

# Blood Flow Restriction-Assisted Rehabilitation for Persistent Osgood-Schlatter Disease in an Adolescent Footballer: A Case Report with Isokinetic Evaluation

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## Learning Point of the Article:

Key take-away lessons include the importance of load management, utilization of objective isokinetic measures which help in supporting clinical decision-making for return-to-sport readiness, and preventing recurrence.

## Abstract

**Introduction:** Osgood-Schlatter disease (OSD), also known as Lannelongue disease, is a type of osteochondritis that affects teenagers. The effectiveness of blood flow restriction training (BFRT) in a structured rehabilitation program for cases that do not respond to conventional treatment has not been studied. By demonstrating the supporting impact of BFRT on progressive loading strategies and functional recovery, this example contributes to the expanding body of information on advanced rehabilitation procedures in OSD.

**Case Report:** A 15-year-old male athlete's main concerns were restricted participation in football, trouble with high-load activities such as running and jumping, and activity-related anterior knee pain. OSD was determined to be the diagnosis based on radiographic assessment. He visited the physiotherapy outpatient department. A clinical examination showed reduced hip abductor strength, altered hamstring-to-quadriceps (H/Q) ratio, and decreased quadriceps and hamstring strength on isokinetic evaluation. A comprehensive 12-week phase-based rehabilitation protocol involving activity modification, BFRT, aerobic exercise, proprioceptive training, and balance retraining. Following the intervention, the patient's isokinetic quadriceps, hamstring, and hip muscular strength significantly increased, and the H/Q ratio returned to normal. An improvement in functional performance allowed for a successful and gradual return to sports without recurrence of symptoms.

**Conclusion:** This example highlights that both proximal biomechanical dysfunctions and local muscular deficits associated with OSD can be effectively addressed through the integration of BFRT within a structured, progressive rehabilitation program, emphasizing the importance of objective isokinetic assessments to inform clinical decision-making, support return-to-sport readiness, and reduce the risk of recurrence.

**Keywords:** Rehabilitation, Return to sport, Hypertrophy, Running, Quadriceps, hamstring, muscle strength

## Introduction

Osgood-Schlatter disease (OSD), sometimes referred to as Lannelongue disease, is a form of osteochondrosis affecting adolescents. It develops when repeated pulling forces from the rectus femoris portion of the quadriceps muscle lead to irritation and inflammation at the growth plate, a condition known as traction apophysitis [1]. Although considered a self-limiting condition, it can significantly impair participation in sports and daily activities, with potential for persistent symptoms if not managed appropriately [2].

OSD usually begins between ages 10–15 in boys and 8–13 in

girls, with boys affected more often (about 3:1). It occurs in roughly 9.8% of cases and can affect both knees in 20–30% of patients. Despite its relatively common occurrence in active youth, the clinical management of OSD remains inconsistent, particularly in physiotherapy practice. Although several risk factors and activities are linked to its development, the exact cause remains unclear [3]. Frequent quadriceps contraction – especially during activities like running and jumping – can lead to irritation, small avulsions, and eventually osteochondritis at the site, further complicating rehabilitation and delaying recovery in athletic populations [4].

In conditions such as OSD, where pain and altered biomechanics

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**Table 1: Isokinetic values**

| Parameters               | Pre-intervention |      | Post-intervention |      |
|--------------------------|------------------|------|-------------------|------|
|                          | Right            | Left | Right             | Left |
| PTE 60°/s (Nm)           | 100              | 87   | 140               | 142  |
| PTF 60°/s (Nm)           | 53               | 66   | 85                | 115  |
| H/Q ratio 60°/s (Nm)     | 53               | 77   | 83                | 81   |
| PTE 180°/s (Nm)          | 81               | 68   | 100               | 89   |
| PTF 180°/s (Nm)          | 56               | 54   | 76                | 79   |
| H/Q ratio 180°/s (Nm)    | 68               | 80   | 76                | 83   |
| Hip abductors 60°/s (Nm) | 42               | 35   | 52                | 46   |
| Hip adductors 60°/s (Nm) | 77               | 69   | 84                | 98   |

**PTE: Peak torque of the knee extensors, PTF: Peak torque of the knee flexors, H/Q: Hamstring-to-quadriceps**

may mask true muscle performance, isokinetic testing enables safe and precise evaluation of quadriceps and hamstring function without excessive joint stress. Incorporating isokinetic parameters in this case report adds novelty by introducing high-resolution, reproducible kinetic data, thereby enhancing the scientific rigor and offering deeper insights into rehabilitation

outcomes beyond subjective and conventional clinical measures [5,6].

Current rehabilitation strategies largely include on activity modification, stretching, and progressive strengthening; however, there is no standardized, evidence-based protocol guiding load progression or safe return to sport, especially in symptomatic individuals who cannot tolerate high-load resistance training. This highlights a critical gap in physiotherapy practice [2].

Blood flow restriction therapy (BFRT) is widely used to increase muscle strength and hypertrophy by partially restricting arterial inflow and fully restricting venous outflow in working musculature during exercise [7,8].

BFRT is increasingly used in sports rehabilitation; its application in OSD remains relatively underexplored, with limited case-based or clinical evidence supporting its use in adolescent populations. Hence, this study is needed to explore BFRT as a novel approach that can safely induce comparable muscle adaptations, potentially expanding current rehabilitation strategies.

### Case Report

A 15-year-old boy reported to at the physiotherapy department complaining of right knee pain that had been bothering him for the previous 2 months and getting worse when he played sports. He is an active football player who plays as a striker position for a club team and was reportedly asymptomatic before the development of symptoms.

His right knee started to hurt when he kicked the ball during play about 2 months ago. Post-activity icing was used to treat the initial mild 3/10 pain level on the Numeric Rating Scale (NRS). For the next 2 months, he played sports at the same level of intensity despite the pain. He consulted with an orthopedic surgeon when the pain progressively worsened to a 6/10 on the NRS over time. The diagnosis of Osgood-Schlatter Syndrome was verified by radiographic evaluation using an X-ray that showed fragmentation formation at the patellar tendon insertion (Fig. 1). After being diagnosed, the patient was prescribed medications -non steroidal anti inflammatory



**Figure 1:** Lateral view of the right side (affected) X-ray showing fragmentation formation at the patellar tendon insertion (red circle).

**Table 2: Girth measurement (in cm)**

| Girth measurement | Pre-intervention |      | Post-intervention |      |
|-------------------|------------------|------|-------------------|------|
|                   | Right            | Left | Right             | Left |
| Quadriceps        | 44               | 43   | 49                | 50   |
| Calf              | 35               | 35   | 38                | 38   |



**Figure 2:** Blood flow restriction training - single-leg balance on BOSU ball.



**Figure 3:** Blood flow restriction training - clamshell in standing.

analgesics and advised to take a 2-month break, with a referred for physical therapy. In addition, he was told to wear a rubber knee sleeve when playing sports. He stated that he was jogging for up to an hour every day without experiencing any pain during the rest interval. He was able to play football at his prior level of intensity while wearing the rubber knee sleeve when his symptoms temporarily subsided. However, the patient's pain recurred after about 15 days of resuming sports, ranging to 7/10 on the NRS. As a result, he visited the physiotherapy outpatient department for further management.

No traumatic history existed. The patient's prior surgical and medical history was ordinary. The current state was not influenced by family or psychological history.

### Clinical findings

The patient gave their informed permission. When the upper anterior tibia near the tibial tuberosity was palpated, there was grade 1 tenderness (i.e., the patient reported discomfort). There was no noticeable swelling. The HUMAC NORM isokinetic machine was used to measure isokinetic muscle strength during

the examination to objectively quantify hip abductor/adductor and quadriceps/hamstring strength (Table 1) [9]. Tape measurements were used to assess the quadriceps and calf muscle girths (Table 2).

### Isokinetic examination

He warmed up for 5 min at a moderate speed before the examination. Testing was done in concentric force at angular speeds of 60°/s and 180°/s for the hamstring/quadriceps and hip adductor/abductor. When he was ready, five maximal warm-ups were repeated after three submaximal warm-ups at 60°/180°/s of angular speed, followed by a 20-s cool-down. The test was completed after 10 min of cooling down and tensioning activities. Table 1 provides isokinetic parameters before and after the intervention.

### Girth measurement

Girth measurement of the quadriceps and calf muscles is performed using a flexible, non-elastic measuring tape. Pre and

**Table 3: Rehabilitation protocol**

| Training                              | Exercise                                                                                                                                                                           | Dosage                                                | Rationale                                                                                                                                                                                                                                                                                                |
|---------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Phase 1 (0–4 weeks)                   |                                                                                                                                                                                    |                                                       |                                                                                                                                                                                                                                                                                                          |
| Strength training                     | Static squats, multiple-angle isometrics at 30, 60° angles, bridging, standing clamshell, standing hip abduction, ball press with knee flexion, wall squat at 90° with calf raises | 30, 15, 15, and 15 with 30 s of rest between the sets | Facilitate early quadriceps activation while minimizing tendon strain, preventing muscle inhibition and atrophy. Improve proximal stability to reduce stress on the knee joint and enhance quadriceps-hamstring co-contraction, thereby improving joint stability and reducing shear forces at the knee. |
| Proprioception and balance training   | Ball toss on stability trainer, single-leg standing on stability trainer                                                                                                           |                                                       |                                                                                                                                                                                                                                                                                                          |
| Cardiovascular endurance training     | Cycling with low resistance                                                                                                                                                        | 5 min                                                 | Reducing the risk of fatigue-related biomechanical compensations and improving aerobic fitness                                                                                                                                                                                                           |
| Phase 2 (4–8 weeks)                   |                                                                                                                                                                                    |                                                       |                                                                                                                                                                                                                                                                                                          |
| Strength training                     | Hamstring isometrics with Swiss ball, bridging on Swiss ball, lateral band walks, lunges, lateral step down                                                                        | 30, 15, 15, and 15 with 30 s of rest between the sets | Required for full restoration of muscle strength and performance capacity. Once pain subsides, higher loads improve tendon capacity and muscular resilience.                                                                                                                                             |
| Proprioception and balance training   | Ball toss on BOSU ball, single-leg standing on BOSU ball, squats on BOSU ball                                                                                                      |                                                       |                                                                                                                                                                                                                                                                                                          |
| Cardiovascular endurance training     | Cycling with resistance, elliptical                                                                                                                                                | 5 min each                                            |                                                                                                                                                                                                                                                                                                          |
| Phase 3: Return to sport (6–12 weeks) |                                                                                                                                                                                    |                                                       |                                                                                                                                                                                                                                                                                                          |
| Agility training                      | Box jumps, single-leg hops, reactive jump and sprint                                                                                                                               | 15 reps each 2 sets                                   | Restoring speed, coordination, and reaction time.                                                                                                                                                                                                                                                        |
| Plyometric training                   | Cone walking drills, ladder drills, T drill, ball dribbling with direction change                                                                                                  | 2 rounds each                                         | Reintroduces controlled tendon loading and improves power, elasticity, and neuromuscular efficiency.                                                                                                                                                                                                     |

advanced based on the patient's tolerance.

Before initiating this phase 3 that is return to sport, an isokinetic evaluation was carried out (Table 1) to objectively assess limb symmetry and the recovery of quadriceps and hamstring strength before moving on to sport-specific training. Despite the lack of widely recognized return-to-sport guidelines for OSD, objective strength evaluation was included to aid in clinical judgment. In particular, it was discovered that a quadriceps limb symmetry index higher than 87% considerably raised the probability of a successful return to play. Thus, the rehabilitation program was associated with improved lower-limb strength symmetry, restoration of the H/Q ratio, and pain-free execution of sport-specific activities. [11].

post-intervention girth measurements are provided in Table 2.

### Physiotherapy intervention

The physiotherapy rehabilitation program was divided into three phases and was planned to be implemented for 12 weeks, 3 days a week, starting on day 1 (the day of admission for physiotherapy).

During the initial visit, patient education focused on avoiding aggravating activities such as prolonged sitting, running, and jumping. The patient received instruction on self-management techniques, such as applying ice, wearing a knee brace while practicing, and being aware of the risk factors linked to OSD. A general lower extremity strengthening program was then started. At the end of the session, McConnell taping was applied to the knee for additional support and symptom relief and the participant was asked to keep the tape for 2 days and not to remove it forcefully.

Blood flow restriction (BFR) was commenced at during the second visit. The participant was informed about the treatment plans and procedures before the procedure, and written informed consent was obtained. The BFR cuff (12 × 51 cm) was placed on the proximal thigh and inflated to occlude 60% of the limb occlusion pressure (LOP) in accordance with the clinical practice guidelines [10]. The pressure of total arterial flow blockage is known as LOP. The cuff was deflated only after 75 repetitions for a rest period of 120 s (Fig. 2, 3, 4) [8].

Every session began with a normal warm-up. To restore strength, neuromuscular control, and cardiovascular endurance for a return to sport, the rehabilitation program was gradually



**Figure 4:** Blood flow restriction training - squats on BOSU ball.



**Figure 5:** Agility training.

This phase emphasized plyometric and agility training without the use of BFRT (Fig. 5).

### Functional outcome measure

Clinical outcome measures were used to assess pre and post-rehabilitation as shown in Table 3. Knee Injury and Osteoarthritis Outcome Score is a self-reported, validated questionnaire used to assess knee-related symptoms and functional status. Vertical jump height is a performance-based outcome measure used to evaluate lower limb power and functional capacity [12]. For 15–16-year-old males, performance can be interpreted as follows: >65 cm = excellent, 56–65 cm = above average, 50–55 cm = average, 40–49 cm = below average, and <40 cm = poor [13].

The rehabilitation program was well tolerated, with no reports of excessive pain or discomfort during or after therapy sessions.

As a result of the rehabilitation process, he managed to regain his confidence when it came to getting back into playing football again. Initially, there were difficulties with his performance, especially in running and kicking, as well as changing directions quickly. This gradually changed with progressive physical

training. Through physical training, significant progress was evident. Not only did the performance on field improve, his confidence in himself improved too. There was also less fear of re injury.

### Discussion

In this case study, a 15-year-old male football player with OSD showed significant improvements in isokinetic strength, functional outcomes, and symptom resolution following a 12-week BFRT rehabilitation program.

The most noteworthy outcome was a 40% increase in quadriceps peak torque on the affected right side, along with a 63% rise on the left (unaffected) side at 60°/s and a 60% and 74% increase in hamstring peak torque on the right and left, respectively. Research demonstrates that by increasing metabolic stress, cellular swelling, and the recruitment of fast-twitch muscle fibers, BFRT in conjunction with low-load resistance training (20–30% 1RM) results in hypertrophy and strength increases equivalent to high-load resistance training (70% 1RM) [14, 15].

As a result, the H/Q ratio increased to 81% on the left and 83% on the right. The H/Q ratio of 60–80% is considered optimal for knee joint stability and injury prevention in athletic populations. Following the intervention, the H/Q ratio returned to normal at 83%, suggesting improved muscle balance and a decreased risk of further injuries. A successful return to sport has been shown to depend on quadriceps strength symmetry [11,16].

Increased hip abductor and adductor strength in both extremities improves frontal plane knee control during dynamic exercises while reducing valgus collapse and patellofemoral joint stress [17].

This case study offers initial proof that BFRT could be a helpful supplement in the treatment of teenage athletes with OSD. While the H/Q ratio assisted in identifying muscular imbalances not apparent on manual testing, isokinetic testing provided objective data to inform decisions about return to sport [18]. The use of BFRT was inspired by symptoms that persisted despite activity moderation and traditional

**Table 4: outcome measure**

| Outcome measure                              | Pre-intervention | Post-intervention |
|----------------------------------------------|------------------|-------------------|
| Knee injury and osteoarthritis outcome score | 61/100           | 100/100           |
| Vertical jump height                         | 50 cm            | 56 cm             |

strengthening, as well as the difficulty of handling high-load resistance exercise [8]. However, its single-case approach hinders causal inference and restricts generalizability.

To the best of the authors' knowledge, this is one of the first studies to report BFR-assisted phased rehabilitation in a teenage football player with OSD using isokinetic dynamometry, H/Q ratio analysis, and return-to-sport results. The study provides unbiased evidence supporting BFRT as a low-load strategy for treating strength impairments in individuals with symptomatic OSD.

### Conclusion

Improvements were observed in isokinetic strength, H/Q ratio, and functional performance following the intervention. While these findings suggest a potential role for BFRT as a low-load

training strategy in this population, conclusions are limited by the single-case design, and further research is required to establish its efficacy, safety, and optimal application.

### Clinical Message

BFRT-assisted rehabilitation may restore quadriceps-hamstring balance, enhance functional performance, facilitate safe return to sport, and reduce the risk of symptom recurrence in adolescents with persistent OSD. Isokinetic assessment provides objective evaluation of muscle recruitment, strength and limb symmetry, supporting clinical decision-making for rehabilitation progression and return-to-sport readiness.

**Declaration of patient consent:** The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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