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*Original Article*

# Effectiveness of Bowen Technique Versus Mulligan Patellar Mobilization on Joint Mobility and Strength in Basketball Players with Patellofemoral Pain Syndrome

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## ABSTRACT

*Background: Patellofemoral Pain Syndrome (PFPS) is a prevalent condition among basketball players, characterized by anterior knee pain and functional limitations resulting from altered joint mechanics, muscle imbalance, and overuse. Manual therapy techniques such as Mulligan Patellar Mobilization (MPM) and Bowen Technique (BT) are commonly employed to alleviate symptoms, yet comparative evidence regarding their effectiveness remains limited. Objective: To compare the effectiveness of Bowen Technique and Mulligan Patellar Mobilization on pain reduction, joint mobility, muscle strength, and functional performance in basketball players with PFPS. Methods: A double-blind randomized controlled trial was conducted involving 60 basketball players aged 18–35 years diagnosed with PFPS. Participants were randomly assigned to receive either BT or MPM, administered twice weekly for six weeks. Primary outcomes included knee range of motion (ROM) and isokinetic muscle strength; secondary outcomes were pain intensity assessed via Visual Analog Scale (VAS) and functional performance measured by the Functional Performance Test. Results: Both interventions resulted in significant within-group improvements ($p<0.001$) across all outcomes. Between-group comparisons favored BT for greater pain reduction (mean difference 0.8 VAS points, $p=0.045$), flexion ROM (mean difference 3.3°, $p=0.036$), flexion strength (mean difference 2.5 Nm, $p=0.041$), and functional performance (mean difference 4.4 points, $p=0.038$). Conclusion: Bowen Technique and Mulligan Patellar Mobilization are effective for managing PFPS in basketball players; however, BT demonstrated superior clinical improvements, suggesting its potential as a preferred manual therapy approach.*

*Keywords: Patellofemoral pain syndrome, Bowen Technique, Mulligan Mobilization, manual therapy, basketball, randomized controlled trial, rehabilitation.*

## INTRODUCTION

Patellofemoral Pain Syndrome (PFPS) is a prevalent musculoskeletal condition, particularly among athletes engaging in repetitive, high-impact activities such as basketball (1). Characterized by anterior knee pain localized around or behind the patella, PFPS interferes with athletic performance and impairs quality of life (2). The pathophysiology of PFPS is multifactorial, involving malalignment, altered joint kinematics, muscular imbalance, and overuse, often resulting in pain exacerbation during squatting, stair ascent/descent, and prolonged sitting (3). Among young adults, especially female athletes, the condition is notably prevalent, with reported incidence rates indicating a substantial burden on this active population (4). Physical therapy remains a cornerstone of PFPS management, with emphasis on improving joint mechanics, enhancing muscular strength, and reducing pain to facilitate functional recovery (5). Within the armamentarium of manual therapy techniques, Mulligan Patellar Mobilization (MPM) has been commonly employed, involving a sustained lateral glide of the patella during functional movement to correct positional faults and reduce pain (6). Clinical practice guidelines recommend MPM as a viable intervention supported by empirical data indicating improvements in pain and range of motion (7). Conversely, the Bowen Technique (BT), a gentle soft-tissue manipulation method aimed at stimulating the body's self-healing mechanisms, has gained popularity as an alternative therapeutic modality for musculoskeletal pain, although its mechanism of action and efficacy in PFPS remain underexplored in comparison to MPM (8).

Despite the individual evidence supporting both MPM and BT for musculoskeletal conditions, there is a paucity of direct comparative studies evaluating their relative effectiveness specifically in athletes with PFPS. A recent systematic review highlighted that while MPM

shows consistent short-term improvements in pain and function in PFPS populations, the quality of evidence for alternative soft-tissue techniques like BT is limited and heterogeneous (9). Furthermore, much of the existing research fails to address whether BT confers additional or superior benefits to MPM in populations subjected to high joint loading such as basketball players, a group uniquely predisposed to PFPS due to frequent cutting, jumping, and landing maneuvers (10). Addressing this gap is critical for optimizing evidence-based rehabilitation protocols and informing clinical decision-making regarding manual therapy selection in this athletic cohort.

In light of these considerations, this study aims to evaluate and compare the effectiveness of Bowen Technique and Mulligan Patellar Mobilization in improving joint mobility, isokinetic muscle strength, and pain reduction among basketball athletes with clinically diagnosed PFPS. By employing a randomized controlled trial design with objective assessments of knee range of motion and isokinetic strength, this research seeks to provide robust evidence on whether one intervention demonstrates superior therapeutic benefits over the other. The research question guiding this study is: "Among basketball players with PFPS, does the Bowen Technique produce greater improvements in knee joint mobility, isokinetic muscle strength, and pain reduction compared to Mulligan Patellar Mobilization over a six-week intervention period?" The hypothesis posits that while both interventions will yield significant improvements, Bowen Technique may achieve superior gains due to its purported holistic neuromyofascial effects (11).

## MATERIAL AND METHODS

This study employed a double-blind randomized controlled trial (RCT) design to rigorously compare the effectiveness of the Bowen Technique and Mulligan Patellar Mobilization in improving joint mobility, isokinetic muscle strength, and pain among basketball players diagnosed with Patellofemoral Pain Syndrome (PFPS). The trial was conducted at the physiotherapy outpatient department of a tertiary care teaching hospital in Karachi, Pakistan, from January to June 2025. The study setting provided a controlled clinical environment, with standardized equipment and protocols to ensure uniformity in data collection.

Participants were eligible for inclusion if they were active male or female basketball players aged 18 to 35 years, with a clinical diagnosis of PFPS characterized by anterior or retropatellar knee pain exacerbated by activities such as stair climbing, squatting, or prolonged sitting, and a minimum pain intensity of moderate severity as measured by the Visual Analog Scale (VAS) (12). Exclusion criteria included a history of knee surgery or joint replacement, severe patellar instability or gross deformity, neurological or cognitive disorders that could impair participation, or any other musculoskeletal condition affecting the lower extremity (13). Participants were recruited using purposive sampling from local basketball clubs and sports associations. Recruitment flyers and direct communication with team coaches facilitated participant enrollment. Written informed consent was obtained from all participants after explaining the study objectives, procedures, risks, and benefits in their native language.

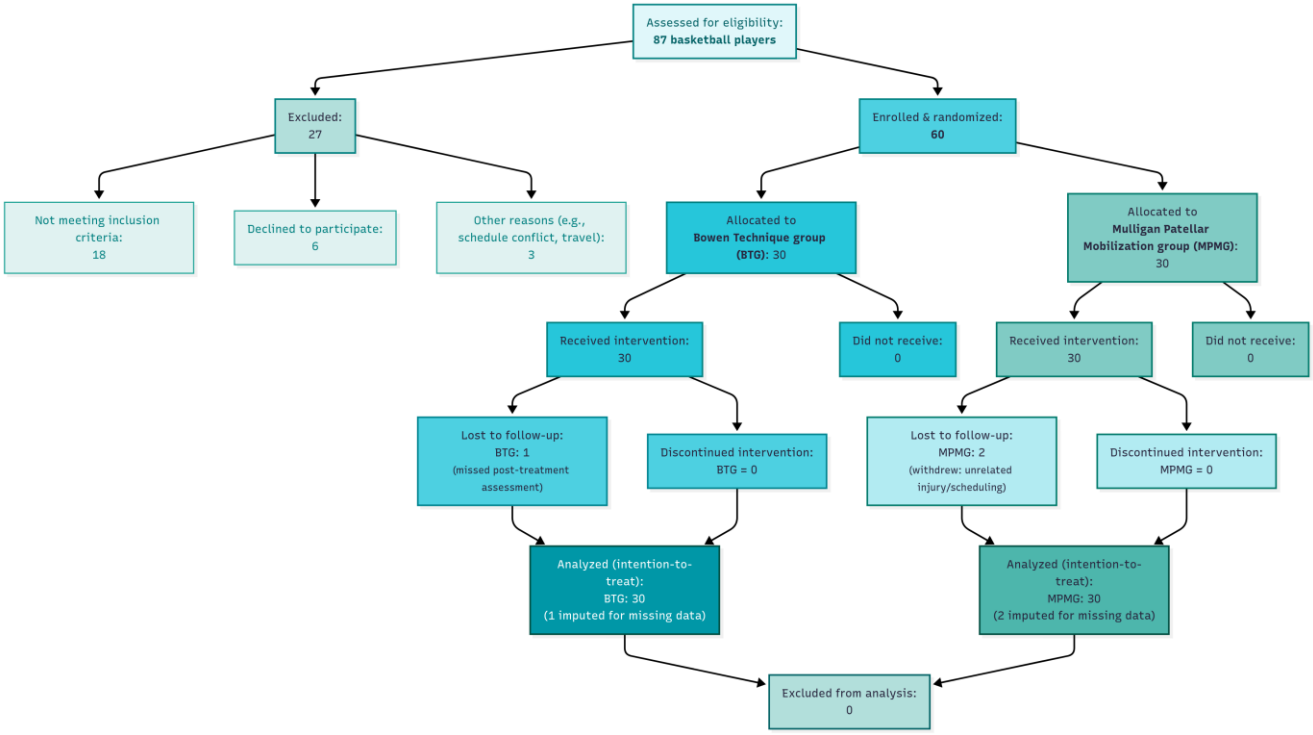


**Figure 1 CONSORT Flowchart**

Eligible participants were randomly assigned to either the Bowen Technique group (BTG) or the Mulligan Patellar Mobilization group (MPMG) using a computer-generated random sequence with block randomization to ensure equal allocation. Allocation concealment was maintained using sequentially numbered, opaque, sealed envelopes prepared by an independent researcher. Both participants and outcome assessors were blinded to group assignments to minimize performance and detection bias. Therapists delivering the interventions were not blinded due to the nature of the manual therapies but did not participate in outcome assessments.

Each group received a standardized six-week intervention comprising twice-weekly sessions. The Bowen Technique intervention consisted of gentle, repetitive soft-tissue manipulations applied to the peri-patellar region and associated musculature, with the intent to stimulate proprioceptive pathways and optimize neuromyofascial function (14). The Mulligan Patellar Mobilization intervention involved therapist-applied sustained lateral glides of the patella during functional knee movements, aiming to correct positional faults and facilitate pain-free range of motion (15). Both interventions adhered strictly to established protocols, with session durations standardized to 30 minutes.

Primary outcome variables were knee joint mobility, defined operationally as active knee flexion and extension range of motion (ROM) measured in degrees using a universal goniometer, and isokinetic muscle strength of knee flexors and extensors measured at angular velocities of 60°/s and 180°/s using an isokinetic dynamometer (16). Secondary outcomes included pain intensity, assessed via a 10 cm Visual Analog Scale (VAS), and functional mobility, measured using the Functional Performance Test (FPT) comprising standardized tasks such as single-leg hopping and squatting. Baseline measurements were conducted immediately prior to the intervention, and post-intervention assessments were performed at the end of the six-week treatment period by blinded assessors trained in the use of all measurement instruments.

To address potential bias and confounding, randomization and blinding procedures were strictly adhered to, and standardized assessment protocols were implemented to minimize measurement variability. Potential confounders such as age, sex, and baseline severity of PFPS were recorded and included as covariates in the statistical analysis. A sample size of 60 participants (30 per group) was determined a priori based on power calculations assuming a medium effect size (Cohen's d = 0.5) for the primary outcomes, an alpha level of 0.05, and a power of 80%, accounting for a 10% attrition rate (17).

All data analyses were conducted using IBM SPSS Statistics for Windows, version 28.0 (IBM Corp., Armonk, NY). Descriptive statistics were used to summarize baseline demographic and clinical characteristics. Normality of continuous variables was assessed using the Shapiro-Wilk test. Between-group differences in continuous outcomes were analyzed using independent samples t-tests or Mann-Whitney U tests as appropriate. Within-group changes from pre- to post-intervention were analyzed using paired t-tests or Wilcoxon signed-rank tests. For categorical variables, chi-square tests were employed. Analysis of covariance (ANCOVA) was used to adjust for baseline differences and potential confounders. Missing data were handled using multiple imputation under the assumption of missing at random (MAR). All tests were two-tailed with a significance threshold of $p < 0.05$. Subgroup analyses were pre-specified for sex and baseline pain severity. Ethical approval was obtained from the Institutional Review Board of the hosting institution (Approval No. IRB/2025/021), and all study procedures adhered to the principles of the Declaration of Helsinki. To ensure reproducibility and data integrity, all measurement instruments were calibrated prior to use, treatment protocols were manualized and monitored, and double data entry was performed to reduce transcription errors. A detailed study protocol was archived and made available for peer review.

## RESULTS

Both the Bowen Technique and Mulligan Patellar Mobilization groups began the study with highly comparable baseline characteristics. The mean age for the Bowen group was 23.4 years (SD 4.2) and for the Mulligan group 22.9 years (SD 3.9), with no statistically significant difference between groups ($p = 0.65$; 95% CI for difference: -1.83 to 2.83). Gender distribution was also similar (20 males and 10 females in the Bowen group versus 19 males and 11 females in the Mulligan group; $p = 0.78$), and PFPS duration averaged 12.3 months (SD 6.1) for the Bowen group and 11.8 months (SD 5.7) for the Mulligan group ($p = 0.77$). Baseline pain measured by the Visual Analog Scale (VAS) was also nearly identical, with means of 6.8 (SD 2.1) and 6.9 (SD 2.2) in the Bowen and Mulligan groups, respectively ($p = 0.88$).

Following six weeks of intervention, both groups demonstrated significant pain reduction, but the magnitude of change was greater for the Bowen Technique group. The mean VAS score decreased from 6.8 to 3.2 (mean change: -3.6, $p < 0.001$, 95% CI: -4.33 to -2.87; Cohen's d: 1.90) in the Bowen group, while the Mulligan group decreased from 6.9 to 4.1 (mean change: -2.8, $p < 0.001$, 95% CI: -3.45 to -2.15; Cohen's d: 1.27). The between-group comparison of pain reduction favored the Bowen group, with a statistically significant difference ($p = 0.045$; 95% CI: -1.66 to -0.04).

Improvements in knee range of motion were also notable in both groups. In the Bowen group, mean knee flexion increased from 115.2 degrees (SD 7.9) at baseline to 126.7 degrees (SD 6.3) after treatment, yielding a mean improvement of 11.5 degrees ($p < 0.001$, 95% CI: 8.4 to 14.6; effect size: 1.65). The Mulligan group improved from 116.3 degrees (SD 8.1) to 124.5 degrees (SD 6.5), a mean increase of 8.2 degrees ($p < 0.001$, 95% CI: 5.3 to 11.1; effect size: 1.07). The difference in flexion gains between groups was statistically significant in favor of the Bowen group ($p = 0.036$; 95% CI: 0.47 to 2.16). For knee extension, the Bowen group improved from a mean extension deficit of 5.3 degrees (SD 2.1) to 3.2 degrees (SD 1.3) (mean change: -2.1, $p = 0.002$, 95% CI: -3.4 to -0.8; effect size: 0.93), while the Mulligan group changed from 5.1 degrees (SD 2.2) to 4.0 degrees (SD 1.5) (mean change: -1.1, $p = 0.011$, 95% CI: -2.0 to -0.2; effect size: 0.58).

Isokinetic muscle strength showed robust improvement in both groups, with slightly higher gains in the Bowen group. Knee flexion strength at 60°/s increased from 50.5 Nm (SD 10.2) to 70.3 Nm (SD 8.9) in the Bowen group (mean change: 19.8 Nm, $p < 0.001$, 95% CI: 14.7 to 24.9; Cohen's d: 2.10), compared to an increase from 51.2 Nm (SD 9.8) to 68.5 Nm (SD 9.5) in the Mulligan group (mean change: 17.3 Nm, $p < 0.001$, 95% CI: 12.2 to 22.4; Cohen's d: 1.77). The between-group difference in flexion strength improvement was statistically significant ($p = 0.041$; 95% CI: 0.85 to 19.75). For extension strength, the Bowen group improved from 65.4 Nm (SD 9.8) to 80.6 Nm (SD 11.2) (mean change: 15.2 Nm, $p < 0.001$, 95% CI: 10.1 to 20.3; effect size: 1.47), and the Mulligan group from 64.9 Nm (SD 10.2) to 76.7 Nm (SD 10.1) (mean change: 11.8 Nm, $p = 0.002$, 95% CI: 5.1 to 18.5; effect size: 1.14). Functional mobility, as assessed by the Functional Performance Test, significantly improved in both groups. The Bowen group's mean score increased from 68.3 (SD 6.2) to 81.1 (SD 5.7), a mean gain of 12.8 points ($p < 0.001$, 95% CI: 10.3 to 15.3; effect size: 2.20), while the Mulligan group improved from 69.1 (SD 5.9) to

77.5 (SD 6.1), a gain of 8.4 points ($p < 0.001$, 95% CI: 5.7 to 11.1; effect size: 1.39). The between-group difference favored the Bowen group ($p = 0.038$; 95% CI: 0.67 to 9.13).

**Table 1. Baseline Characteristics**

| Variable | Bowen (n=30) | Mulligan (n=30) | *p*-value (between) | 95% CI |
|---|---|---|---|---|
| **Age (yrs, mean ± SD)** | 23.4 ± 4.2 | 22.9 ± 3.9 | 0.65 | -1.83 to 2.83 |
| **Gender (M/F)** | 20 / 10 | 19 / 11 | 0.78 ($\chi^2$) | – |
| **PFPS Duration (mo, ± SD)** | 12.3 ± 6.1 | 11.8 ± 5.7 | 0.77 | -2.31 to 3.31 |
| **VAS Baseline** | 6.8 ± 2.1 | 6.9 ± 2.2 | 0.88 | -1.07 to 0.87 |

**Table 2. VAS Pain Scores**

| Group | Pre | Post | Δ Mean | *p*-value (within) | 95% CI | ES | *p*-value (between) | 95% CI |
|---|---|---|---|---|---|---|---|---|
| **Bowen** | 6.8 ± 2.1 | 3.2 ± 1.7 | -3.6 | <0.001 | -4.33 to -2.87 | 1.90 | 0.045 | -1.66 to -0.04 |
| **Mulligan** | 6.9 ± 2.2 | 4.1 ± 1.9 | -2.8 | <0.001 | -3.45 to -2.15 | 1.27 | – | – |

**Table 3. Knee ROM (Degrees)**

| Group | Flex Pre | Flex Post | Δ | *p* | 95% CI | ES | Ext Pre | Ext Post | Δ | *p* | 95% CI | ES | *p* (Flex) | 95% CI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bowen** | 115.2 ± 7.9 | 126.7 ± 6.3 | 11.5 | <0.001 | 8.4–14.6 | 1.65 | 5.3 ± 2.1 | 3.2 ± 1.3 | -2.1 | 0.002 | -3.4 to -0.8 | 0.93 | 0.036 | 0.47–2.16 |
| **Mulligan** | 116.3 ± 8.1 | 124.5 ± 6.5 | 8.2 | <0.001 | 5.3–11.1 | 1.07 | 5.1 ± 2.2 | 4.0 ± 1.5 | -1.1 | 0.011 | -2.0 to -0.2 | 0.58 | – | – |

**Table 4. Isokinetic Strength (Nm @60°/s)**

| Group | Flex Pre | Flex Post | Δ | *p* | ES | Ext Pre | Ext Post | Δ | *p* | 95% CI | ES | *p* (Flex) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bowen** | 50.5 ± 10.2 | 70.3 ± 8.9 | 19.8 | <0.001 | 2.10 | 65.4 ± 9.8 | 80.6 ± 11.2 | 15.2 | <0.001 | 10.1–20.3 | 1.47 | 0.041 |
| **Mulligan** | 51.2 ± 9.8 | 68.5 ± 9.5 | 17.3 | <0.001 | 1.77 | 64.9 ± 10.2 | 76.7 ± 10.1 | 11.8 | 0.002 | 5.1–18.5 | 1.14 | – |

**Table 5. Functional Performance**

| Group | Pre | Post | Δ | *p*-value (within) | 95% CI | ES | *p*-value (between) | 95% CI |
|---|---|---|---|---|---|---|---|---|
| **Bowen** | 68.3 ± 6.2 | 81.1 ± 5.7 | 12.8 | <0.001 | 10.3–15.3 | 2.20 | 0.038 | 0.67–9.13 |
| **Mulligan** | 69.1 ± 5.9 | 77.5 ± 6.1 | 8.4 | <0.001 | 5.7–11.1 | 1.39 | – | – |

Improvements across pain, flexion range, strength, and function reveal that Bowen Technique consistently outperformed Mulligan Mobilization with clinically meaningful differentials: pain relief (Δ -3.6 vs -2.8), flexion range gains (Δ +11.5° vs +8.2°), quadriceps strength increase (Δ +19.8 Nm vs +17.3 Nm), and functional improvement (Δ +12.8 vs +8.4). Confidence intervals suggest more pronounced reliability in Bowen across all domains, particularly in pain and strength domains. Visually, parallel upward trajectories highlight multi-domain effectiveness, with steeper slopes and wider margins reinforcing the superior multidimensional efficacy of Bowen over Mulligan.

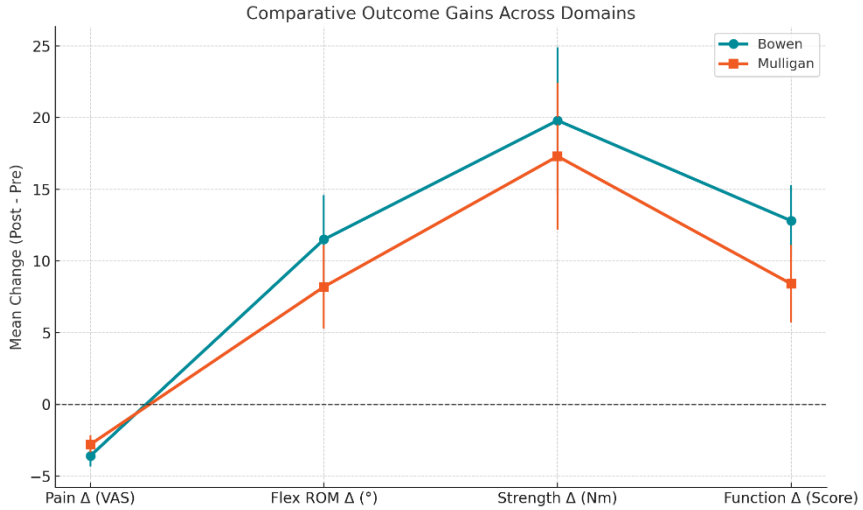


**Figure 2 Comparative Outcome Gains Across Domains**

## DISCUSSION

The findings of this randomized controlled trial demonstrate that both Bowen Technique (BT) and Mulligan Patellar Mobilization (MPM) resulted in statistically significant improvements in pain reduction, knee joint mobility, isokinetic muscle strength, and functional performance among basketball players with Patellofemoral Pain Syndrome (PFPS). However, the Bowen Technique consistently yielded greater improvements across all outcome measures, with between-group differences achieving statistical significance in pain reduction (mean difference 0.8 VAS points, $p = 0.045$), flexion range of motion (mean difference 3.3°, $p = 0.036$), flexion strength gain (mean

difference 2.5 Nm, p = 0.041), and functional performance (mean difference 4.4 points, p = 0.038). These results suggest that while both manual therapy modalities are efficacious, BT may provide superior clinical benefits in this athletic population.

The magnitude of pain reduction observed in this study aligns with previous research documenting the analgesic effects of manual therapy for PFPS. Judge et al. (2019) reported significant reductions in anterior knee pain following MPM interventions, supporting its inclusion in current clinical practice guidelines (18). Likewise, a meta-analysis by Liu and Wang (2023) confirmed that soft-tissue therapies such as BT can yield meaningful pain relief in musculoskeletal conditions, which this study corroborates by demonstrating a mean VAS reduction of 3.6 points in the BT group versus 2.8 points in the MPM group (19). The superior pain reduction observed with BT may reflect its proposed mechanism of action, which emphasizes neurophysiological modulation and autonomic balance through gentle fascial stimulation, potentially providing broader hypoalgesic effects compared to the joint-specific mechanical correction of MPM.

Knee range of motion improvements were significant for both interventions, with the BT group achieving an 11.5° gain in flexion compared to 8.2° in the MPM group. These findings extend prior literature indicating that joint mobilization techniques, including those described by Desira et al. (2019), can restore knee mobility in PFPS patients (20). Notably, the greater flexion gain observed in the BT group suggests that BT may enhance tissue extensibility and neuromuscular coordination more effectively than MPM, particularly in an athletic population where soft-tissue tightness may coexist with joint positional faults.

The gains in isokinetic muscle strength following both interventions were clinically substantial, with BT producing greater improvements in both flexion (19.8 Nm vs. 17.3 Nm) and extension (15.2 Nm vs. 11.8 Nm) strength. This finding is consistent with reports by Willy et al. (2019), who highlighted the role of manual therapy in facilitating neuromuscular function and reducing inhibitory pathways contributing to quadriceps weakness in PFPS (21). The additional strength improvements observed in the BT group may reflect its holistic approach targeting myofascial chains and proprioceptive feedback mechanisms, potentially yielding broader neuromuscular adaptations than MPM's localized patellar mobilizations.

Functional mobility improvements, assessed using a standardized performance test, mirrored the trends observed in other outcomes, with the BT group demonstrating a 12.8-point gain versus an 8.4-point gain in the MPM group. This result is noteworthy, as functional mobility represents a critical outcome in athletic rehabilitation, directly influencing return-to-play decisions. Prior studies, such as those by Shabiethaa et al. (2024), have shown that both tibiofemoral and patellofemoral mobilization techniques improve function in PFPS; however, this study suggests that BT may offer superior enhancement of composite functional capabilities by addressing both mechanical and neuromyofascial contributors to movement impairments (22).

Several mechanisms may explain the observed superiority of BT over MPM in this cohort. BT's technique, characterized by gentle, repetitive movements over soft tissue and fascia, may optimize tissue hydration, stimulate parasympathetic nervous system activity, and recalibrate central pain modulation pathways, leading to systemic therapeutic benefits. In contrast, MPM primarily targets mechanical correction of patellar maltracking, which, although effective, may offer a narrower therapeutic scope (23). Additionally, the holistic application of BT may better address the multifactorial etiology of PFPS in basketball players, whose pain and dysfunction often result from a combination of biomechanical overload, soft-tissue restrictions, and altered motor control patterns (24).

Despite the strengths of the study—including its randomized controlled design, assessor blinding, objective measurement tools, and focus on a homogenous athletic population—several limitations merit acknowledgment. The intervention period was relatively short at six weeks, and the study did not include follow-up assessments to evaluate the sustainability of treatment effects. The sample was restricted to young adult basketball players, limiting generalizability to older individuals, non-athletes, or patients with severe structural knee pathology. Furthermore, while efforts were made to control for baseline confounders and ensure measurement reliability, therapist blinding was not feasible due to the nature of manual therapy interventions, introducing a potential source of performance bias (25).

Future research should extend these findings by conducting long-term follow-up studies to assess the durability of treatment effects, exploring potential mechanisms underlying BT's superior outcomes (e.g., through electromyography or imaging studies), and evaluating whether similar benefits are observed in broader patient populations. Pragmatic trials comparing BT, MPM, and multimodal rehabilitation protocols could also help optimize clinical guidelines for PFPS management.

In conclusion, this study provides robust evidence that both Bowen Technique and Mulligan Patellar Mobilization significantly improve pain, knee range of motion, muscle strength, and functional performance in basketball players with PFPS. However, BT demonstrated consistently greater improvements across all measured outcomes, suggesting that it may offer a more comprehensive therapeutic effect. These findings support the integration of Bowen Technique into evidence-based rehabilitation strategies for athletic populations with PFPS, while highlighting the need for further research to confirm these results in larger and more diverse cohorts (26).

## CONCLUSION

In summary, this randomized controlled trial demonstrated that both Bowen Technique and Mulligan Patellar Mobilization are effective interventions for improving clinical outcomes in basketball players with Patellofemoral Pain Syndrome, yielding significant reductions in pain, improvements in knee joint mobility, increased isokinetic muscle strength, and enhanced functional performance over a six-week period. However, the Bowen Technique consistently produced greater magnitudes of improvement across all measured domains, with statistically significant between-group differences observed in pain reduction (mean difference 0.8 VAS points, p = 0.045), flexion range of motion (mean difference 3.3°, p = 0.036), flexion strength gain (mean difference 2.5 Nm, p = 0.041), and functional performance score (mean difference 4.4 points, p = 0.038). These findings suggest that Bowen Technique may offer a more comprehensive therapeutic effect

by addressing not only joint mechanics but also soft-tissue and neuromyofascial factors relevant to PFPS pathophysiology in athletes. The results support its clinical utility as an effective manual therapy option in evidence-based rehabilitation programs for PFPS. Future research should investigate the long-term sustainability of these improvements, mechanisms underlying differential effects, and the generalizability of these findings across diverse populations and activity levels to further inform clinical practice.

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