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Regeneration of the Anterior Talofibular Ligament Following PRP Therapy: A Case Report with Serial MRI Evidence

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Abstract

Lateral ankle sprain (LAS) is one of the most common lower limb injuries, particularly in individuals involved in sports and recreational activities. The anterior talofibular ligament (ATFL) is the structure most frequently affected. Platelet-rich plasma (PRP) has shown potential in promoting tissue regeneration and accelerating healing. We report a case of a grade 3 ATFL tear treated with a single PRP injection combined with functional rehabilitation therapy, with serial MRI scans demonstrating ligament continuity and clinical recovery. This case highlights PRP hypothesized as a useful adjunct treatment for LAS involving ATFL injury when combined with functional rehabilitation, as it may promote ligamentous healing, improve short-term symptoms, and potentially reduce the long-term risk of developing chronic ankle instability.

1. Introduction

Lateral ankle sprain (LAS) is the most common musculoskeletal injury of the lower limb, particularly among individuals engaged in athletic or recreational physical activity [1]. While most LAS cases are managed conservatively, a subset progresses to chronic ankle instability (CAI), resulting in functional limitations, reduced activity levels, and increased healthcare costs [2]. The anterior talofibular ligament (ATFL) is the primary structure injured in LAS [3, 4]. Standard treatment typically involves rehabilitation, while surgical reconstruction is reserved for cases unresponsive to conservative therapy. However, surgery carries risks, including infection and sensory deficits [5].

For the past decade, platelet-rich plasma (PRP) has been known for its potential to promote healing, stimulate tissue regeneration, and enhance recovery. PRP is a blood component (plasma) that contains platelet concentrations five to ten times higher than normal levels [6]. Researchers believe that PRP, which contains platelet-derived growth factor, endothelial growth factor, transforming growth factor (TGF), and other cytokines such as interleukin-4, will facilitate tissue regeneration [6]. PRP preparation can be categorized into several types based on the concentration of platelets, the inclusion of white blood cells, and the method of activation [7]. Commonly used preparations include leukocyte-rich PRP (LR-PRP), which contains a higher concentration of white blood cells and is often used for its anti-inflammatory properties, and leukocyte-poor PRP (LP-PRP), which has

Table 1. Ankle sprain grading scale proposed by Wells et al. [8].

Grade I	Grade II	Grade III
- No loss of function	- Some loss of function	- Near total loss of function
- No ligamentous laxity with anterior drawer and talar tilt testing	- Positive anterior drawer test, negative talar tilt test	- Positive anterior drawer and talar tilt test
- Little or no bruising	- Bruising	- Bruising
- No point tenderness	- Point tenderness	- Extreme point tenderness
- Decreased total ankle motion of 5 degrees or less	- Decreased total ankle motion > 5 degrees but < 10 degrees	- Decreased total ankle motion > 10 degrees
- Swelling of 0.5 cm or less as measured by figure-of-eight testing	- Swelling > 0.5 cm but < 2.0 cm	- Swelling > 2.0 cm

fewer white blood cells and is preferred for tissue regeneration and wound healing. Additionally, pure PRP is created by centrifuging blood at a specific speed to concentrate platelets without significant contamination from other blood cells. At the same time, fibrin-rich PRP incorporates fibrin, a clotting agent, to enhance tissue healing. The choice of PRP type is determined by the clinical indication and desired outcome, with different activation methods, such as calcium chloride or thrombin, used to trigger platelet release of growth factors. This heterogeneity is the main reason PRP evidence remains inconsistent across studies.

This report presents a rare case of successful ATFL regeneration following a combination of PRP therapy and rehabilitation therapy, supported by serial imaging up to 6 months. Most PRP studies lack objective imaging evidence of structural healing, making this case notable for its clear visualization of ligament regeneration.

2. Cases

A 40-year-old active male recreational badminton player sustained a right ankle sprain during a match. Immediately following the injury, he was unable to bear weight on the affected limb. During the first three days, the patient managed the injury with self-administered treatment, applying ice and compression twice daily. Due to persistent pain and swelling in the right ankle, the patient sought medical treatment from a family medicine specialist. Initial assessment by the family physician ruled out fractures, and standard conservative management (Protection, Rest, Ice, Compression, Elevation [PRICE]) was initiated. To expedite return to sport, he was referred to a sports medicine clinic.

Physical examination revealed lateral ankle swelling, ecchymosis, tenderness over the ATFL region, and a positive talar tilt test and anterior drawer test. The ankle dorsiflexion and inversion are limited due to pain. Bedside ultrasound demonstrated a hypoechoic defect in the ATFL region, suggesting ligament discontinuity. MRI confirmed a Grade III tear of the anterior talofibular ligament (ATFL) according to the Wells et al. classification (Table 1), accompanied by moderate joint effusion [8]. After reviewing the treatment choices in detail, the patient elected to receive a PRP injection to accelerate the recovery process.

In this case, PRP was prepared using the Ycellbio PRP kit® [9]. The patient's blood sample was processed according to the manufacturer's system, which incorporates an internal anticoagulant and separation mechanism. A total volume of approximately 15 ml of whole blood was introduced into the device, after which it was centrifuged using the kit's standard protocol (single spin with 3700 RPM). This process yielded a PRP fraction of roughly 3–4 ml, with platelet concentrations estimated to be 9–13 times above baseline. The kit's built-in control lever allowed for isolation of the leukocyte-rich PRP layer, which was subsequently transferred into a sterile syringe for use in the patient's treatment.

The 3 mL of PRP was administered under ultrasound guidance directly into the ATFL region. The patient was fitted with a stirrup brace and allowed to weight-bear as tolerated. A rehabilitation program focusing on strength and proprioception training was initiated.

By six weeks post-injection, the patient reported complete resolution of pain and had returned to full, pain-free activities of daily living. At three months, he had resumed badminton training and had regained his pre-injury level of function. The Foot and Ankle Disability Index (FADI) score improved from 30 pre-injection to 90 following treatments. Clinical assessment demonstrated that the patient achieved 90% of the performance of the contralateral, uninjured limb on the single-hop test. Follow-up imaging at 3 and 6 months demonstrated restored ligament continuity on ultrasound and MRI (Figures 1 and 2).

3. Discussions

Data showed that up to 40% of individuals who experienced LAS may develop CA [10]. The development of CAI is characterized by a combination of mechanical

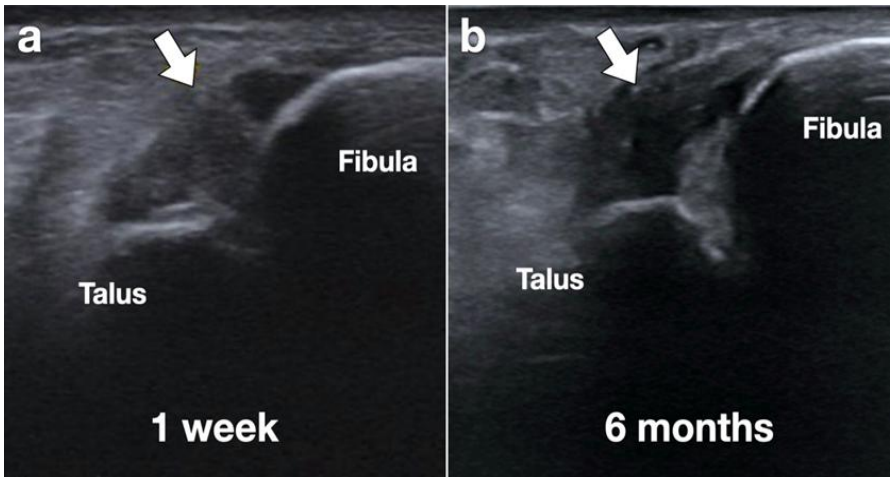

Figure 1. (a) Ultrasound of right ATFL (arrow) at 1-week post-injury. (b) An ultrasound at 6 months post-injection showed right ATFL thickening and healing with fibrosis, which corresponded to the findings in the MRI.

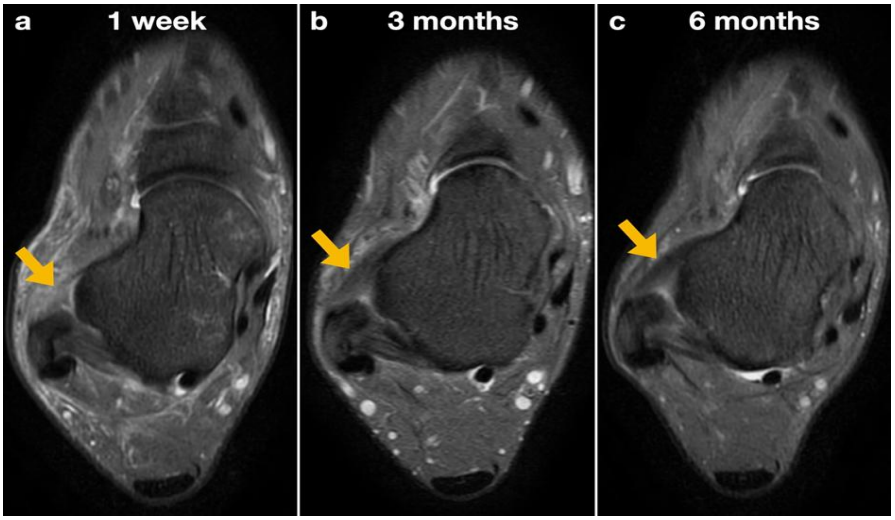

Figure 2. MRI of right ankle Proton Density Fat Saturation (PD-FS) sequence in axial view showed (a) ATFL (arrow) with high signal and full tear (grade 3) at origin end (fibula) at 1-week post-injury pre-injection (b) ATFL was thickened and showed reduced high signal (arrow), indicating healing with fibrosis at 3 months post-injection. (c) Further healing and reduced high signal of ATFL (arrow) with more conspicuous fibers at 6 months post-injection.

and sensorimotor impairments that manifest after LAS [10]. One of the most common structures injured following LAS is ATFL [3]. Based on a biomechanical study, the ATFL is the primary structure that contributes to the mechanical stability of the lateral ankle. Before the existence of PRP therapy, LAS was used to manage conservatively with functional rehabilitation or surgically with ATFL reconstructions. One of the meta-analyses found no difference in the rate of recurrent ankle injuries between these two treatment methods. However, surgical management showed there is an increased rate of complications such as surgical site infections, sensory loss, and scar tenderness [5]. Ideally, both mechanical and sensory-motor impairment should be restored to prevent CAI.

Rehabilitation alone has been shown to yield excellent outcomes in most LAS cases, owing to the favourable healing capacity of the involved ligaments and the substantial contribution of neuromuscular recovery to functional stability. The ATFL and calcaneofibular ligament (CFL) generally heal reliably with conservative management, while structured rehabilitation effectively addresses the proprioceptive deficits, muscular weakness, and altered sensorimotor control that accompany acute ligament injury [11]. Restoration of dynamic stability through balance training, peroneal strengthening, and progressive functional tasks is often sufficient to compensate for mild residual mechanical laxity, thereby reducing the risk of recurrent instability [11]. Compared with immobilization, functional rehabilitation preserves joint mobility, minimizes muscle atrophy, and promotes a more rapid return to activity, leading to superior recovery trajectories [12]. As a result, most patients, even those with moderate sprains,

demonstrate substantial improvement with nonoperative management, and surgical intervention is generally reserved for those with persistent mechanical instability or recurrent sprains despite comprehensive rehabilitation [12]. A previous case series demonstrated MRI-confirmed healing of the ATFL and CFL within 6 weeks following conservatively treated acute ankle sprains [13]. In the present case report, the healing of a grade III ATFL tear is documented with serial MRI findings extending up to 6 months.

The time required for return to sport (RTS) following lateral ligamentous ankle sprains depends on multiple factors, including injury severity, the athlete's baseline ability, and the availability and quality of rehabilitation resources [14]. Despite this, the current literature lacks formal, standardized criteria to guide RTS decisions in athletes with lateral ligament injuries. Existing evidence indicates that individuals with grade III ATFL injuries managed conservatively can typically resume activities of daily living within approximately 21 days and return to sports by around 60 days, particularly in elite athletes [15]. This timeline aligns closely with the recovery observed in our patient.

Healing of the ATFL can be considered in terms of anatomical versus functional recovery, and the distinction is important when interpreting outcomes after lateral ankle sprains [11]. Anatomical healing refers to the structural re-approximation of the torn ATFL, typically through scar formation. This fibrous tissue can bridge the gap between disrupted ligament ends, creating continuity on imaging or inspection. However, scar tissue often differs from native ligament in collagen alignment, tensile strength, and stiffness [16]. Thus, anatomical healing does not necessarily restore the mechanical performance of the original ATFL. Functional healing, in contrast, implies that the ligament's biomechanical role is restored, namely, controlling anterior translation and internal rotation of the talus, maintaining proprioceptive input, and contributing to lateral ankle stability during dynamic activities [11]. Functional healing requires not only continuity of tissue but restoration of normal collagen architecture, stiffness, and neuromuscular control. Even when the ATFL appears "healed" anatomically, the long-term stability of a fibrous repair remains uncertain. The remodeled tissue may be more compliant and less capable of resisting inversion stress, potentially predisposing patients to chronic ankle instability [17]. This helps explain why some individuals continue to have mechanical laxity or recurrent sprains despite evidence of tissue continuity. The ATFL healing is not solely about closing the gap; true recovery requires the return of native biomechanical function, and the durability of scar-based repairs remains a subject of ongoing uncertainty.

PRP can be one of the minimally invasive alternative treatment options to help in promoting ligament healing. The high concentration of platelets, which contain growth factors and cytokines, as mentioned above, may promote inflammation, angiogenesis, and stem cell migration with proliferation. The injection should be done with ultrasound, as it showed significantly higher accuracy than blind injection techniques [18].

This case report demonstrates that PRP therapy may enhance ATFL healing, as objectively tracked through serial MRI and ultrasonography. The findings suggest that PRP treatment may help restore ligament integrity, with the hope of improving mechanical stability, which is a critical factor in preventing chronic ankle instability (CAI) that may develop after an acute ankle sprain. Moreover, ultrasound-guided PRP injections present a safer alternative to surgery, with minimal procedural risks.

However, as with any single case report, the findings are limited by the absence of a comparator or control group, making it difficult to attribute the observed outcomes solely to the intervention. Additionally, spontaneous or natural healing processes may have contributed to the patient's improvement, potentially confounding the interpretation of treatment-related effects.

4. Conclusions

PRP can be hypothesized as a useful adjunct treatment for LAS involving ATFL injury when combined with functional rehabilitation, as it may promote ligamentous healing, improve short-term symptoms, and potentially reduce the long-term risk of developing chronic ankle instability.

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