Bilateral Quadriceps Rupture: Results With and Without Platelet-rich Plasma

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This article presents a 46-year-old man with bilateral atraumatic quadriceps rupture that occurred while he was descending stairs. The patient underwent surgery the day after the accident. In the left knee, quadriceps reinsertion was performed using a conventional technique. In the right knee, platelet-rich plasma (PRP), both in its liquid and semisolid patterns, was added intraoperatively.

Ultrasonography and magnetic resonance imaging evaluations were performed 1, 6, and 24 months postoperatively. At 6 and 24 months postoperatively, clinical and functional evaluations also were performed. Clinical examination showed no differences between the knees, and functional scores were the same for both knees. Ultrasonographic evaluation showed bilateral persistent tendon thickening and gross echotexture abnormalities, with no side-to-side differences. Magnetic resonance imaging showed signals of vascularized granulation tissue in both knees, which was more evident in the right (PRP) knee at 1 month postoperatively, along with a better signal of scar tissue in the right knee at 6 and 24 months postoperatively.

The use of PRP yielded no better clinical or functional results than the lack of its use. However, a more intense and significant reparative healing process occurred where the PRP was used, thus suggesting a more rapid completion of the healing process, although this effect seems to remain only a radiographic finding with no clinical correlation.
Bilateral simultaneous rupture of quadriceps tendons is rare1-2 in patients who are not affected by chronic systemic diseases3-6 or who have been receiving systemic or local steroid injections,7,8 and it is even rarer when it occurs in the absence of trauma. Treatment is always surgical, and it has been shown that the sooner surgical repair is performed, the better the postoperative results.9-12 Some authors have already demonstrated how mechanical loads13,14 and pharmacological treatments15 may improve the tendon-healing process after a rupture. It is also known that repaired tendons have lower biomechanical properties than original tendons16; therefore, recurrence can represent a catastrophic event for patients.

In recent years, the use of platelet-rich plasma (PRP) has become increasingly popular in tendon and muscle repair. However, its role continues to be debated. Sánchez et al17 reported that patients with Achilles tendon rupture had an earlier return to sports activities following intraoperative injections of PRP. In a histological study on rabbits, Lyras et al18 showed a significantly higher angiogenesis in rabbit tendons treated with PRP during the first 2 weeks after injection, thus supporting the role of PRP in enhancing neovascularization and accelerating the healing process. In contrast, Schepull et al19 reported that PRP was not helpful in improving Achilles tendon repair.

The current authors sought to evaluate the effect of PRP on tendon healing in a patient with bilateral atraumatic simultaneous quadriceps rupture who was treated surgically by adding an intraoperative infiltration of PRP on 1 side only. To the authors’ knowledge, this case represents the first published report of simultaneous bilateral quadriceps rupture in which the 2 repaired tendons were treated with and without the use of PRP.

The patient provided informed consent that data concerning his case would be submitted for publication, and institutional review board approval was obtained.

**CASE REPORT**

In January 2011, a 46-year-old man presented to the emergency department after simultaneous sudden collapse of both knees while he was descending stairs. After the fall, he was unable to lift his legs. He had no history of systemic diseases and had not used any drugs immediately before his accident. The patient had no history of sports practice at any level, and he also reported no type of trauma to his lower limbs.

On physical examination, the patient was in a wheelchair. He was unable to walk at all, even with the use of crutches. He reported moderate pain on palpation at the upper level of the patella, and he had moderate bilateral joint swelling. A suprapatellar defect was visible on both sides (Figure 1). When asked to lift his lower limbs, he was unable to do so.

Ultrasoundography showed complete bilateral rupture of both quadriceps tendons close to their patellar insertions, along with diffuse local hematoma. Surgery to reinsert the tendons was scheduled for the following day. Prior to undergoing surgery, the patient gave his consent for the use of PRP; he was unaware of which knee was being treated with PRP. A transcervical incision was performed on both knees at the level of the patellar bone. In both knees, the quadriceps tendon was completely avulsed from the cranial pole of the patella. The tendons were prepared and reinserted on the upper side of the patella through a transosseous hole with Vicryl [AQ: Which manufacturer?] 2-0 suture. Small portions of the torn quadriceps tendons were sent for histological evaluation, with the aim of assessing for the presence of hidden collagen disorders.

In the left knee, quadriceps reinsertion was performed using a conventional technique as described. In the right knee, PRP in both liquid and semisolid patterns was added intraoperatively. The PRP was supplied by the Immunohaematology and Transfusion Department at the authors’ hospital using MyCells Autologous Platelet Preparation System (Kaylight Ltd, Ramat-Hasharon, Israel). The PRP was prepared in accordance with the manufacturer’s instructions. Twenty mL of venous blood (collected approximately 60 minutes preoperatively) were collected from the cubital vein. The whole blood was mixed in a disposable sterile tube with acid-citrate-dextrose to prevent early clotting. After blood collection and 10 minutes of centrifugation at 1500 g, 4 mL of PRP (platelet concentration of 4X; no white blood cell content) were obtained. After reinsertion of the tendon on the patella, 2 mL of PRP in liquid form without activation were applied near the surgical suture; furthermore, a scaffold-PRP (2 mL), obtained by adding thrombin and 10% calcium gluconate a few minutes before its use, was sutured onto the peritendineum (Figure 2).

Postoperatively, the patient wore a full-extension brace on both legs, with weight bearing prohibited for 30 days. He then was allowed to progressively bear weight with the use of 2 crutches and the brace in full extension. At his 40-day follow-up visit, the braces were progressively unlocked.

An independent radiologist performed a blind ultrasonographic and magnetic resonance imaging (MRI) evaluation at 1, 6, and 24 months postoperatively. At 6 and 24 months postoperatively, the patient was also evaluated clinically and functionally by a physician who was not
aware of the details of the PRP treatment.
At the same time points, the patient’s pain level was assessed using a visual analog scale (VAS), with 0 corresponding to no pain and 10 corresponding to the worst pain possible. Finally, the Roles and Maudsley score was used as a subjective 4-point patient assessment, taking into account pain and limitation of activity, with 1 point representing an excellent result without symptoms; 2 points, a good result with the patient having improved significantly and being satisfied with the results; 3 points, a reasonable result with the patient having some improvement and being partially satisfied with the results; and 4 points, a poor outcome with minor improvements and high dissatisfaction. The results were considered satisfactory, with the patient achieving an excellent or good score on the Roles and Maudsley score.

Histological evaluation of the tendinous tissues revealed areas of myxoid and hyaline degeneration of the morphological pattern, along with a loss of the longitudinal axis of the tendinous fibers; these alterations were judged as compatible with nonspecific degenerative tendinopathy. During the 2-year observation, no re-rupture of the sutured tendons occurred.

Ultrasonography at 1, 6, and 24 months postoperatively confirmed the viability of both tendons and showed bilateral persistent tendon thickening and gross echo-textural abnormalities, reflecting a disorganized structure of the collagen bundles. Furthermore, both repaired tendons showed intratendinous hyperechoic areas compatible with areas of heterotopic ossification. Dynamic scanning performed at 6 and 24 months postoperatively revealed the recovered tendon gliding function in the absence of clear tendon adhesions or longitudinal discontinuities (Figure 3). Ultrasonography revealed no significant difference between the 2 tendons.

Magnetic resonance imaging was performed with and without contrast with T1- and T2-weighted multiplanar scans and fat-saturated T1-weighted images. At 1 month postoperatively, both knees showed vascularized granulation tissue; this was more evident on the right (PRP) side (Figure 4). Similarly, at 6 and 24 months postoperatively, the right knee showed a better signal of scar tissue, which at the same time was thicker and more vascularized (Figures 5, 6).

Clinical examination showed no relevant objective differences between the 2 knees at 6 and 24 months postoperatively; thigh circumference (measured at 8 cm...
from the patellar pole) was almost identical for both thighs, with an additional 0.2 cm for the right thigh at 6 months postoperatively and 0.1 cm at 24 months postoperatively. Gait was normal, and the patient reported no pain or restriction during his activities of daily living. Range of motion was satisfactory in both knees, with complete extension and 130° of flexion on the right side and 135° of flexion on the left side. The patient subjectively judged the surgical procedure and clinical outcome as good, with no differences in terms of PRP use. Evaluation scores reported by the patient were the same for both sides. Scores were 0 (no pain) for the VAS and 1 (satisfactory result) for the Roles and Maudsley score at 6 and 24 months postoperatively.

**DISCUSSION**

Localization of the quadriceps rupture has been shown to be 1 to 2 cm away from the upper patellar pole in most cases, which corresponds to the avascular region of the quadriceps tendon. Tendon healing involves several stages, including angiogenesis, cell proliferation, and the deposition of extracellular matrix. These stages are followed by remodelling and maturation phases, during which the healing tendon ultimately should regain its mechanical strength; however, the scar tissue does not often maintain the original biomechanical properties, thus representing a weak point that may not allow for a satisfactory return to daily life or sports activities.

In animal models, upregulated temporal expression of some growth factors and their receptors has been reported during the healing process of tendinous tissue. Furthermore, it has been shown that the healing tendon is also responsive to locally applied growth factors; this finding has been the rational basis for the use of local stimulating factors, such as PRP, as in this case.

The authors decided to perform the current study in light of the conflicting results in the literature concerning PRP use. This is the first case report in which a patient with a simultaneous bilateral tendon rupture was treated blindly with and without the use of PRP. As stated previously, the effects of these stimulating factors might be different depending on the different sensitivity of each individual patient; therefore, such a bias was avoided by the authors through testing the PRP on 2 similar tendons in the same patient. This is one of the strongest points of this study because the use of such a type of growth factor has no type of potential associated factors (in relation to the patient) that may have altered the effect of PRP. In fact, tendon rupture occurred in the same patient, at the same level, at the same time, and in the same way; the ruptures were treated on both sides using the same surgical technique and at the same time point after the trauma occurred. Thus, the only difference that could have been detected clinically and radiographically after this type of treatment was the presence of the PRP positioned locally.

Other authors have reported that use of PRP resulted in no clinical difference between the 2 sides, as objectively reported by the physical examination and the evaluation scoring scales used in the current patient (VAS, 0; Roles and Maudsley, 1). However, radiographic images showed some differences in the tendon on the PRP side. More specifically, ultrasonography highlighted no difference between the 2 knees; different patterns of inflammatory evolution were noted only by MRI. At 1 month postoperatively, MRI showed a higher contrast agent concentration around tenorraphy on the side treated with PRP (Figure 4). At 6 months postoperatively, this initial feature was confirmed by earlier recovery of a normal morphology/thickness of the tendinous chords than the contralateral side not treated with PRP. Such a recovery was highlighted by earlier recovery of a normal signal intensity, even following contrast, thus pointing to a more rapid completion of the healing process (Figure 5). The assessment at 2 years postoperatively shows a morphological difference and a different signal intensity, with decreased thickness and increased homogeneity in relation to the signal of...
the tendon treated with PRP (Figure 6). Nevertheless, these different patterns of healing process showed no correlation with the clinical examination or patient satisfaction. Moreover, the patient was not a sportsman; this can reduce stimulus and functional requests at the tendon level, which would avoid any re-rupture.

In athletes, a benefit can be seen from PRP treatment because they are able return to play much more quickly. Sánchez et al. reported a more rapid recovery in athletes undergoing PRP-enhanced Achilles tendon repair. The PRP-treatment group presented an earlier recovery of range of motion and a faster return to jogging and sport, in addition to no wound complications and a lower Achilles cross-sectional area.

This is why a 24-month follow-up period was chosen for the current patient. This allowed for long-term evaluation of a patient who does not play sports, and it also enabled the current authors to assess that no re-rupture of the 2 sutured tendons occurred. However, it should be noted that the weaker knee could stop a patient from performing (even if this is only subconscious), and the patient would not be able to experience the difference between the sides.

In the current patient, the use of PRP during quadriceps repairs provided no better clinical or functional result than the lack of its use; however, a possibly more intense and significant reparative healing process occurred on the PRP side, although this effect seems to remain only a radiographic finding with no clinical correlation. For a more comprehensive picture, further study with different cases of spontaneous patellar tendon rupture is needed.

REFERENCES