

Effect of Structured Physiotherapy Intervention on Pain and Function in an Adolescent with Bilateral Osgood–Schlatter Disease: A Case Study

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Abstract:

➤ *Background:*

Osgood–Schlatter disease (OSD) is a common overuse-related traction apophysitis of the tibial tuberosity, predominantly seen in adolescent athletes during periods of rapid growth. Despite its high prevalence, evidence guiding specific physiotherapeutic interventions, exercise dosage, and progression criteria remains limited and heterogeneous.

➤ *Objective:*

To document the physiotherapeutic assessment and short-term management of a bilateral Stage II OSD case in an adolescent athlete and to highlight existing gaps in physiotherapy-focused research.

➤ *Case Presentation:*

A 13-year-old male student and recreational athlete presented with bilateral infrapatellar and tibial tuberosity pain of 6–7 months' duration, more pronounced on the left side, leading to reduced sports participation. Clinical examination revealed swelling and prominence of the tibial tuberosity, increased Q-angle with bayonet sign due to proximal tibia vara, bilateral patellar lateral maltracking, hamstring and gastro-soleus tightness, impaired proprioception, and early-stage genu recurvatum. Gait assessment demonstrated a mild antalgic pattern pre-intervention. Radiographic evaluation confirmed bilateral Stage II OSD with apophyseal irregularity and partial separation of the tibial tuberosity.

➤ *Intervention:*

An individualized physiotherapy program was initiated, focusing on pain management, activity modification, targeted stretching of tight musculature, progressive quadriceps strengthening, patellar alignment strategies, proprioceptive training, and gait re-education. The intervention was delivered over three consecutive days with continuous reassessment.

➤ *Results:*

Post-intervention assessment demonstrated a reduction in pain intensity, improvement in gait pattern, and enhanced functional tolerance during daily and sports-related activities.

➤ *Conclusion:*

This case supports the effectiveness of individualized physiotherapeutic management in reducing symptoms and improving function in adolescents with OSD. However, the absence of standardized physiotherapy protocols, limited high-quality controlled trials, and lack of long-term outcome data represent significant research gaps. Further well-designed studies are needed to establish evidence-based rehabilitation guidelines for OSD.

Keywords: Adolescent Athlete; Anterior Knee Pain; Osgood–Schlatter Disease; Physiotherapy; Rehabilitation.

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I. INTRODUCTION

Osgood–Schlatter Disease (OSD) is a common cause of anterior knee pain in children and adolescents, particularly during periods of rapid skeletal growth. It is classified as a traction apophysitis of the tibial tuberosity, resulting from repetitive tensile forces exerted by the patellar tendon on an incompletely ossified apophysis. The condition predominantly affects physically active individuals and is frequently associated with sports involving running, jumping, and rapid changes in direction. Although often considered benign and self-limiting, OSD can significantly impair physical function, sports participation, and quality of life during adolescence.

The pathophysiology of OSD is closely linked to the vulnerability of the developing tibial apophysis. During growth spurts, the secondary ossification center of the tibial tuberosity is particularly susceptible to repetitive microtrauma. Excessive or poorly regulated loading of the quadriceps mechanism leads to inflammation, fragmentation, and, in some cases, partial avulsion of the apophyseal cartilage or bone. These pathological changes manifest clinically as localized pain, swelling, and tenderness over the tibial tuberosity, often exacerbated by activity and relieved by rest. Radiological findings typically progress through recognized stages reflecting apophyseal development and injury.

Epidemiological studies indicate that OSD is more prevalent in males and commonly presents between 11 and 15 years of age, although increasing sports participation among females has narrowed this gender disparity. Bilateral involvement is not uncommon and may further complicate functional performance. Despite its high incidence, the natural history of OSD remains incompletely understood, with symptom duration varying widely among individuals. While many adolescents experience symptom resolution following skeletal maturity, a subset continues to report persistent pain, functional limitations, or residual bony prominence into adulthood.

Conservative management is widely accepted as the first-line approach for OSD. Traditional recommendations have emphasized rest, activity restriction, and symptomatic relief. However, prolonged inactivity may negatively affect physical conditioning, psychosocial well-being, and athletic development. As a result, contemporary management strategies increasingly favor active rehabilitation approaches that promote symptom-guided activity modification rather than complete cessation. Physiotherapy plays a central role in this paradigm shift, offering interventions aimed at pain management, biomechanical correction, and functional restoration.

Physiotherapeutic management of OSD typically includes flexibility exercises to address muscle tightness, strengthening programs targeting the quadriceps and surrounding musculature, and functional training to improve movement efficiency. Addressing lower limb biomechanics and neuromuscular control has gained attention, as altered

alignment and movement patterns may increase stress on the tibial tuberosity. Despite widespread clinical use, the scientific evidence supporting specific physiotherapy interventions remains fragmented. Considerable variability exists in exercise selection, dosage, and progression, reflecting the absence of standardized rehabilitation protocols.

Another important consideration in OSD management is the role of load management. The concept of controlled mechanical loading recognizes that complete rest may not be necessary or desirable, provided that symptoms are monitored and activities are modified appropriately. This approach aligns with contemporary sports medicine principles emphasizing tissue adaptation and graded exposure. However, clear guidelines defining safe loading thresholds and return-to-sport criteria for adolescents with OSD are lacking, leading to inconsistent clinical decision-making.

Outcome assessment in OSD research further highlights existing gaps. Studies employ diverse outcome measures, including pain scales, functional questionnaires, and radiographic findings, limiting comparability across investigations. Moreover, few studies incorporate objective assessments of movement quality, neuromuscular control, or long-term functional outcomes. This lack of comprehensive outcome evaluation hampers the development of evidence-based physiotherapy guidelines.

Although several narrative reviews and cohort studies support exercise-based management of OSD, high-quality randomized controlled trials are scarce. Emerging modalities such as extracorporeal shockwave therapy and immobilization have been explored, yet their clinical utility remains inconclusive. Consequently, physiotherapy continues to rely heavily on clinical reasoning and extrapolation from related musculoskeletal conditions.

In this context, detailed physiotherapy-focused case reports remain valuable for illustrating clinical decision-making, identifying biomechanical contributors, and highlighting areas requiring further research. By documenting assessment strategies, intervention rationale, and short-term outcomes, such reports contribute to the evolving evidence base and inform future experimental studies.

Therefore, the purpose of this article is to present the physiotherapeutic management of Osgood–Schlatter Disease through a structured case approach, emphasizing rehabilitation strategies and outcome-based reasoning. Additionally, this work aims to underscore existing research gaps and support the need for standardized, evidence-informed physiotherapy protocols to optimize outcomes for adolescents affected by OSD.

➤ Objectives

The primary objective of this case study was to evaluate the short-term effectiveness of a structured physiotherapeutic intervention in reducing pain and

improving functional performance in an adolescent athlete diagnosed with bilateral Stage II Osgood–Schlatter Disease (OSD). Secondary objectives included identifying biomechanical impairments such as muscle tightness, quadriceps weakness, patellar maltracking, and proprioceptive deficits, and addressing these through individualized rehabilitation. Additionally, this case aimed to contribute clinical evidence toward the existing research gaps concerning standardized physiotherapy protocols, progression criteria, and outcome-based decision-making in the conservative management of OSD.

II. MATERIALS AND METHODS

This prospective case study was conducted at Nopany Physiotherapy Clinic. The participant was a 13-year-old male student and athlete presenting with bilateral infrapatellar and tibial tuberosity pain of 6–7 months' duration, with the left side more symptomatic. Written informed consent was obtained from the patient's guardian prior to assessment and intervention.

A comprehensive physiotherapeutic evaluation was performed, including postural analysis, gait assessment, palpation, muscle length testing, manual muscle testing (MMT), sensory examination, and functional balance assessment. Pain intensity was assessed using the Visual Analog Scale (VAS). Gait parameters were analyzed observationally. Radiological assessment included bilateral anteroposterior and lateral knee radiographs, confirming Stage II OSD characterized by apophyseal irregularity and partial separation of the tibial tuberosity.

Key impairments identified included bilateral quadriceps weakness, hamstring and gastro-soleus tightness, increased Q-angle with bayonet sign due to proximal tibia vara, bilateral patellar lateral maltracking, impaired proprioception, and early-stage genu recurvatum. Baseline findings guided the formulation of an individualized physiotherapy program. The intervention was administered over three consecutive days, with reassessment performed post-intervention.



Fig 1 Localised Observation of the Knees



Fig 2 Observation of Both Knees in Weight-Bearing Position

➤ Interventions

The physiotherapy intervention focused on symptom reduction, correction of biomechanical impairments, and restoration of functional movement patterns. Pain management strategies included activity modification, patient education regarding load regulation, and avoidance of aggravating activities such as jumping and kneeling. Cryotherapy was applied locally to the tibial tuberosity to reduce pain and inflammation.

Flexibility exercises targeted bilateral hamstrings, gastro-soleus complex, and quadriceps to reduce excessive traction forces on the tibial tuberosity. Strengthening exercises emphasized isometric and progressive isotonic quadriceps training within pain-free ranges, along with hip stabilizer strengthening to improve lower limb alignment and patellofemoral mechanics.

Patellar alignment strategies included corrective exercises and facilitation techniques to address lateral maltracking. Proprioceptive training was incorporated using single-leg stance and balance-based activities to improve neuromuscular control, particularly given the identified proprioceptive deficits. Gait re-education focused on correcting the antalgic pattern and improving symmetry during stance and swing phases.

The intervention was progressed cautiously based on pain response and functional tolerance, ensuring adherence to conservative management principles appropriate for a skeletally immature athlete.



Fig 3 Irregularity of Apophysis with Separation from the Tibial Tuberosity Shown in Lateral View of X-Ray



Fig 4 AP View of Bilateral Lateral Shifting of Patella

➤ Outcome Measures

Outcome measures included pain intensity assessed using the Visual Analog Scale (VAS), observational gait analysis, and functional performance during weight-bearing and ambulation tasks. Muscle strength was evaluated using manual muscle testing, while flexibility was assessed through standard muscle length tests for the hamstrings and gastro-soleus complex. Proprioception was assessed through

single-leg stance performance. Radiological findings were used for diagnostic confirmation but not as a post-intervention outcome measure. Pre- and post-intervention comparisons were made to evaluate short-term changes following physiotherapy.

III. RESULTS

Post-intervention assessment demonstrated a reduction in bilateral infrapatellar pain, as reflected by decreased VAS scores. Gait analysis revealed improvement from a mildly antalgic pattern to a more symmetrical and normalized gait. Functional tolerance during standing and walking activities improved, and the patient reported reduced discomfort during daily activities. Improvements were also observed in lower limb control and balance performance. Although structural alignment changes were not expected in the short term, the patient demonstrated improved movement quality and symptom relief following the physiotherapy intervention.

The graphical representation of Numeric Pain Rating Scale (NPRS) scores demonstrates a clear reduction in pain intensity across all assessed conditions following physiotherapeutic intervention. At baseline (Day 0), the patient reported higher pain levels during functional activities, with greater severity in the left knee compared to the right, particularly following running and prolonged walking. Resting pain was minimal but present bilaterally. By Day 3, a marked improvement was observed, with complete resolution of resting pain in both knees. Post-running pain could not be assessed on Day 3 due to activity restriction; however, pain following prolonged walking showed a substantial decrease bilaterally, indicating improved load tolerance. Overall, the graphs highlight an early positive response to conservative physiotherapy, with a more pronounced reduction in activity-related pain and asymmetrical baseline involvement, supporting the role of targeted rehabilitation in the short-term management of Osgood–Schlatter disease.

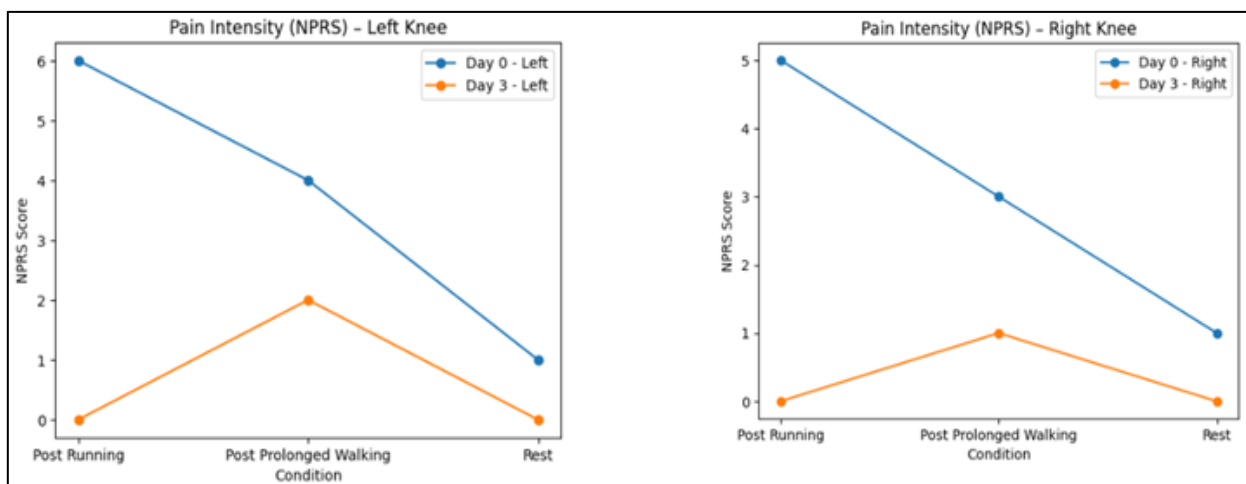


Fig 5 Numeric Pain Rating Scale (NPRS)

➤ Statistical Analysis

As this was a single-subject case study, inferential statistical analysis was not performed. Descriptive analysis was used to document changes in pain levels, gait pattern, and functional performance following the intervention. Pre- and post-intervention values were compared clinically to determine treatment effectiveness. The absence of statistical testing reflects a recognized limitation of case-based designs; however, such descriptive data remain valuable for hypothesis generation and identification of clinically relevant trends in the physiotherapeutic management of OSD.

IV. DISCUSSION

Osgood–Schlatter Disease (OSD) is widely recognized as a traction-related apophysitis of the tibial tuberosity occurring during skeletal immaturity. Although commonly considered a self-limiting condition, persistent symptoms during adolescence can significantly interfere with physical activity and sports participation. The present case contributes to the growing body of evidence supporting physiotherapy as a primary conservative management strategy, while also emphasizing the absence of standardized, evidence-based rehabilitation protocols for OSD.

Current literature consistently identifies excessive mechanical loading of the extensor mechanism during growth spurts as the principal etiological factor in OSD. Repetitive quadriceps contraction generates increased tensile forces at the patellar tendon insertion, predisposing the tibial apophysis to microtrauma and inflammation. While rest and activity restriction have traditionally been recommended, recent studies advocate for load modification rather than complete cessation of activity. The physiotherapeutic approach adopted in this case aligns with this evolving paradigm, focusing on controlled loading, symptom-guided progression, and functional restoration.

Exercise-based interventions remain the cornerstone of conservative OSD management; however, significant variability exists in the type, intensity, and duration of

exercises prescribed across studies. Strengthening of the quadriceps is frequently emphasized to improve knee stability and functional capacity, yet excessive or poorly timed loading may exacerbate symptoms. This underscores the importance of individualized exercise prescription and close monitoring of pain response. Flexibility training targeting the quadriceps, hamstrings, and gastro-soleus complex is commonly recommended to reduce tensile stress on the tibial tuberosity, although robust evidence quantifying its isolated effect remains limited.

An important consideration in OSD rehabilitation is the role of proximal and distal kinetic chain factors. Altered lower limb biomechanics, including malalignment and impaired neuromuscular control, may contribute to abnormal load distribution across the knee joint. Addressing these factors through hip strengthening, movement retraining, and gait re-education may reduce recurrent stress on the apophysis. Despite their clinical relevance, such components are inconsistently reported in existing studies, highlighting a gap between clinical practice and research documentation.

Proprioceptive and neuromuscular training represent emerging but underexplored components of OSD management. Improved sensorimotor control may enhance dynamic knee stability and reduce injurious loading during functional tasks. Although balance and coordination exercises are commonly incorporated in sports rehabilitation, their specific role in OSD has not been systematically evaluated. The functional improvements observed following neuromuscular-focused interventions in this case suggest potential benefits that warrant further investigation through controlled trials.

Pain reduction following physiotherapy is frequently reported in the literature, yet the mechanisms underlying symptom improvement remain multifactorial. Reduced inflammation through load management, improved muscle function, and optimized movement patterns may collectively contribute to clinical improvement. Importantly, early symptomatic relief can improve adherence to rehabilitation

and prevent deconditioning, particularly in young athletes eager to resume sports participation.

Despite positive clinical outcomes, the existing evidence base for OSD management is limited by methodological shortcomings. Most studies employ observational or cohort designs with small sample sizes and short follow-up periods. Outcome measures vary considerably, ranging from pain scales to functional questionnaires, limiting comparability across studies. Furthermore, few studies establish clear criteria for return to sport or long-term prognosis, leaving clinicians reliant on clinical judgment rather than evidence-based benchmarks.

Emerging interventions such as extracorporeal shockwave therapy and short-term immobilization have been explored in isolated studies, but evidence supporting their routine use remains insufficient. Physiotherapy-based exercise interventions continue to demonstrate the most consistent benefits with minimal risk, reinforcing their role as first-line management. However, future research should prioritize high-quality randomized controlled trials comparing different exercise protocols, dosages, and progression strategies.

Another critical research gap relates to long-term outcomes. While OSD is often described as self-resolving, a subset of individuals report persistent pain, functional limitations, or prominent tibial tuberosity into adulthood. Longitudinal studies examining the influence of early physiotherapeutic intervention on long-term symptom resolution and athletic participation are notably lacking.

In summary, this discussion reinforces physiotherapy as a central component of conservative OSD management while emphasizing the need for greater standardization and scientific rigor in rehabilitation research. Individualized, load-modified, and function-oriented physiotherapy appears effective in managing symptoms and restoring activity participation. Advancing the evidence base will require well-designed studies incorporating biomechanical analysis, neuromuscular training, and long-term follow-up to establish comprehensive, evidence-based guidelines for OSD rehabilitation.

V. CONCLUSION

This case study demonstrates the beneficial short-term outcomes of an individualized physiotherapeutic approach in the conservative management of bilateral Stage II Osgood–Schlatter Disease in an adolescent athlete. A comprehensive rehabilitation program focusing on pain modulation, flexibility restoration, progressive strengthening, proprioceptive retraining, and gait re-education resulted in meaningful improvements in functional performance and symptom relief. These findings reinforce the role of physiotherapy as a primary, non-invasive intervention for managing OSD during the growth phase, allowing adolescents to maintain functional independence while minimizing symptom exacerbation.

Despite favorable clinical outcomes, the current literature continues to lack standardized, evidence-based rehabilitation protocols, clear exercise dosage guidelines, and well-defined progression and return-to-sport criteria for this population. Furthermore, the scarcity of high-quality randomized controlled trials limits the generalizability of existing recommendations. Therefore, future research should focus on well-designed studies evaluating structured physiotherapy interventions, incorporating objective outcome measures and long-term follow-up, to establish comprehensive and clinically applicable guidelines for the physiotherapeutic management of Osgood–Schlatter Disease.

➤ Conflict of Interest

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