

# Application of Extracorporeal Shockwave Therapy for Recalcitrant Patellar Tendinopathy Following Anterior Cruciate Ligament Reconstruction with Patellar Tendon Autograft

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## Abstract

Extracorporeal shockwave therapy (ESWT) has been increasingly utilized for musculoskeletal pathology, including conditions such as patellar tendinopathy. More recently, there is growing evidence to support the use of ESWT following anterior cruciate ligament (ACL) reconstruction to support post-operative rehabilitation and optimize return to sport.

We report a case of a 21-year-old collegiate male athlete with a relevant history of Osgood–Schlatter disease who suffered from an acute ACL rupture and subsequently underwent ACL reconstruction (ACLR) using bone-patellar tendon-bone (BTB) autograft. His rehabilitation course was complicated by worsening anterior knee pain consistent with patellar tendinopathy. His symptomatic knee was treated with four sessions of ESWT using both focused and radial devices. He was able to return to play 1 month later with improvement in pain, quadriceps strength, and on-field sports-specific function.

ESWT may serve as an adjunct to conventional rehabilitation following ACLR, particularly in patients experiencing patellar tendon-related pain.

**Keywords:** Patellar Tendinopathy; Anterior cruciate ligament reconstruction; Focused shock waves, Radial pressure waves

## Introduction

The incidence of anterior cruciate ligament (ACL) tears has gradually risen, with young people participating in athletic activity continuously found to be at higher risk [1]. There are three primary autograft options generally utilized for ACL reconstruction (ACLR): Bone-patellar tendon-bone (BTB), hamstring tendon, and quadriceps tendon [2]. ACLR using BTB autograft has known complications, including kneeling difficulty and anterior knee pain that is often secondary to patellar tendinopathy [3]. Extracorporeal shockwave therapy (ESWT) and radial pressure wave therapy (RPWT) have emerged as evidence-based treatments for tendinopathy and fasciopathies by leveraging mechanotransduction to induce neovascularization, inflammation modulation, enhanced collagen synthesis, and pain modulation. Multiple studies have demonstrated clinical improvement in knee function following focused shockwave therapy as well as RPWT for patellar tendinopathy [4, 5, 6]. While studies have demonstrated the efficacy of ESWT use following ACLR with hamstring autografts, no published studies have specifically examined the use of ESWT on BTB ACLR or for the treatment of patellar tendinopathy following this surgery [2]. This article aims to highlight a case of patellar tendinopathy in a patient with a history of

Osgood–Schlatter disease and subsequent ACLR using a BTB autograft treated successfully with ESWT.

## Case Report

The patient is a 21-year-old male collegiate American Football player with a relevant history of bilateral Osgood–Schlatter disease who had an acute left ACL rupture during a game. He underwent left knee ACLR with BTB autograft as well as left lateral meniscus radial tear repair and anterolateral ligament reconstruction with allograft.

The patient had an uncomplicated rehabilitation course following ACLR for 12 months, but then began experiencing progressive left anterior knee pain at the tibial tubercle as soon as he began to resume sports-specific activities. Quadriceps testing illustrated decreased strength with knee extension compared to the contralateral side, as well as a feeling of apprehension with sports-specific movements. Physical examination at this time was consistent with distal and proximal patellar tendinopathy without concern for other ligamentous or intraarticular injury (Figure 1). Given prior research illustrating the safety of ESWT for in-season athletes and its use in both patellar tendinopathy and following ACLR, the decision was made to treat his left knee with ESWT.

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**Figure 1:** Anterior-posterior and lateral radiographs of the left knee following anterior cruciate ligament reconstruction illustrating normal post-operative changes. There is a prominent inferior patellar pole at prior surgical site at proximal patellar tendon origin.

He was treated with combined radial pressure waves and focused shockwave therapy to the left anterior knee with a focus on the patellar tendon, tibial tubercle, inferior patellar pole, and quadriceps muscles/tendon. Four sessions, spaced out 1 week, were completed with clinical focusing and no procedural anesthesia. RPWT was delivered to the patellar tendon, quadriceps muscles, and quadriceps tendon (R15 applicator head, Storz Medical, OrthoPulse 100RPWT device (EPAT) 2.0–3.5 bar, 3000 pulses, 12–15 Hz). Focused shockwave therapy, generated using an electromagnetic device (Storz Medical, Masterpuls 100), was additionally focused at the tibial tubercle and patella (0.10–0.30 mJ/mm<sup>2</sup>, 1500 pulses, 5–6 Hz, large gel-standoff). The patient tolerated applications well without any complications or side effects during treatment. The use of non-steroidal anti-inflammatories (NSAIDs) was avoided 1 week before the treatment, during the treatment course, and for 3 weeks following the last treatment sessions.

One month after the last shockwave therapy session, the patient reported achieving over 90% performance during his football training camp and full progression of plyometric movements without any procedural complications or limitations. He was able to compete in his sport for the duration of the season without recurrence of his left knee symptoms.

### Discussion

The previous work has focused primarily on ESWT following hamstring tendon ACLR with generally favorable outcomes assessing general post-operative recovery [4, 5, 6, 7, 8]. Prior studies have also demonstrated ESWT as an effective and safe treatment modality for patellar tendinopathy [9, 10, 11] with benefits for in-season athletes [5, 9]. To the best of our knowledge, this is the first case report to assess the effectiveness of ESWT for patellar tendinopathy after ACLR using

a bone-patellar tendon-bone autograft.

In 2009, van Leeuwen et al. [11] conducted a narrative review examining the use of ESWT for patellar tendinopathy. Across seven included studies, ESWT was reported to be an effective treatment with no serious adverse effects observed. Based on pooled findings, approximately 74.7% of patients treated with ESWT demonstrated clinical improvement and enhanced knee function. Limitations of this review include inconsistent study quality.

A meta-analysis of seven studies on focused ESWT for patellar tendinopathy found outcomes comparable to patellar tenotomy surgery and superior to non-operative treatments such as NSAIDs, physical therapy, exercise programs, and activity modification [9]. In addition, Cheng et al. [12] reported that athletes treated with RPWT experienced significant improvements in pain and strength at 16 weeks compared with controls who received acupuncture, ultrasonic wave therapy, and microwave therapy.

Some studies compared the use of ESWT following hamstring tendon ACLR. In 2014, Wang et al. [5] evaluated the effects of a single session of focused shockwave therapy (0.298 mJ/mm<sup>2</sup>, impulses 1500) administered immediately postoperatively in 53 patients who underwent ACLR with a semitendinosus (ST) autograft. Over a 2-year follow-up, the ESWT group demonstrated significantly better Lysholm functional scores and reduced anterior–posterior knee laxity compared with controls at 2 years. Magnetic resonance imaging (MRI) findings further showed reduced tibial tunnel enlargement at both 6 months and 24 months.

In another study, Rahim et al. [6] evaluated the use of ESWT following ACLR with ST and gracilis autografts over 6 months. Patients received either three sessions (0.09 mJ/mm<sup>2</sup>, 500 pulses) or six sessions (0.18 mJ/mm<sup>2</sup>, 500 pulses) administered once weekly in addition to standard physical therapy. The six-session ESWT protocol resulted in

improved graft incorporation within the tibial tunnel. However, this treatment group did not demonstrate significant improvements in knee function scores at 6 months post-ACLR.

Similarly, Weninger et al. [8] reported enhanced graft maturation on MRI in patients who received three ESWT sessions at post-operative weeks 4, 5, and 6. In their prospective cohort of 65 patients, functional outcomes were significantly improved in the ESWT group (0.25 mJ/mm<sup>2</sup>, 1500 pulses) compared with controls at all post-operative time points assessed (3-, 6-, 9-, and 12-months). Shockwave therapy was also associated with earlier return to sport: Mean time to return to pivoting sports was 27.92 weeks (~6.4 months) versus 42.64 weeks (~9.8 months) in controls, and return to running occurred at 10.46 weeks (~2.4 months) versus 18.46 weeks (~4.3 months) in controls.

Randomized control trials have also evaluated the effect of RPWT following ACLR. Zhang et al. [4] investigated RPWT (5 sessions, 0.05–0.11 mJ/mm<sup>2</sup>, 2000 impulses) on graft maturation and functional outcomes in patients undergoing ACLR with hamstring autografts, reporting improvements in both MRI-based graft maturation and functional scores at 24-month follow-up. In contrast, Song et al. [7] found that early RPWT (0.298 mJ/mm<sup>2</sup>, 2500 impulses) administered at 3- and 6-weeks postoperatively resulted in improved joint function, pain scores, and patient-reported activities of daily living. However, these differences were not sustained at 24-week

follow-up.

Based on our literature search, there are no published studies or case reports evaluating the effectiveness of ESWT following ACLR using a bone–patellar tendon–bone autograft. Across available ESWT studies in post-operative ACL populations, minimal to no adverse reactions have been reported, and ESWT is generally considered safe and well-tolerated. As a noninvasive modality with few side effects, ESWT often allows athletes to continue participating in sport as pain permits without significant time away from sport. As a result, it may be favored over more invasive treatment options that require variable periods of time away from sport. In our patient, only 24-h of relative rest were incorporated post-treatment without any immobilization or weight-bearing restrictions during his treatment course.

### Conclusion

ESWT is a safe and effective therapeutic option for musculoskeletal conditions in athletes. A growing body of literature indicates that when ESWT is integrated with conventional rehabilitation modalities, athletes may return to sport more rapidly, often with minimal interruption in participation. Following ACLR with a bone–patellar tendon–bone autograft, ESWT may serve as an adjunct to conventional treatment and rehabilitation, particularly in patients experiencing patellar tendon-related pain.

**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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