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Article

Comparative Effects of Bowen's Technique and Mulligan Bent Leg Raise Technique on Range of Motion and Function in Kabaddi Players with Hamstring Tightness

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ABSTRACT

Background: Hamstring tightness is a prevalent musculoskeletal issue among kabaddi players, often leading to reduced range of motion, impaired function, and increased injury risk. Although multiple manual therapy techniques exist, comparative evidence between Bowen's Technique and Mulligan's Bent Leg Raise (BLR) Technique in athletic populations remains scarce. **Objective**: This study aimed to compare the effects of Bowen's Technique and Mulligan's BLR Technique on hamstring flexibility, range of motion, and lower extremity functional outcomes in kabaddi players diagnosed with hamstring tightness. **Methods**: A randomized controlled trial was conducted involving 44 male kabaddi players aged 18–30 years (n = 44), randomly allocated into two intervention groups. Group A received Bowen's Technique and Group B received Mulligan's BLR for 6 weeks. Inclusion criteria included hamstring tightness with 20°–50° loss of active knee extension. Participants with neurological symptoms, recent surgeries, or lower limb injuries were excluded. Outcome measures included Active Knee Extension Test (AKET), Finger-to-Floor Test (FTF), Sit-and-Reach Test (SAR), and Lower Extremity Functional Scale (LEFS). Ethical approval was obtained from the Riphah Institutional Review Board following the Helsinki Declaration. Data were analyzed using SPSS v25. Paired and independent T-tests were applied based on normality tests. **Results**: Both interventions significantly improved AKET (Right: Bowen 8.13° vs. Mulligan 9.92°, $p < 0.001$), FTF, SAR, and LEFS (Bowen: 12.18; Mulligan: 14.28; $p < 0.001$ within groups). Between-group post-intervention comparison showed statistically significant improvement in AKET for the right leg in the Mulligan group ($p < 0.050$), while other outcomes showed no significant difference. **Conclusion**: Both Bowen's and Mulligan's techniques effectively enhanced hamstring flexibility and functional capacity in kabaddi players, with Mulligan's BLR showing slightly superior outcomes in active knee extension. These results support the clinical application of both methods in sports rehabilitation to optimize lower limb performance and injury prevention.

Keywords: Hamstring Muscles, Physical Therapy Modalities, Manual Therapy, Athletic Performance, Muscle Stretching Exercises, Range of Motion, Kabaddi Players.

INTRODUCTION

Kabaddi, a traditional South Asian sport with rising global popularity, is known for its high physical demands that include strength, agility, endurance, and flexibility. Among the various physical components critical to a kabaddi player's performance, hamstring flexibility plays a pivotal role in ensuring optimal movement efficiency and injury prevention (1). The sport involves repetitive sprints, sudden direction changes, and dynamic postures, all of which place substantial stress on the hamstrings. A lack of flexibility in these muscles may not only hinder performance but also predispose athletes to strains, lower limb injuries, and chronic musculoskeletal disorders (2,3). Several studies have highlighted that hamstring tightness can disrupt the length-tension relationship of muscles, reduce shock absorption, impair joint mobility, and lead to postural deviations (5,6). Given the contact-intensive nature of kabaddi and the uneven playing surfaces involved, hamstring flexibility becomes even more vital for injury avoidance and functional performance enhancement (4).

Manual therapy techniques have long been employed to address flexibility limitations, particularly in the hamstrings. Among the emerging approaches, Bowen's Technique and Mulligan's Bent Leg Raise (BLR) Technique have gained considerable interest. Bowen's

Technique involves gentle, rolling movements over muscles and connective tissue, aimed at stimulating the autonomic nervous system to facilitate muscle relaxation and healing (14). It has been shown to be effective in improving flexibility and reducing musculoskeletal discomfort in various populations (13,19). On the other hand, Mulligan's BLR Technique, part of a broader manual therapy system, utilizes passive movements combined with sustained joint mobilization to enhance soft tissue extensibility and joint mechanics. It has demonstrated efficacy in improving hamstring flexibility, lumbar mobility, and functional performance, particularly in athletes and individuals with lower back complaints (10,16,24). However, despite their individual merits, limited studies have compared the effects of these two techniques on athletic populations, especially within the context of kabaddi, where movement patterns are unique and highly demanding (7,11).

While previous research has explored the application of these techniques in clinical populations—such as individuals with chronic low back pain or asymptomatic subjects with general hamstring tightness—there remains a significant gap in understanding how these interventions influence sport-specific flexibility and function in athletes like kabaddi players (18,26). Studies such as those by Khatri et al. and Adkitte et al. reported beneficial effects of Mulligan and Muscle Energy Techniques in runners and football players, but did not include sport-specific contextualization for kabaddi (8,9). Likewise, research by Kage et al. and Batool et al. demonstrated positive outcomes of Bowen and MET in non-athletic populations, yet lacked focus on sports that demand high functional load from the lower extremities (30,31). Furthermore, while both techniques have independently shown improvements in hamstring length and functional outcomes, there is insufficient evidence to determine their comparative efficacy in athletes performing at high intensity and under competitive pressure.

Considering the high incidence of hamstring-related injuries in kabaddi and the limited sports-specific literature evaluating these manual therapy interventions, this study aimed to fill a critical knowledge gap. By directly comparing the effects of Bowen's Technique and Mulligan's Bent Leg Raise Technique on hamstring flexibility, range of motion, and functional performance in kabaddi players with clinically identified hamstring tightness, this investigation sought to provide evidence-based recommendations for rehabilitation and performance enhancement strategies in this population. The findings of this study have the potential to assist clinicians and sports trainers in developing targeted interventions to mitigate injury risk and enhance performance in kabaddi athletes. Therefore, the research was designed as a randomized clinical trial to answer the primary question: Is there a significant difference between the effects of Bowen's Technique and Mulligan's Bent Leg Raise Technique on hamstring flexibility and functional capacity in kabaddi players with hamstring tightness? The study tested the null hypothesis that no significant difference exists between the two interventions regarding their impact on range of motion and function.

MATERIAL AND METHODS

This study was a prospective, randomized controlled trial conducted to compare the effects of Bowen's Technique and Mulligan's Bent Leg Raise Technique on hamstring flexibility and lower extremity function in kabaddi players presenting with hamstring tightness. The study was carried out from January 2024 to January 2025 after receiving ethical approval from the Research Ethical Committee of the Faculty of Rehabilitation and Allied Health Sciences, Riphah International University, Lahore. Male kabaddi players aged between 18 and 30 years were included if they exhibited hamstring tightness characterized by a 20° to 50° active knee extension loss with the hip positioned at 90° of flexion and demonstrated full passive range of knee extension, thus ruling out any joint pathology. Exclusion criteria encompassed a history of acute or chronic low back pain, recent injuries to the lower extremity within the past three months, spinal deformities, fractures or surgeries involving the back, pelvis, or lower limbs, recent abdominal surgeries, or any neurological conditions suggestive of a prolapsed intervertebral disc or radiating pain (12-17).

Participants were recruited from local kabaddi sports clubs under the jurisdiction of the Pakistan Sports Board, Lahore. A non-probability convenience sampling method was used, and participants were screened for eligibility against the defined inclusion and exclusion criteria. After explaining the study protocol in detail, written informed consent was obtained from each participant. Confidentiality was maintained through anonymized data coding, and participants were informed about their right to withdraw at any stage without penalty. Randomization was performed using a simple lottery method without replacement to allocate participants into two intervention groups. Group A received Bowen's Technique while Group B received Mulligan's Bent Leg Raise Technique. Participants were blinded to the treatment group to minimize performance bias (18).

The primary outcomes were changes in hamstring flexibility and functional capacity, assessed using the Active Knee Extension Test (AKET), Finger to Floor Test (FTF), and Sit and Reach Test (SAR). The secondary outcome was the improvement in overall lower limb function as measured by the Lower Extremity Functional Scale (LEFS), a validated questionnaire for assessing lower limb musculoskeletal function (29). All assessments were conducted at baseline and at the end of the six-week intervention period. The interventions were administered three to five times per week for six weeks. Each session lasted 20 minutes for Bowen's Technique and 15 minutes for Mulligan's BLR, delivered by trained physiotherapists with standardized protocols to ensure intervention fidelity. The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Ethical approval was granted by the institutional ethics committee, and all participants provided informed consent. Personal data confidentiality was upheld through secure digital storage with restricted access.

Data analysis was performed using SPSS version 27.0. Descriptive statistics were used to summarize demographic variables, with means and standard deviations for continuous data and frequencies for categorical variables. The Shapiro-Wilk test was used to assess the normality of distribution. Within-group comparisons of pre- and post-intervention outcomes were analyzed using paired t-tests, and between-group comparisons

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were analyzed using independent t-tests. A p-value of less than 0.05 was considered statistically significant.

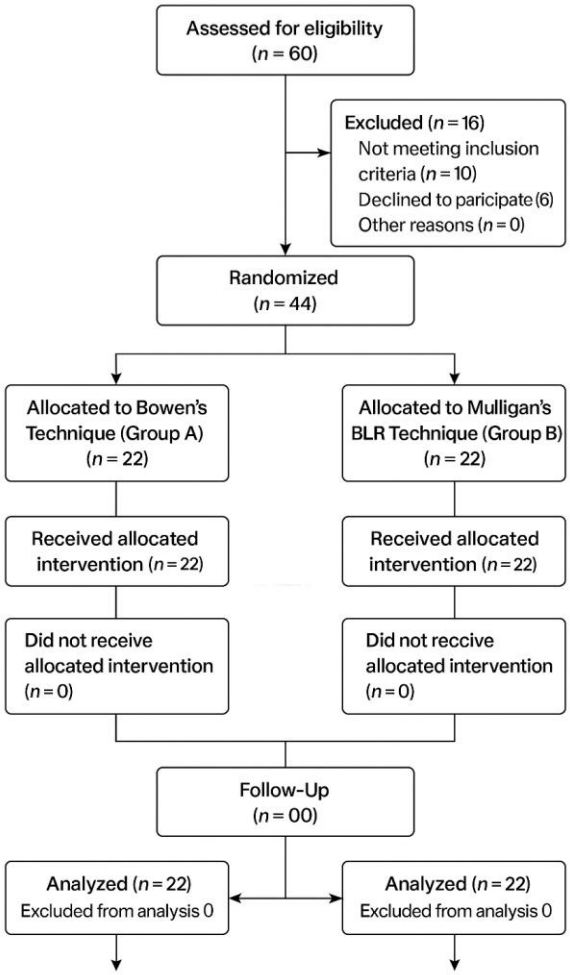

Figure 1 CONSORT Flowchart

Missing data were handled using pairwise deletion, and no imputation was necessary due to complete data availability at both time points. Potential confounding variables such as baseline flexibility and BMI were evaluated to ensure homogeneity between groups. Sensitivity analyses were not required due to the controlled randomization and balanced baseline characteristics.

RESULTS

The graphical comparison of demographic and anthropometric variables between the Bowen Technique and Mulligan's Bent Leg Raise (BLR) groups (Figure 1) illustrates closely matched distributions across key baseline metrics, ensuring comparability between groups. Mean age, weight, height, and BMI were similar, with only minor variations. Specifically, the Bowen group showed a mean age of 21.76 ± 2.89 years compared to 21.42 ± 3.08 years in the Mulligan group. Body weight and height were also nearly identical, with the Bowen group at 69.64 ± 4.82 kg and 175.19 ± 7.04 cm, and the Mulligan group at 70.21 ± 4.48 kg and 175.01 ± 8.97 cm, respectively. BMI values showed minimal difference: 22.42 ± 1.71 kg/m^2 (Bowen) vs 22.45 ± 1.01 kg/m^2 (Mulligan). The overlapping error bars and similar trend lines reinforce the equivalence of the groups at baseline, indicating that any post-intervention differences observed are more likely attributable to the treatment effects rather than pre-existing disparities.

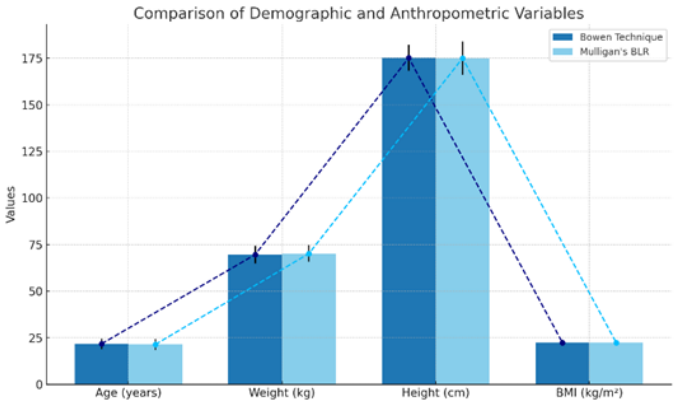

Figure 2 Demographics

The assumption of normality for all primary and secondary outcomes was verified using the Shapiro-Wilk test, summarized in Table 1. Results confirmed that all variables—including Active Knee Extension Test (AKET), Finger to Floor Test (FTF), Sit and Reach Test (SAR), and Lower Extremity Functional Scale (LEFS)followed a normal distribution ($p > 0.05$). This justified the use of parametric statistical methods for subsequent analyses. Baseline characteristics of participants, including demographic and anthropometric variables, are summarized in Table 2.

Table 1: Shapiro-Wilk Test for Normality

Variable	Statistic	df	p-value
AKET (Right Leg)	0.94	28	0.38
AKET (Left Leg)	0.79	28	0.75
FTF (Right Leg)	0.91	28	0.90
FTF (Left Leg)	0.95	28	0.97
SAR (Right Leg)	0.84	28	0.49
SAR (Left Leg)	0.90	28	0.58

Table 2: Demographic and Anthropometric Variables

Variable	Bowen Technique (Mean ± SD)	Mulligan's BLR (Mean ± SD)
Age (years)	21.76 ± 2.89	21.42 ± 3.08
Weight (kg)	69.64 ± 4.82	70.21 ± 4.48
Height (cm)	175.19 ± 7.04	175.01 ± 8.97
BMI (kg/m^2)	22.42 ± 1.71	22.45 ± 1.01

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No statistically significant differences were identified between the Bowen Technique and Mulligan's BLR groups ($p > 0.05$), indicating effective randomization and balanced groups at baseline. Participants in both intervention groups demonstrated significant improvements from baseline to post-intervention in all outcome measures, indicating enhanced hamstring flexibility and lower extremity function. The Bowen Technique group (Table 3) exhibited substantial improvements with significant increases in AKET for both legs (Right: 8.13°, Left: 6.09°), decreased distances in FTF (Right: 11.08 cm, Left: 11.94 cm), improved SAR scores (Right: 7.59 cm, Left: 8.19 cm), and increased LEFS scores (12.18 points). All results were statistically significant ($p < 0.001$).

Table 3: Within-Group Comparison – Bowen Technique

Variable	Pre-intervention (Mean ± SD)	Post-intervention (Mean ± SD)	Mean Difference	p-value
AKET (Right Leg)	30.43 ± 5.90	38.56 ± 4.40	8.13	<0.001
AKET (Left Leg)	36.81 ± 4.80	42.90 ± 3.71	6.09	<0.001
FTF (Right Leg)	16.72 ± 6.40	5.64 ± 4.31	11.08	<0.001
FTF (Left Leg)	18.30 ± 6.81	6.36 ± 4.63	11.94	<0.001
SAR (Right Leg)	14.63 ± 6.90	7.04 ± 4.50	7.59	<0.001
SAR (Left Leg)	15.95 ± 7.20	7.76 ± 4.70	8.19	<0.001
LEFS	64.46 ± 6.80	76.64 ± 8.70	12.18	<0.001

Similarly, the Mulligan's Bent Leg Raise group (Table 4) showed notable improvement with even greater increases in AKET scores (Right: 9.92°, Left: 8.16°), significant reductions in FTF distances (Right: 10.28 cm, Left: 11.00 cm), SAR enhancements (Right: 8.16 cm, Left: 8.60 cm), and functional gains as indicated by a LEFS increase of 14.28 points ($p < 0.001$). Baseline comparisons (Table 5) indicated no significant differences between Bowen and Mulligan groups across all measured outcomes, ensuring comparability at study initiation.

Table 4: Within-Group Comparison – Mulligan's Bent Leg Raise

Variable	Pre-intervention (Mean ± SD)	Post-intervention (Mean ± SD)	Mean Difference	p-value
AKET (Right Leg)	31.04 ± 6.30	40.96 ± 4.20	9.92	<0.001
AKET (Left Leg)	35.36 ± 4.92	43.52 ± 3.70	8.16	<0.001
FTF (Right Leg)	16.00 ± 9.38	5.72 ± 4.20	10.28	<0.001
FTF (Left Leg)	17.36 ± 9.69	6.36 ± 4.51	11.00	<0.001
SAR (Right Leg)	15.20 ± 8.75	7.04 ± 4.68	8.16	<0.001
SAR (Left Leg)	16.32 ± 9.03	7.72 ± 4.94	8.60	<0.001
LEFS	66.37 ± 6.40	80.65 ± 8.10	14.28	<0.001

Table 5: Baseline Between-Group Comparison

Variable	Bowen (Pre) Mean ± SD	Mulligan (Pre) Mean ± SD	p-value
AKET (Right Leg)	30.43 ± 5.90	31.04 ± 6.30	0.357
AKET (Left Leg)	36.81 ± 4.80	35.36 ± 4.92	0.748
FTF (Right Leg)	16.72 ± 6.40	16.00 ± 9.38	0.902
FTF (Left Leg)	18.30 ± 6.81	17.36 ± 9.69	0.973
SAR (Right Leg)	14.63 ± 6.90	15.20 ± 8.75	0.485
SAR (Left Leg)	15.95 ± 7.20	16.32 ± 9.03	0.577
LEFS	64.46 ± 6.80	66.37 ± 6.40	0.322

Post-intervention comparison (Table 6) revealed a significant advantage for the Mulligan group in right-leg AKET ($p < 0.05$). No other significant differences were identified, suggesting both interventions similarly enhanced functional and flexibility outcomes. Clinically, both interventions provided meaningful improvements, though Mulligan's technique showed slight superiority in right-leg flexibility.

Table 6: Post-Intervention Between-Group Comparison

Variable	Bowen (Post) Mean ± SD	Mulligan (Post) Mean ± SD	p-value
AKET (Right Leg)	38.56 ± 4.40	40.96 ± 4.20	<0.050
AKET (Left Leg)	42.90 ± 3.71	43.52 ± 3.70	0.427
FTF (Right Leg)	5.64 ± 4.31	5.72 ± 4.20	0.947
FTF (Left Leg)	6.36 ± 4.63	6.36 ± 4.51	1.010
SAR (Right Leg)	7.04 ± 4.50	7.04 ± 4.68	0.446
SAR (Left Leg)	7.76 ± 4.70	7.72 ± 4.94	0.491
LEFS	76.64 ± 8.70	80.65 ± 8.10	0.235

DISCUSSION

This study investigated the comparative efficacy of Bowen's Technique and Mulligan's Bent Leg Raise (BLR) Technique in improving hamstring flexibility and lower limb function in kabaddi players diagnosed with hamstring tightness. Both interventions significantly improved flexibility, range of motion, and functional outcomes, with the Mulligan technique demonstrating a marginally superior effect on active knee extension on the dominant leg. These findings align with previous research highlighting the effectiveness of manual therapies for musculoskeletal flexibility and function (8, 12).

Our results corroborate those of Batool et al. (30), who compared Bowen Technique and Muscle Energy Technique (MET) in individuals with chronic low back pain, demonstrating significant improvements in hamstring flexibility, although without marked differences between groups. Similar to Batool et al., the current study noted substantial within-group improvements in both interventions, underscoring Bowen's Technique as a viable method to enhance hamstring flexibility, despite the slightly stronger gains observed with Mulligan's BLR. These findings reinforce Bowen's potential for widespread clinical application, particularly for athletes requiring rapid flexibility enhancement without invasive techniques (12-16).

In contrast, a randomized clinical trial by Kage et al. (31) comparing Bowen Technique and MET in asymptomatic participants reported superior flexibility improvements with Bowen. However, our investigation found Mulligan's BLR marginally superior, particularly concerning right-leg active knee extension. Such differences could be attributed to the specific demands and muscular adaptations associated with high-intensity sports like kabaddi, where unilateral movements and repetitive dynamic loading may respond differently to targeted mobilization methods. Mechanistically, Mulligan's BLR combines passive joint mobilization with active-assisted neuromuscular facilitation, optimizing joint mechanics and increasing proprioceptive feedback, potentially explaining its slight advantage over Bowen Technique in functional gains (10,16). Bowen's Technique, emphasizing soft-tissue manipulation and autonomic modulation, improves flexibility primarily via neuromuscular relaxation, fascial hydration, and altered muscle spindle sensitivity (14,18). The integration of proprioceptive and joint-mobilization elements in Mulligan's approach likely facilitated more immediate neuromuscular adaptations relevant to functional performance in athletes (25-29).

Clinically, the significant improvements in both interventions underscore their utility in rehabilitation and preventive training programs, especially in sports demanding substantial flexibility and rapid directional changes. Although Mulligan's BLR demonstrated marginally superior flexibility gains, Bowen's gentler approach could be preferentially employed when treating athletes who require less aggressive tissue manipulation or when acute pain sensitivity limits aggressive manual therapy.

This study contributes to existing literature by specifically evaluating kabaddi players—a population underrepresented in rehabilitation research despite high physical demands and frequent lower extremity injuries (2,3). Prior studies, such as Khatri et al. (32), demonstrated that Mulligan techniques significantly enhance flexibility in marathon runners, supporting our findings regarding the positive impact of Mulligan's BLR on hamstring flexibility. However, our research advances previous knowledge by directly comparing this technique against Bowen Technique in a sport-specific context, thus offering tailored insights beneficial for clinicians and coaches managing athletes involved in similar high-intensity, intermittent sports. Despite the promising outcomes, several limitations warrant acknowledgment. Firstly, the sample size was relatively small, potentially limiting statistical power and generalizability. A larger cohort would provide more robust conclusions, particularly regarding subtle functional differences observed between techniques. Furthermore, the study lacked long-term follow-up assessments, restricting insights into the sustainability of observed improvements. Additionally, only male kabaddi players were included, limiting generalization to females or athletes from other sports (17-24).

Future research should address these limitations by employing larger, gender-inclusive samples and extended follow-up durations to evaluate long-term efficacy and maintenance of hamstring flexibility gains. Moreover, future investigations could explore combining Bowen and Mulligan techniques, potentially yielding synergistic effects beneficial for injury prevention and rehabilitation strategies. The incorporation of biomechanical assessments, such as kinetic and kinematic analyses, may further elucidate underlying mechanisms and refine therapeutic applications, enhancing tailored recommendations for sports-specific rehabilitation protocols. Both Bowen Technique and Mulligan's Bent Leg Raise significantly improved hamstring flexibility and lower limb functional outcomes among kabaddi athletes. Mulligan's technique demonstrated slightly superior outcomes in dominant leg flexibility, suggesting particular suitability for sports with unilateral dynamic demands. These findings highlight the clinical importance of manual therapy techniques in athletic training programs, emphasizing personalized interventions based on sport-specific performance demands and individual athlete needs (3, 7, 29).

CONCLUSION

This study concluded that both Bowen's Technique and Mulligan's Bent Leg Raise Technique significantly improved hamstring flexibility, range of motion, and lower limb function in kabaddi players with hamstring tightness, with Mulligan's technique demonstrating slightly superior results in enhancing active knee extension, particularly in the dominant leg. These findings imply that manual therapy interventions, especially Mulligan's BLR, could be strategically integrated into rehabilitation and preventive care programs to enhance athletic performance and reduce injury risk in sports demanding high flexibility and agility, such as kabaddi. Clinically, both techniques offer non-invasive, effective therapeutic options, highlighting the importance of individualized treatment approaches based on specific functional needs. Further research should investigate long-term sustainability of these benefits, the combined effects of different manual therapy approaches, and their biomechanical impacts in broader athletic populations.

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