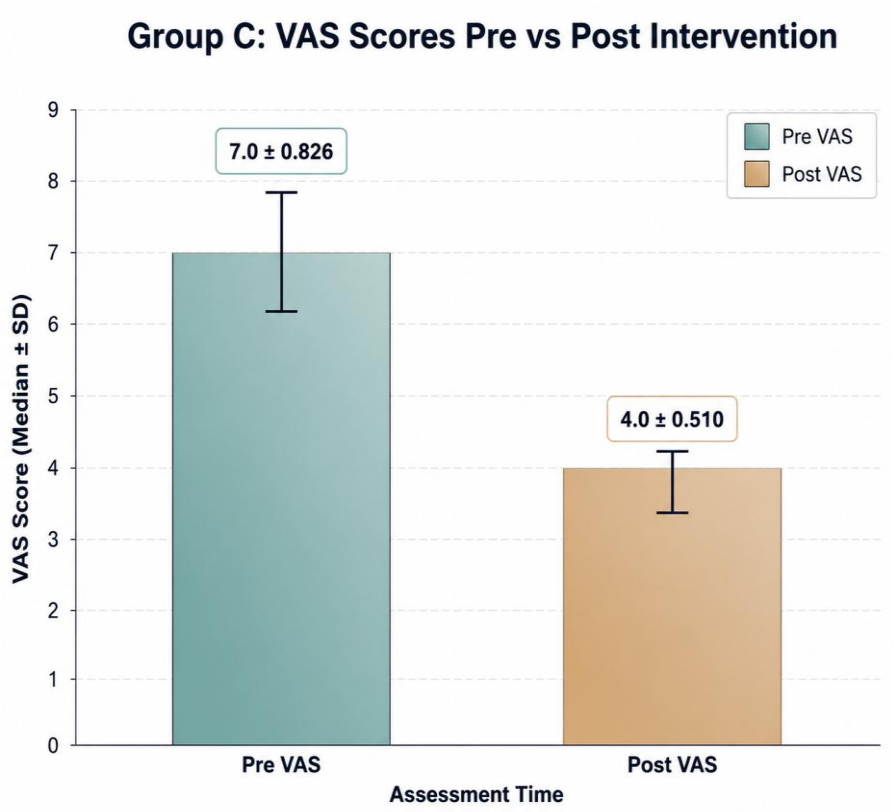


Figure 3: Intragroup comparison of VAS scores in Group C (neutral patellar taping).

In Group C (neutral patellar taping + isometric exercises), participants demonstrated a significant reduction in VAS scores, with median values decreasing from 7.0 ± 0.826 pre-intervention to 4.0 ± 0.510 post-intervention ($p < 0.001$). This highly significant change indicates that neutral patellar taping combined with isometric strengthening exercises effectively alleviated knee pain, showing a moderate improvement compared to the medial taping group.

Table 1: Intergroup comparison of median VAS score changes

Comparison	Median VAS Change	Test Statistic	Adjusted p-value	Result
Overall (Kruskal-Wallis)	NA	$\chi^2 = 49.13$, df = 2	< 0.001	Highly Significant
Group A vs Group B	-2.0	Z = -6.91	< 0.001	Significant
Group A vs Group C	-1.5	Z = -4.46	< 0.001	Significant
Group B vs Group C	0.5	Z = 2.45	0.022	Significant

The intergroup analysis of median VAS change using the Kruskal-Wallis test revealed a highly significant difference among the three groups ($\chi^2 = 49.13$, df = 2, $p < 0.001$). Post-hoc comparisons indicated that Group A experienced significantly greater pain reduction than Group B (median difference = -2.0, Z = -6.91, $p < 0.001$) and Group C (median difference = -1.5, Z = -4.46, $p < 0.001$). Additionally, Group C showed a modest but significant improvement compared to Group B (median difference = 0.5, Z = 2.45, p = 0.022). Overall, all interventions resulted in statistically significant reductions in VAS scores, with the greatest reduction observed in Group A.

RESULTS

All three groups demonstrated significant reductions in VAS scores following four weeks of intervention ($p < 0.001$).

Group A demonstrated the greatest reduction in VAS scores, decreasing from 7.50 ± 0.61 to 2.50 ± 0.51. Group C improved from 7.50 ± 0.61 to 3.50 ± 0.51, whereas Group B improved from 7.50 ± 0.61 to 4.50 ± 0.51.

The Kruskal–Wallis test revealed a statistically highly significant difference among the three groups ($p < 0.001$). Dunn's post-hoc analysis demonstrated significant differences between all pairwise comparisons.

The order of effectiveness was:

Medial Patellar Taping > Neutral Patellar Taping > Lateral Patellar Taping

These findings indicate that medial patellar taping combined with isometric strengthening exercises produced the greatest reduction in pain among patients with patellofemoral osteoarthritis.

DISCUSSION

The present study compared the effectiveness of medial patellar taping, lateral patellar taping, and neutral patellar taping combined with isometric strengthening exercises in patients with patellofemoral osteoarthritis. Pain was assessed using the Visual Analog Scale (VAS). The findings demonstrated significant pain reduction in all three groups following four weeks of intervention. However, medial patellar taping produced the greatest improvement, followed by neutral patellar taping, while lateral patellar taping showed the least improvement.

The superior effect of medial patellar taping may be attributed to its ability to improve patellar alignment and reduce excessive stress on the patellofemoral joint. In individuals with patellofemoral osteoarthritis, lateral patellar maltracking often increases compressive forces on the lateral patellar facet, contributing to pain generation. Medial taping assists in correcting this malalignment, thereby improving patellar tracking and reducing mechanical stress on pain-sensitive structures around the knee.[2]

In addition to biomechanical correction, medial patellar taping may enhance proprioceptive feedback and neuromuscular control. Increased sensory input from cutaneous mechanoreceptors can facilitate more effective quadriceps activation and improve dynamic patellar stability during functional activities. These mechanisms may contribute to the greater pain reduction observed in the medial taping group.[19]

Neutral patellar taping also resulted in significant pain reduction and demonstrated better outcomes than lateral taping. Since neutral taping does not produce directional correction of patellar alignment, its beneficial effects are likely related to enhanced proprioceptive feedback and sensory stimulation around the knee joint. Improved joint awareness may facilitate better movement control and reduce pain during daily activities.[8] Furthermore, the perceived support provided by the tape may contribute to reduced pain perception and improved confidence during movement.[20]

Lateral patellar taping produced significant but comparatively smaller improvements in pain. The lower effectiveness of lateral taping may be explained by the fact that most individuals with patellofemoral osteoarthritis commonly present with lateral patellar maltracking. Therefore, applying a lateral corrective force

may not adequately address the underlying biomechanical dysfunction responsible for symptom generation.[21] Isometric strengthening exercises were incorporated in all three groups and likely contributed to the overall reduction in pain. Isometric exercises improve muscle activation without producing excessive joint movement, thereby minimizing patellofemoral stress while enhancing quadriceps function. Improved quadriceps activation contributes to greater joint stability and more efficient load distribution across the knee joint, which may reduce pain during functional activities.[6]

Pain reduction may also be explained by the neurophysiological effects of isometric contractions. Sustained muscle contractions have been shown to activate descending inhibitory pathways and reduce nociceptive transmission, resulting in exercise-induced hypoalgesia and improved pain tolerance.[22] Additionally, isometric exercise improves proprioceptive function and neuromuscular control, further contributing to symptom improvement.[5]

Overall, the findings of the present study suggest that although all three taping techniques combined with isometric strengthening exercises are effective in reducing pain in patients with patellofemoral osteoarthritis, medial patellar taping provides superior clinical benefits. The results support the use of medial patellar taping as an effective adjunct to isometric strengthening exercises in the conservative management of patellofemoral osteoarthritis.[3]

CONCLUSION

The findings of the present study indicate that medial patellar taping, lateral patellar taping, and neutral patellar taping combined with isometric strengthening exercises are effective in reducing pain in patients with patellofemoral osteoarthritis. However, medial patellar taping demonstrated significantly greater pain reduction compared with neutral and lateral patellar taping.

Therefore, medial patellar taping may be considered the most effective adjunct to isometric strengthening exercises for pain management in individuals with patellofemoral osteoarthritis.

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