International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Effects of Plyometric Training and Shoulder Muscle Strengthening Exercises in Improving Shoulder Stability among Badminton Players: A Case Study

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ABSTRACT

Background: Badminton is an overhead sport which can cause mechanical stress on the shoulder joint because of repetitive movements such as smashes, clears, and serves. Repeated overhead activity can reduce dynamic shoulder stability, reduced neuromuscular control, and can affect sports performance. Physiotherapy interventions combining plyometric training with shoulder muscle strengthening may enhance shoulder stability and improve functional performance among badminton player.

Objective: To evaluate the effectiveness of a six-week physiotherapy intervention combining plyometric training and shoulder muscle strengthening exercises in improving shoulder stability and upper-limb functional performance in a recreational badminton player.

Methodology: A single case study was conducted on a 23-year-old recreational badminton player who was presented with reduced shoulder stability and fatigue while performing repeated overhead movements. Shoulder stability and upper-limb performance were assessed using the Closed Kinetic Chain Upper Extremity Stability Test (CKCUEST) and Plate Tapping Test (PTT). The participant underwent a supervised six-week physiotherapy intervention consisting of plyometric training and shoulder strengthening exercises, given 3‑4 sessions per week. Pre- and post-intervention outcomes were compared to evaluate the effectiveness of the intervention.

Results: Following the intervention, the CKCUEST score improved from 20 to 24 repetitions, indicating enhanced dynamic shoulder stability and upper-limb endurance. The Plate Tapping Test time improved from 14.0 seconds to 11.8 seconds, reflecting better speed, coordination, and neuromuscular performance. The participant also reported improved confidence during overhead strokes and reduced fatigue while playing badminton.

Conclusion: This case study showed a combined effect of upper-limb plyometric training and shoulder muscle strengthening exercises may improve dynamic shoulder stability, coordination, and functional performance in recreational badminton players. Further studies involving larger sample sizes are recommended to confirm these findings.

Keywords: Badminton, Case study, Plyometric training, Shoulder strengthening, Shoulder stability, CKCUEST, Plate Tapping Test.

INTRODUCTION

Badminton is one of the most physically demanding racket sports, requiring players to perform repeated overhead strokes, rapid directional changes, jumping, lunging, and high-speed movements throughout a match. These activities place considerable demands on the upper extremity, particularly the shoulder complex, which must generate power while maintaining stability and movement precision. Because of the repetitive overhead actions involved in badminton, shoulder-related problems are frequently encountered and may negatively influence both athletic performance and participation in the sport [1].

The shoulder joint is designed to provide exceptional mobility, allowing a wide range of upper-limb movements required during sporting activities. Unlike many other joints, its stability relies less on bony congruency and more on coordinated function of static structures, including the capsule, ligaments, and glenoid labrum, together with dynamic stabilizers such as the rotator cuff and scapular muscles. Efficient neuromuscular control of these structures is essential to maintain proper positioning of the humeral head during overhead movements. Disturbances in muscle strength, proprioception, or coordinated muscle activation can alter shoulder mechanics and increase the likelihood of injury [2,3,15].

Regular participation in badminton exposes the shoulder to repeated high-velocity loading. Over time, these repetitive forces may result in muscular fatigue, weakness of the rotator cuff, altered scapular movement, impaired proprioception, and reduced dynamic stability. Such alterations may decrease stroke effectiveness, reduce accuracy and power, and increase susceptibility to overuse injuries. Consequently, maintaining adequate shoulder stability has become an important objective in rehabilitation program as well as in strategies aimed at preventing sports-related injuries [2,4].

Exercise-based rehabilitation plays a vital role in restoring shoulder function in overhead athletes. Among the available interventions, plyometric training has been widely used to improve explosive strength, rapid muscle activation, and neuromuscular efficiency through the stretch-shortening cycle. Upper-limb plyometric exercises, including medicine ball throws, wall dribbling, and plyometric push-ups, replicate the fast and forceful movements commonly performed during badminton play, making them particularly relevant for sport-specific rehabilitation [5,6].

Strengthening exercises are equally important for improving the functional capacity of the shoulder. Progressive resistance training directed at the rotator cuff, deltoid, serratus anterior, and scapular stabilizers enhances muscular strength, endurance, and coordinated movement while promoting better control of the glenohumeral joint during repetitive overhead tasks. Improved muscular support contributes to efficient biomechanics and reduces unnecessary stress on the shoulder during sporting activities [4,15].

Combining strengthening exercises with plyometric training may provide additional functional benefits by addressing multiple components of shoulder performance simultaneously. Resistance exercises primarily improve muscular capacity and joint support, whereas plyometric exercises enhance movement speed, neuromuscular responsiveness, and explosive force production. The integration of these two approaches may therefore optimize dynamic shoulder stability, improve upper-limb function, and enhance badminton-specific performance [5,6,7,10].

Previous research has showed outcomes following plyometric and strengthening programmes in overhead athletes, including improvements in agility, neuromuscular control, balance, and functional performance. But the published evidence specifically describing the combined application of these interventions in an individual badminton player remains limited. A detailed case study can provide an important clinical information about the assessment, treatment and rehabilitation outcomes in sports physiotherapy [7–14].

Therefore, the present case study was undertaken to examine the effectiveness of a six-week physiotherapy intervention consisting of upper-limb plyometric training and progressive shoulder strengthening exercises in improving dynamic shoulder stability and functional performance in a recreational badminton player. The effectiveness of the intervention was evaluated using the Closed Kinetic Chain Upper Extremity Stability Test (CKCUEST) and the Plate Tapping Test before and after the intervention [8,10].

Case Presentation

A 23-year-old male recreational badminton player presented to the Physiotherapy Department with complaints of difficulty performing repetitive overhead smashes during badminton. The symptoms had gradually developed over several weeks and was associated with reduced upper-limb performance, particularly during high-intensity smashes. The patient reported a feeling of shoulder weakness while executing overhead strokes, which affected his overall playing performance. There was no history of acute trauma, shoulder dislocation, fracture, or previous shoulder surgery. The patient had been playing badminton regularly for more than one year and participated in recreational practice sessions several times per week.

The patient was medically stable and had no history of neurological disorders, inflammatory joint disease, or other musculoskeletal conditions affecting the upper limb. Based on the clinical history and physical examination, the patient had the eligibility criteria for physiotherapy intervention.

Clinical Examination

The initial physiotherapy assessment included observation, functional evaluation, and standardized outcome measures. Visual inspection revealed no obvious deformity, swelling, or muscle wasting around the shoulder complex. Mild reduction in dynamic shoulder control was observed during repeated overhead movements. Functional performance was affected mainly during forceful smashes and sustained overhead activities.

Dynamic shoulder stability was assessed using the Closed Kinetic Chain Upper Extremity Stability Test (CKCUEST), while upper-limb speed and coordination were evaluated using the Plate Tapping Test (PTT).

Baseline assessment demonstrated:

Outcome Measures	Pre intervention
Closed Kinetic Chain Upper Extremity Stability Test (CKCUEST)	20 repetitions
Plate Tapping Test	14.0 seconds

The findings indicated reduced upper-extremity stability, coordination, and movement efficiency during functional activities.

Clinical Impression

Based on the subjective history and physical examination, the patient demonstrated impaired dynamic shoulder stability during overhead activities, along with decreased neuromuscular control, upper-limb coordination, and movement speed. Repetitive movements particularly overhead smashes, were associated with early fatigue and reduced functional efficiency. These findings indicated reduced shoulder

performance affecting sport-specific activities. In accordance with the assessment findings, a structured six-week physiotherapy rehabilitation program consisting of progressive shoulder strengthening and upper-limb plyometric exercises was developed to improve dynamic shoulder stability, improve neuromuscular control and coordination, increase muscular endurance, and optimize functional performance while playing badminton.

Physiotherapy Intervention

Following the baseline assessment, the patient underwent a supervised physiotherapy intervention for 6 weeks, with 3–4 sessions per week. Each session lasted approximately 30–40 minutes. The rehabilitation combined upper-limb plyometric training with progressive shoulder muscle strengthening exercises to improve dynamic shoulder stability, neuromuscular control, muscular strength, and functional performance during badminton-specific activities.

The exercise program was individualized according to the patient's tolerance, and progression was introduced gradually to maintain exercise quality and prevent fatigue. Adequate rest periods were provided between sets.

Table 1. Physiotherapy Intervention Protocol

Exercises	Dosage	Purpose
Medicine Ball Chest Pass	8–10 repetitions × 2–3 sets	Improve upper-limb power and explosive strength
Overhead Medicine Ball Throw	8–10 repetitions × 2–3	Enhance overhead power and shoulder stability
Plyometric Push-ups	6–8 repetitions × 2	Improve neuromuscular control and dynamic stability
Wall Dribbling with Medicine Ball	15–20 seconds × 3 sets	Improve proprioception and coordination
Isometric Rotator Cuff Exercises	5–10 seconds, 8–10 repetitions	Activate rotator cuff muscles and improve joint stability
Theraband Internal Rotation	10–15 repetitions × 2–3 sets	Strengthen internal rotators
Theraband External Rotation	Rotation10–15 repetitions × 2–3 sets	Strengthen external rotators
Scapular Stabilization Exercises	10 repetitions × 2–3 sets	Improve scapular control
Wall Push-ups	10 repetitions × 2–3 sets	Enhance closed-chain shoulder stability

Dumbbell Shoulder Strengthening	10–12 repetitions × 2–3 sets	Improve overall shoulder muscle strength
Prone Y, T and W Exercises	8–10 repetitions × 2 sets	Strengthen lower trapezius and rhomboids
Serratus Punches	10–15 repetitions × 2–3 sets	Improve serratus anterior activation
Closed Kinetic Chain Weight-bearing Exercises	According to tolerance	Improve functional shoulder stability

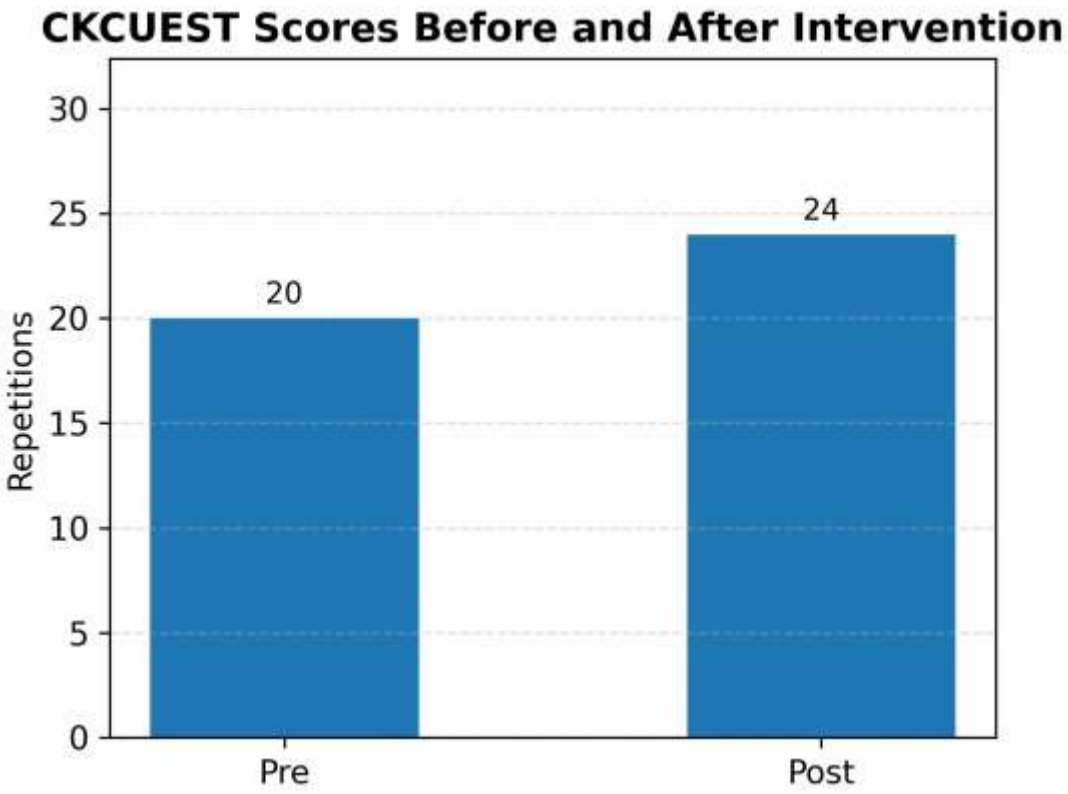
Exercise intensity was progressively increased throughout the rehabilitation period based on the patient's tolerance. All treatment sessions were supervised by a physiotherapist to ensure correct exercise technique, appropriate progression, and patient safety.

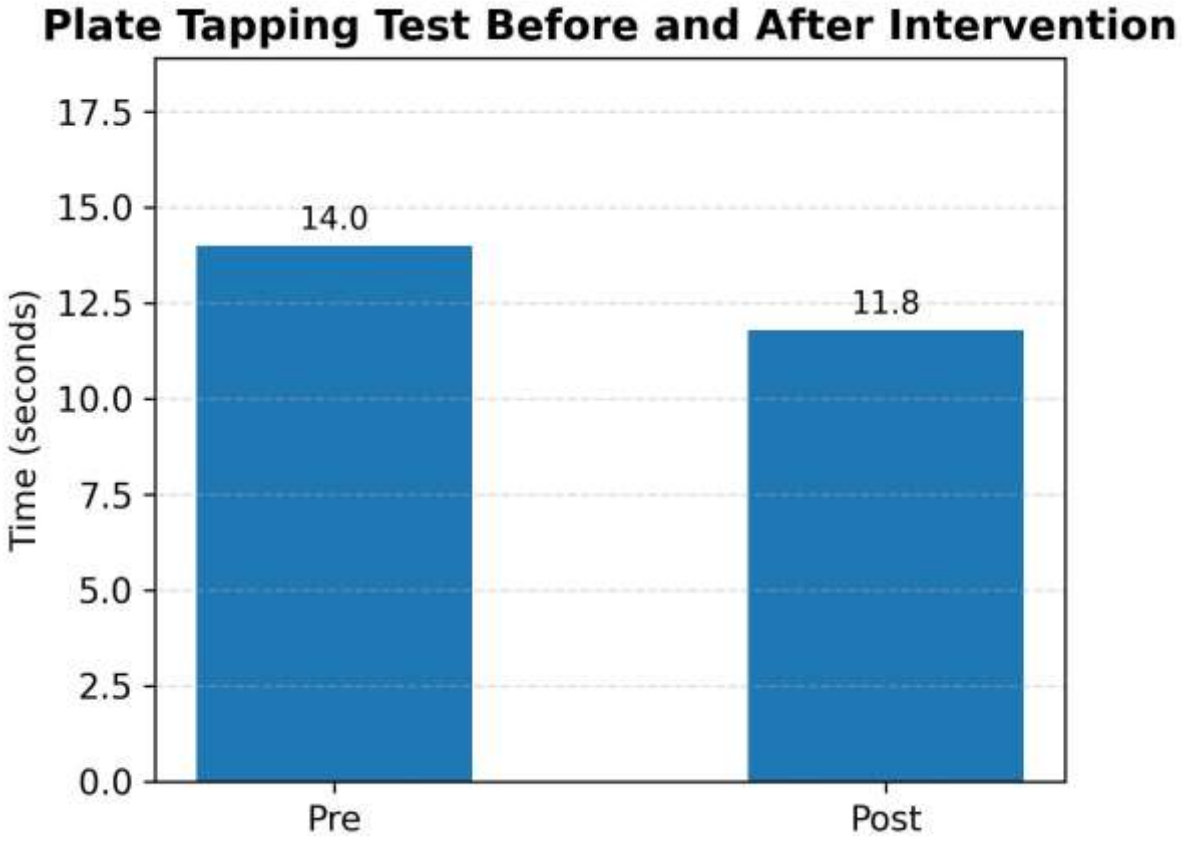
Results

The patient completed the six-week intervention program and demonstrated good compliance throughout the rehabilitation period. Post-intervention assessment showed improvements in both outcome measures.

Table 2. Pre- and Post-intervention Outcome Measures

Outcome measures	Pre intervention	Post intervention
Closed Kinetic Chain Upper Extremity Stability Test (CKCUEST)	20 repetitions	24 repetitions
Plate Tapping Test	14 seconds	11.8 sec





Following the intervention, the CKCUEST score improved by 4 repetitions, indicating enhanced upper-extremity dynamic stability and functional endurance. Similarly, the Plate Tapping Test time decreased by 2.2 seconds, reflecting improvements in upper-limb speed, coordination, and neuromuscular performance.

Clinically, the patient reported greater confidence while performing overhead smashes, reduced fatigue during prolonged play, and improved overall badminton performance. No pain or complications were reported during the intervention period.

DISCUSSION

The present case study is about a 23 year old male badminton player who was presented with difficulty in performing repetitive overhead smashes. Post intervention assessment was taken using CKCUEST score and plate tapping test. The CKCUEST score showed 20 rep and the plate tapping test score was 14 sec. A 6 week physiotherapy intervention was stared which included upper limb plyometric training and shoulder strengthening exercises which was given for 30-40 min per day, 3-4 session per week. After 6 weeks post intervention assessment was taken using CKCUEST and plate taping test. CKCUEST score improved from 20 rep to 22 rep and in plate taping test time was reduced from 14 sec to 11 sec. The post intervention score showed a an improvement in dynamic shoulder stability and upper limb strength which has helped to reduce fatigue during overhead smashes

Shoulder joint players an important role in badminton as it includes repetitive overhead movements. In badminton players repeated smashes can produce early fatigue and reduced confidence among the players Badminton players often present with reduced dynamic stability and poor neuromuscular control which can reduce the quality of overhead smashes often leading to early fatigue. Thus restoring these components are important to improve functional performance among badminton players.

Upper limb plyometric training were given which focused on improving movement speed and neuromuscular responsiveness. Upper limb plyometric training involve medicine ball throws, wall dribbles, plyometric push ups which helps in muscle activation similar to that is needed during badminton strokes

Along with plyometric for the upper limb shoulder strengthening exercises were also given which include isometrics of rotator cuff muscle, serratus punches, theraband exercises and dumbell shoulder strengthening. As the treatment progressed the patient demonstrated a good improvement which was reflected in CKUEST score and plate tapping test this leads the conclusion that improving shoulder muscle strength and endurance can improve dynamic shoulder stability during repeated overhead movements.

From this study we observed that combining plyometric training and shoulder strenghtening exercises was able to produce a more functional outcome compared to intervention that only include muscle strengthening. An improved muscular support and improved neuromuscular control can contribute to a better performance in badminton players. Similar studied have be reported where the result showed an improvement in shoulder function and sports performance

Although patient responded positively to the intervention, this study have several limitation. As this was a case study the findings are based on a single individual badminton players and therefore cannot be generalized to all badminton players. Other outcome measures such as muscle strength testing, pain assessment, range of motion were not included in this study, future study which include larger population and randomized control trail study design are needed to be performed to provide a stronger evidence regarding the combined effects of plyometric training and shoulder strengthening exercises in improving shoulder stability among badminton players.

Conclusion

This case study demonstrates that a six-week intervention combining upper-limb plyometric training with shoulder muscle strengthening exercises that effectively improved dynamic shoulder stability, upper-limb coordination, and functional performance in a 23 year old recreational badminton player. Improvements in CKCUEST and Plate Tapping Test scores suggest enhanced neuromuscular control and improved dynamic stability of shoulder. Combined plyometric and strengthening exercises may therefore be considered an effective physiotherapy intervention for badminton players experiencing functional shoulder instability. Further studies involving larger populations and long-term follow-up are required to confirm these findings.

Acknowledgement

The authors express their sincere gratitude to the participant for willingly participating in this case study. The authors also thank the Department of Physiotherapy, Laxmi Memorial College of Physiotherapy, Mangalore, for providing the facilities and support required to complete this work. Special thanks are extended to Dr. Chaithra B. Shetty for her valuable guidance and continuous encouragement throughout the preparation of this manuscript.

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