Majalah Ilmiah Fisioterapi Indonesia
Indonesian Scientific Journal of Physiotherapy

Case Reports / Case Studies
ISSN (Print): 2303-1921
ISSN (Online): 2722-0443
Volume 14, Number 2, Pages 535-538 (2026)
DOI: https://doi.org/10.24843/mifi.000001822

Physiotherapy Exercise in Osgood–Schlatter Disease: A Case Report

Kusumandari Nur Shafana[1], Suryo Saputra Perdana[2], Hakny Kusuma Maulana Arkan[3]

[1]Physiotherapist Professional Education Program, Faculty of Health Sciences, Universitas Muhammadiyah Surakarta, Surakarta, Central Java, Indonesia
[2]Department of Physiotherapy, Faculty of Health Sciences, Universitas Muhammadiyah Surakarta, Surakarta, Central Java, Indonesia
[3]Physiotherapist, Klinik Kala Rehab, Surakarta, Central Java, Indonesia

Corresponding author:
Suryo Saputra Perdana
Email: ssp741@ums.ac.id
Phone: +62-813-8662-5585

Received 15 April 2026; Revised 20 April 2026; Accepted 21 April 2026; Published 17 May 2026

Abstract

Background: Osgood–Schlatter Disease (OSD) is a traction apophysitis of the tibial tuberosity commonly occurring in physically active adolescents, particularly in sports involving repetitive jumping and rapid directional changes. This condition may lead to anterior knee pain and functional limitations.

Objective: To describe the clinical outcomes of a structured physiotherapy exercise program in a badminton athlete with OSD.

Methods: A case report was conducted on a 14-year-old male badminton athlete diagnosed with OSD in the progressive loading phase. The patient underwent six physiotherapy sessions over two weeks. The intervention included functional and plyometric exercises such as runner's climb exercise, single-leg squat, squat jumps, box jumps, single-leg hop, and speed skaters. Outcome measures included pain intensity using the Visual Analog Scale (VAS), knee range of motion (ROM), muscle strength assessed by Manual Muscle Testing (MMT), and functional performance using the Kujala Anterior Knee Pain Scale.

Results: Pain decreased from VAS 1 (palpation) and 2 (movement) to 0 and 1, respectively. Knee flexion improved from 110° to 125°, while muscle strength remained at 5/5. Functional performance increased, with the Kujala score improving from 65 to 76 points.

Conclusion: A structured physiotherapy program incorporating functional and plyometric exercises may improve pain, joint mobility, and functional performance in adolescents with OSD. Findings should be interpreted cautiously due to the single-case design.

Keywords

Osgood-Schlatter Disease; Exercise Therapy; Knee Pain; Rehabilitation; Return to Sport; Plyometric Training

Introduction

Osgood–Schlatter Disease (OSD) is one of the most common causes of anterior knee pain in physically active adolescents, particularly during periods of rapid growth.[1] This condition is characterized by traction apophysitis at the tibial tuberosity due to repetitive mechanical loading from the patellar tendon.[1] It predominantly affects individuals aged 10–15 years who participate in sports involving running, jumping, and rapid changes of direction, such as badminton.[2] The repetitive stress imposed on the immature skeletal structure during growth spurts increases susceptibility to microtrauma, inflammation, and pain at the tibial tuberosity.[1]

Although OSD is generally considered a self-limiting condition, its clinical course may vary substantially among individuals.[1,3] A proportion of adolescents experience persistent symptoms that extend beyond the expected recovery period, leading to prolonged pain, reduced functional capacity, and limitations in sports participation.[4] In such cases, unresolved symptoms may interfere with neuromuscular performance, including deficits in quadriceps strength, altered movement patterns, and reduced dynamic stability, all of which can compromise athletic performance and increase the risk of further injury.[5,6] Therefore, appropriate management strategies are essential to optimize recovery and facilitate a safe return to sport.

Current conservative management of OSD emphasizes activity modification, therapeutic exercise, and progressive loading strategies.[2] Exercise-based physiotherapy interventions typically include flexibility training, muscle strengthening, and neuromuscular control exercises targeting the lower extremity.[7,8] Recent evidence highlights the importance of load management combined with progressive strengthening to improve pain and functional outcomes in adolescents with OSD.[1] Furthermore, the incorporation of functional and sport-specific exercises, including plyometric training, has been increasingly recognized as a key component in advanced rehabilitation phases to restore dynamic performance and readiness for return to sport.[2,9]

Despite growing evidence supporting exercise-based interventions, the majority of existing studies focus on early-stage management or general conservative approaches.[10] There remains limited clinical evidence describing physiotherapy management in the later stages of OSD, particularly during the progressive loading phase (phase IV), where the primary rehabilitation goals shift toward restoring high-level functional performance and sport-specific capacity.[10,11] In addition, reports detailing the integration of structured plyometric training within physiotherapy programs for adolescent athletes with OSD are still scarce.[10] This gap highlights the need for clinically relevant case-based evidence to inform advanced rehabilitation strategies tailored to sport-specific demands.

This case report describes the physiotherapy management of a 14-year-old badminton athlete with Osgood–Schlatter Disease in the progressive loading phase. The intervention focused on a structured program combining functional strengthening and plyometric exercises aimed at improving neuromuscular control, endurance, and sport-specific performance. The objective of this study was to describe the clinical outcomes of this intervention in terms of pain reduction, joint mobility, and functional performance.

Methods

This study was designed as a single-patient case report and reported in accordance with the CARE (CAse REport) guidelines to ensure clarity and transparency in clinical reporting. The study describes the physiotherapy management of an adolescent badminton athlete diagnosed with Osgood–Schlatter Disease (OSD) in the progressive loading phase (phase IV).

The patient was a 14-year-old male competitive badminton athlete who presented with anterior knee pain localized at the tibial tuberosity. The initial onset of symptoms occurred approximately one year prior to the current intervention, with a confirmed diagnosis established through clinical examination and plain radiography (X-ray), demonstrating fragmentation of the tibial tuberosity consistent with OSD. At the time of assessment, the patient had undergone prior conservative management and had been in the progressive loading phase for approximately three months.

Baseline clinical assessment revealed mild intermittent pain, particularly after high-intensity activity. Pain intensity was measured using the Visual Analog Scale (VAS), a widely used and reliable instrument for subjective pain assessment in musculoskeletal conditions.[12] Knee joint range of motion (ROM) was assessed using a universal goniometer with established reliability.[13] Muscle strength of the quadriceps and hamstring was evaluated using Manual Muscle Testing (MMT), a standardized clinical tool for gross muscle strength assessment.[14] Functional performance was assessed using the Kujala Anterior Knee Pain Scale, a validated patient-reported outcome consisting of 13 items with a maximum score of 100.[15] Additional functional tests included single-leg hop and lunge tests to assess pain provocation and dynamic performance.

The physiotherapy intervention was conducted over six sessions within a two-week period, with a frequency of three sessions per week. Each session lasted approximately 45–60 minutes. The intervention consisted of a structured program of functional strengthening and plyometric exercises, including runner's climb exercise, single-leg squat, double-leg squat jumps, double-leg box jumps (up/down), single-leg hop (up/down), and speed skaters. Exercise intensity was progressively increased based on patient tolerance, movement quality, and pain response, with pain maintained at ≤3/10 on the VAS during exercise.[12,16] To enhance reproducibility and clarity, the sequence of clinical events from onset to follow-up is summarized in Table 1.

Table 1. Clinical Timeline of the Patient

Phase	Description
Initial onset	Knee pain began approximately 1 year prior due to sports activity
Medical diagnosis	Diagnosed with OSD via clinical examination and X-ray
Early management	Underwent conservative management (rest and basic therapy)
Progressive phase	Entered phase IV (progressive loading) approximately 3 months prior
Baseline assessment (T1–T2)	Initial evaluation before structured physiotherapy
Intervention period	Six physiotherapy sessions over 2 weeks
Follow-up (T3–T4)	Ongoing evaluation during and after intervention

Outcome evaluations were performed at four time points to monitor clinical progression. The interval between assessments was approximately 3–4 days. A summary of outcome measures and evaluation schedule is presented in Table 2.

Table 2. Outcome Measures and Evaluation Schedule

Time Point	Timing	Outcome Measures
T1	Baseline	VAS, ROM, MMT, Kujala Score
T2	Pre-intervention confirmation	VAS, ROM, MMT, Kujala Score
T3	Mid-intervention	VAS, ROM, MMT, Kujala Score
T4	Post-intervention	VAS, ROM, MMT, Kujala Score

Note: VAS = Visual Analog Scale; MMT = Manual Muscle Testing; ROM = Range of Motion

A clinically meaningful improvement was operationally defined as a reduction in pain intensity and an increase in functional score across evaluation points. A clinically meaningful improvement was operationally defined as a reduction in pain intensity of at least 1 point on the Visual Analog Scale (VAS) and an increase in the Kujala score based on previously reported minimal clinically important difference (MCID) thresholds.Data analysis was performed descriptively by comparing changes in outcome measures across time points without inferential statistical testing, consistent with the nature of a single-case report.

Results

Clinical outcomes were assessed across four evaluation time points (T1–T4) to describe changes in pain intensity, joint range of motion, muscle strength, and functional performance following the physiotherapy intervention. The detailed quantitative findings are presented in Table 3.

Table 3. Clinical Outcomes Across Evaluation Time Points

Variable	Measurement	T1	T2	T3	T4
Pain (VAS)	Palpation	1	1	1	0
	Movement	2	2	1	1
Muscle Strength (MMT)	Knee flexors	5/5	5/5	5/5	5/5
	Knee extensors	5/5	5/5	5/5	5/5
Range of Motion (ROM)	Knee flexion (°)	110	115	120	125
Functional Score	Kujala Score (points)	65	70	74	76

Note: VAS = Visual Analog Scale; MMT = Manual Muscle Testing; ROM = Range of Motion

As presented in Table 3, the observed clinical outcomes demonstrate gradual changes across the evaluation period. Pain intensity measured using the Visual Analog Scale (VAS) showed a reduction in both palpation and movement-related pain. Pain on palpation remained stable at a score of 1 from T1 to T3 and decreased to 0 at T4, while pain during movement decreased from a score of 2 at T1 and T2 to 1 at T3 and T4. Muscle strength, assessed using Manual Muscle Testing (MMT), remained consistently at a maximal score of 5/5 for both knee flexors and extensors throughout all time points, indicating that no observable change occurred in gross muscle strength during the intervention period.

In contrast, knee joint range of motion demonstrated a progressive increase in flexion, improving from 110° at T1 to 125° at T4. Similarly, functional performance measured using the Kujala Anterior Knee Pain Scale increased incrementally across all evaluation points, from 65 points at baseline to 76 points at the final assessment. To provide a clearer overview of the direction and pattern of change across all variables, the progression of outcomes over time is summarized in Table 4.

Table 4. Summary of Clinical Progression Across Time Points

Variable	Trend Pattern	Description
Pain (VAS)	Decreasing	Gradual reduction in both palpation and movement-related pain, with complete resolution of palpation pain at T4
ROM (knee flexion)	Increasing	Continuous improvement in knee flexion across all time points
Muscle Strength (MMT)	Stable	Maintained at maximal value (5/5) throughout the intervention
Kujala Score	Increasing	Progressive improvement in functional performance from T1 to T4

All outcomes are presented descriptively to reflect changes observed during the intervention period, without the application of inferential statistical analysis, in accordance with the single-case study design. The observed increase in the Kujala score from 65 to 76 points represents an improvement of 11 points, which approaches or exceeds the minimal clinically important difference (MCID) reported for anterior knee pain populations.

Discussion

This case report describes the clinical course of an adolescent badminton athlete with Osgood–Schlatter Disease (OSD) in the progressive loading phase following a structured physiotherapy program incorporating functional strengthening and plyometric exercises. The findings indicate improvements in pain intensity, knee range of motion, and functional performance over the intervention period, while muscle strength remained stable at a maximal level. These results highlight the role of targeted exercise-based rehabilitation in addressing residual symptoms and functional limitations during the later stages of OSD recovery.

The observed reduction in pain intensity may be explained by the application of progressive loading principles and controlled exercise dosage. In this case, exercise intensity was regulated to maintain pain levels within a tolerable range (≤3/10 on the VAS), which aligns with current recommendations for load management in tendon-related conditions.[2,10,16] Previous studies have demonstrated that appropriately dosed mechanical loading can promote tissue adaptation, reduce nociceptive sensitivity, and improve load tolerance in adolescents with OSD. [2,10] The gradual reduction in both palpation and movement-related pain observed in this report is consistent with these mechanisms, suggesting that symptom-guided exercise progression may be effective in modulating pain during rehabilitation.

The improvement in knee joint range of motion (ROM) observed across the intervention period may be associated with reduced pain inhibition and enhanced neuromuscular coordination. Although ROM was not initially restricted, the increase in flexion suggests improved movement efficiency and tolerance to end-range loading. This finding is in line with evidence indicating that therapeutic exercise, particularly when combined with dynamic and functional movement patterns, can facilitate joint mobility and reduce compensatory movement strategies.[1,10] Importantly, the absence of joint stiffness at baseline indicates that ROM gains in this case are more likely attributable to functional adaptation rather than structural limitation.

Muscle strength, as measured by Manual Muscle Testing (MMT), remained stable at 5/5 throughout the intervention. This finding reflects a ceiling effect of the measurement tool, which is limited in its sensitivity to detect subtle changes in strength, particularly in physically active individuals who already demonstrate maximal scores.[17] The absence of observable change in MMT does not necessarily indicate a lack of physiological adaptation, but rather highlights the limitation of using gross strength assessment tools in advanced rehabilitation phases. More sensitive measures, such as isokinetic testing or functional performance metrics, may be required to capture changes in muscle performance in similar populations.

The progressive improvement in functional performance, as indicated by the increase in Kujala score, suggests enhanced capacity to perform daily and sport-specific activities. This outcome is particularly relevant in the context of late-stage OSD rehabilitation, where the primary goal shifts from symptom reduction to restoration of functional performance and return to sport.[5] The integration of plyometric exercises in this case likely contributed to improvements in dynamic stability, coordination, and force generation. [5,9,11] This magnitude of improvement is consistent with previous studies reporting clinically relevant functional gains following structured exercise-based rehabilitation in adolescents with anterior knee pain.[7,10]

From a physiological perspective, the combination of functional strengthening and plyometric exercises may facilitate adaptations in both muscular and tendon structures. Repeated exposure to controlled loading can improve tendon stiffness, optimize force transmission, and enhance the coordination of muscle activation patterns.[9] In adolescent athletes, these adaptations are particularly important given the ongoing musculoskeletal development and the increased vulnerability to overuse injuries during growth spurts.[4,6,11] Therefore, a structured and progressive exercise program that integrates both strength and power components appears to be a rational approach in managing OSD in its later stages.

Despite these positive findings, it is important to consider the influence of natural recovery in OSD, which is widely recognized as a self-limiting condition.[2] The observed improvements may partially reflect the natural progression of the condition rather than the sole effect of the intervention. Additionally, placebo effects and increased patient adherence due to supervised therapy may have contributed to the outcomes. These factors represent inherent limitations of a single-case design and should be acknowledged when interpreting the results.

Another limitation relates to the short duration of follow-up, which restricts the ability to evaluate long-term outcomes and recurrence risk. Furthermore, the use of relatively simple clinical outcome measures, such as MMT, limits the sensitivity of detecting subtle physiological changes. The absence of objective performance metrics, such as jump height or agility testing, also constrains the evaluation of sport-specific recovery.

This case also highlights a gap in the current literature regarding physiotherapy management during the progressive loading phase (phase IV) of OSD. While most studies focus on early-stage management and symptom control, there is limited evidence describing structured, sport-specific rehabilitation strategies aimed at restoring high-level functional performance.[1,10] The present findings contribute to this area by illustrating the potential role of plyometric and functional exercises in facilitating advanced rehabilitation in adolescent athletes.

Future research should focus on larger cohort studies or controlled trials to evaluate the effectiveness of structured physiotherapy programs incorporating plyometric training in OSD. In addition, the inclusion of objective performance-based outcome measures and longer follow-up periods would provide a more comprehensive understanding of recovery trajectories and return-to-sport readiness.

Conclusion

This case report demonstrates that a structured physiotherapy program incorporating functional strengthening and plyometric exercises was associated with improvements in pain intensity, knee joint mobility, and functional performance in an adolescent badminton athlete with Osgood–Schlatter Disease in the progressive loading phase. Muscle strength remained stable at a maximal level throughout the intervention period. Given the single-case design, these findings should be interpreted cautiously and cannot be generalized. However, the results suggest that progressive, sport-specific exercise may support functional recovery and facilitate readiness for return to sport in similar clinical contexts.

From a practical perspective, physiotherapists working with adolescent athletes may consider integrating controlled plyometric and functional exercises in the later stages of OSD rehabilitation, with careful monitoring of pain response and movement quality to ensure safe load progression. Future studies with larger samples, longer follow-up periods, and the inclusion of objective performance-based measures are recommended to further evaluate the effectiveness and generalizability of this rehabilitation approach.

Author Contribution

Kusumandari Nur Shafana: Conceptualization, Investigation, Data curation, Formal analysis, Writing original draft.
Suryo Saputra Perdana: Supervision, Methodology, Validation, Writing review and editing, Project administration.
Hakny Kusuma Maulana Arkan: Clinical investigation, Resources, Data collection, Writing review and editing.

Acknowledgments

The author expresses sincere gratitude to the patient and his family for their cooperation and willingness to participate in this case report. Appreciation is also extended to the clinical supervisors and instructors for their professional guidance and support throughout the physiotherapy management process.

Conflict of Interest Statement

The author declares no conflict of interest.

Funding Sources

This research received no external funding.

Ethics Statement

Written informed consent was obtained from the patient and his legal guardian for participation and publication of this case report. Ethical approval was not required for this case report according to institutional policy.

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