

# Profound Healing of a Quadriceps Tendon Tear Following Intratendinous Minimally Invasive Platelet-Rich Plasma Injection

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## Introduction

Quadriceps tendon tears caused by injury or degeneration occur in sports and nonathletic life (1). Current treatment includes rest, immobilization, surgery (in the case of complete ruptures), and physical therapy (PT) (1). Platelet-rich plasma (PRP) injections have been successfully used for Achilles and lateral epicondyle tendinopathies; however, there is limited literature on quadriceps tendon injuries (2,3). Meta-analyses have demonstrated PRP to produce superior overall healing, compared with other treatments using standard metrics for various musculoskeletal conditions (4). Among clinical cases examining PRP treatment for tendinopathy, there have been no demonstrated differences in Visual Analog Scale scores at short term follow-up (2 to 6.5 months after injections). Results are equivocal at long-term follow-up, likely due to variable rigor of the studies. This case report describes an unequivocal recovery of a severe quadriceps tendon tear treated with PRP injections.

## Case Report

A 53-year-old male avid hiker presented with severe right suprapatellar pain and weakness in knee extension. The injury occurred suddenly, while ice climbing in Patagonia, Argentina, on September 26, 2015, reported with a pain score of 10/10. The patient was initially seen by another physician who diagnosed him with a quadriceps strain and prescribed ibuprofen, but no imaging was ordered at the time. As pain and disability

continued unabated, the patient's primary care physician ordered an MRI on November 13, 2015, completed prior to his first appointment with the specialist on November 18, 2015. His exam was significant for 4/5 strength in right knee extension on manual muscle testing, but negative for extensor lag, deformity, or muscle atrophy. Ice, rest, and non-steroidal anti-inflammatory drugs (NSAIDs) provided no relief since injury. The MRI on November 13, 2015, revealed full thickness, partial breadth tearing of the lateral fibers of the distal quadriceps tendon in which a 1.1 × 0.7 cm stump of completely torn tendon was retracted by 4 cm with a diffuse severe tendinopathy that was seen proximally (Fig. 1). Orthopedic consultation was performed and the surgeon advised against surgery as the tendon had not completely ruptured. The surgeon suggested intratendinous PRP injections to the patient. After reviewing potential risks and benefits of PRP injections and alternative treatments, including PT, the patient elected PRP and PT instead of solely PT. Up to three injections were planned to address the substantial tendinosis and tearing seen on MRI, but only two injections proved necessary.

Before each injection, 15 mL of blood was drawn from the patient's antecubital fossa using an Arthrex double syringe (which permits both drawing of blood and isolation of PRP from the fraction of blood containing predominately erythrocytes or contaminated with leukocytes). Thus, autologous conditioned plasma (ACP) was used, but in this manuscript, we use the terms PRP and ACP interchangeably. The double syringe was then spun down using an Arthrex® Hettich benchtop centrifuge at 1500 RPM for 5 min.

After certification, the yellow PRP layer visible by eye was removed using the manufacturer's instructions. For the injections, the skin over the quadriceps tendon was prepped with isopropyl alcohol/iodine and anesthetized with lidocaine and marcaine using a 27-gauge needle. Under ultrasound guidance from a Sonosite M-Turbo® system equipped with a 15- to 6-MHz HFL50 transducer, three to four intratendinous PRP injections were performed using a 21-gauge needle. Care was taken to place the needle within the regions of greatest pain and visible tendinosis (seen on ultrasound as dark hypochoic regions with loss of brush-like parallel fibrillar

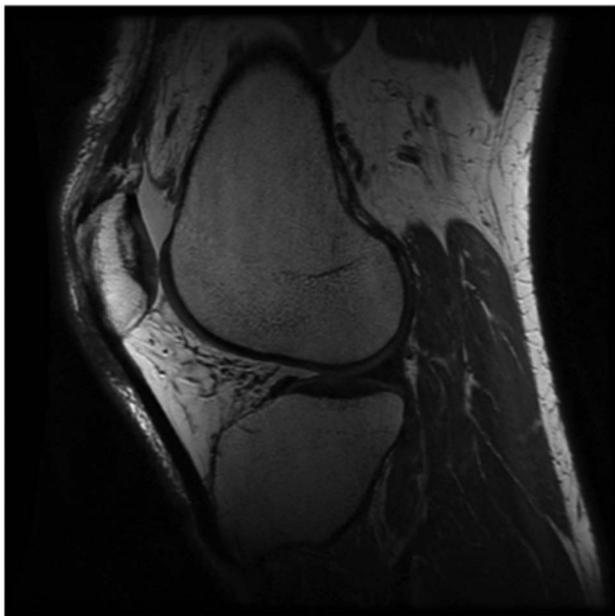
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**Figure 1:** Quadriceps tendinopathy and a near full thickness tear demonstrated on T1 Sagittal MRI image soon after injury.

echogenic texture) and darker anechoic regions that correlated with the known areas of tendon tears (4).

The first treatment on November 19, 2015, involved the injection of 5 mL of PRP into the proximal half of the quadriceps tendon, which correlated with the region of greatest pain. The injections were wholly intratendinous, as none spread to adjacent structures. Following the injections, the patient was placed in a knee immobilizer for 1 wk (2 wk were advised, however, given his high level of activity he was unable to tolerate 1 wk) and afterward performed at home isometric and range of motion activities. The patient reported no adverse reactions. Four weeks postinjection, there was a reduction of the hypoechoic regions in the proximal half of the patient's quadriceps tendon; however, the anechoic region of his distal quadriceps tendon (which corresponded to the greatest area of tearing on MRI) remained present.

A second PRP injection was administered on January 4, 2016 to continue the healing process, as suggested by successful PRP treatments for other tendons (5,6). Using the same technique as above, 5.5 mL of PRP was injected into the distal half of the quadriceps tendon with the bulk of the PRP carefully injected into the anechoic portion that correlated with the patient's most significant region of tearing. Once again, there was no spread of injectate to adjacent structures observed on ultrasound.

Following the same postinjection protocol, again no adverse reactions were reported. An MRI on February 24, 2016, strongly suggested the previously anechoic portion of the tendon to now be replaced with confluent, somewhat hypoechoic tissue (Fig. 2). An independent radiologist also reported marked improvement and near complete healing of the quadriceps tendon tear. The patient reported near full resolution of his pain, and his knee extension strength normalized. He declined a third injection as his symptoms had substantially improved. The patient continued to perform low-impact

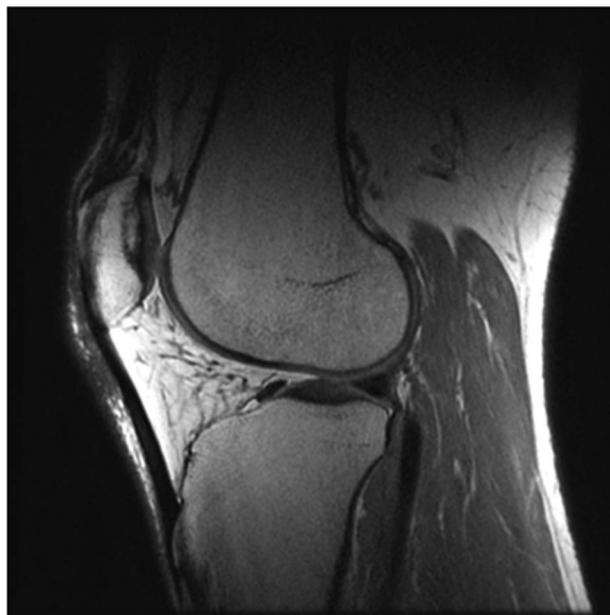
stretching at home and was advised to avoid plyometric activities, such as jumping.

The patient resumed his previous level of activity after follow-up on March 7, 2016. Immediately prior to clinic follow-up on July 25, 2016, he did briefly pursue PT, then transitioned to a home exercise program after being cleared to continue hiking. While strenuously hiking in the Canadian Rockies in early August 2016, he reported a minor pain flare and thus from an abundance of caution, requested another MRI. On August 8, 2016, the patient was seen again for follow-up after 2 wk in the mountains. This final follow-up included a physical examination that remained unchanged (no weakness, extensor lag, or deformity were noted), and the MRI on August 8, 2016, ruled out a recurrent tear but displayed residual hypertrophic scarring of the distal central and lateral quadriceps tendon, consistent with the previous near complete tear region (Fig. 3), but no evidence of reinjury. He has not reported any symptoms since that office visit and MRI, and consistently reports a quadriceps muscle and tendon that is even stronger than prior to his injury (Fig. 4).

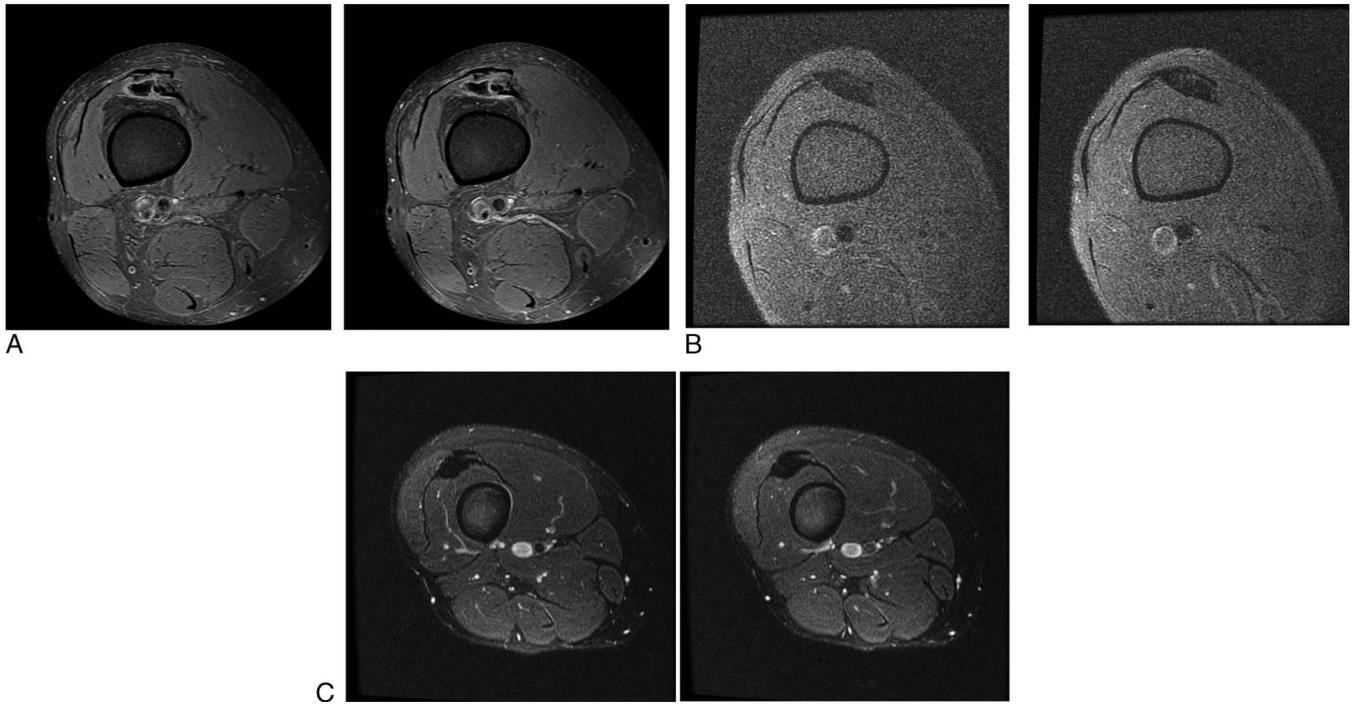
## Discussion

Tendon tears are a type of severe tendinopathy characterized by replacing well-organized type 1 collagen fibers with a disorganized tangle of poorly aligned collagen of various subtypes that are poorly able to sustain tensile loads satisfactorily.

Whereas immediate surgery is accepted as the most appropriate treatment for complete quadriceps ruptures, incomplete tendon tears are often treated with immobilization in extension for 3 to 6 wk. However, the outcomes from this treatment are often suboptimal, with patients commonly experiencing muscle atrophy and associated weakness, extension lag, as well as other adverse effects, such as profound patellar tendonitis (1). In animal models, collagen fascicles from stress-shielded rabbit patellar tendons demonstrated lower tensile strength than controls (2). While training and rehabilitation have improved the tensile strength and



**Figure 2:** Marked healing of quadriceps tendon tear after two PRP injections. This MRI was taken 3 months after injury.

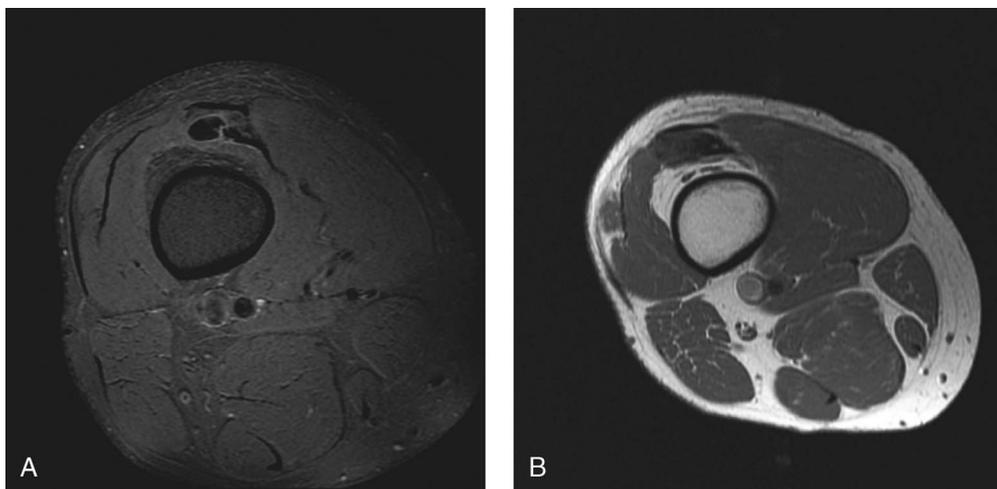


**Figure 3:** Axial MRI images of the quadriceps tendinopathy and tears at the initial MRI (A), approximately 3 months after the first PRP injection and thus 13 weeks after the initial MRI (B), and approximately 9 months after the initial MRI, which was about 1 wk after minor pain flare reported by the patient during mountain hiking (C). Special care was taken with these images to select slides at similar anatomic levels for consistency in interpretation of the images.

cross-sectional area in animal tendons, little data are available to confirm that strengthening and physical therapy result in structural tendon healing in humans (3). The use of PRP has been reported extensively, but without mechanistic information, and have demonstrated its potential for healing various types of connective tissue and beneficially altering the natural history of degenerative tendinopathy and incomplete tendon tears by promoting tissue regeneration through high concentrations of interleukins, cytokines, chemokines, and growth factors, whose identities are yet to be elucidated (7,8).

PRP has been shown to be superior to injected corticosteroids in pain and functional outcome measures in treating lateral epicondylitis and Achilles tendinopathy (5,9). Randomized controlled trials in animals have shown PRP to be far superior over corticosteroids in quadriceps tendon tears (10). Although a relative paucity of well-documented human studies demonstrating the efficacy of PRP, their results are promising and point to the superiority of this treatment over current modalities (4,5,11).

This case report illustrates the potential for PRP to be used in quadriceps tendon tears, as it demonstrates the profound efficacy



**Figure 4:** Initial axial MRI images demonstrating high grade quadriceps tendon tearing (A) and follow-up MRI 9 months after the initial studies demonstrating confluent healing of previous tears (B).

of intratendinous PRP injections in a severe near-complete quadriceps tendon tear with confirmation of structural healing on two follow-up MRIs with long-term complete clinical resolution of symptoms. Given the potential complications and cost of surgery, such an easy, effective, and minimally invasive procedure is predicted to be eagerly welcomed by patients. We look forward to the discovery of the intracellular and extracellular mechanisms of this powerful treatment for such injuries.

The manuscript has been approved by all authors and neither this manuscript nor one with substantially similar content has been published or is being considered for publication elsewhere. None of the authors have disclosures concerning this research.

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