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Novel use of preconditioned autologous PRP-derived exosomes for partial Achilles tendon rupture repair: A three-week recovery case report

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ABSTRACT

Background: Partial Achilles tendon ruptures are uncommon, often misdiagnosed, and lack effective regenerative treatments. Exosomes have emerged as a promising therapy to enhance tendon healing.

Case report: A 43-year-old male sustained a 5.5 mm partial Achilles tendon rupture during sports. He received autologous platelet-rich plasma (PRP)-derived exosomes using the MCT System (MCT kit plus MCT Unit). Fifteen milliliters of whole blood were centrifuged at 4000 rpm for 8 minutes to yield 10 mL PRP, which was placed in the MCT Kit and processed with the MCT Unit using the Exosome preset (1 J/cm^2, 467 nm, 37 °C, 10 minutes) to prime platelets and stimulate exosome release. The preconditioned PRP was injected intratendinously under ultrasound guidance at approximately 13 mm in depth and at a 45° angle.

Ultrasound at one week showed near-complete tendon recovery. By week two, fibers were fully restored, and by week three, initial tendon fiber alignment was observed. The patient then began a controlled loading program. Treatment was well-tolerated, with no adverse effects.

Conclusions: PRP-derived exosome therapy via the MCT System enabled complete recovery of a partial Achilles tendon rupture within three weeks, offering a safe, effective, and innovative regenerative option with potential to improve tendon injury management.

1. Introduction

Tendons are fibrous connective tissues that transmit force from muscles to bones, but their poor vascularization limits regenerative capacity, making tendon injuries common and challenging to treat.[1] Healing occurs in three overlapping stages, during which the tendon gradually regains biomechanical strength.[2] The healing stages includes inflammation, proliferation, mediated by growth factors such as transforming growth factor-beta (TGFβ), basic fibroblast growth factor (bFGF), platelet-derived growth factor (PDGF), bone morphogenetic protein (BMP), vascular endothelial growth factor (VEGF), and insulin-like growth factor (IGF-1); and remodeling, during which fibers mature and tendon biomechanical strength is restored.[3]

Partial Achilles tendon ruptures are relatively rare, often misdiagnosed due to overlapping symptoms with tendinopathy and full-thickness tears.[4] Typically affecting young, athletic men, they present with localized pain, weakness, tendon thickening, and sometimes palpable discontinuity, with ultrasonography providing up to 92 % diagnostic accuracy.[5] Treatment options include conservative and surgical approaches, but no consensus exists. Surgery is sometimes indicated for ruptures exceeding 50 % of the cross-sectional area or involving the proximal myotendinous junction.[6] Conservative management, including structured rehabilitation and heel raises,[7] extracorporeal shock wave therapy,[8] and platelet-rich plasma (PRP) injections.[9]

Exosomes, key mediators of cell signaling can be found in almost all cell types. PRP-derived exosomes are involved in coagulation and hemostasis, angiogenesis, inflammation, wound healing,[10] apoptosis, and cell growth and survival,[11] and have been proved their therapeutic potential in tendón and tendón-bone healing.[12] Their regenerative potential can be enhanced through preconditioning strategies such as photothermal biomodulation (PTBM) consisting of photobiomodulation (PBM) and temperature modulation.[13] PTBM has been proven that prime platelets and stimulate the exosome release to optimize their therapeutic properties.[14] The MCT System is an innovative platform that preconditions autologous samples using PTBM, light and temperature, to enhance PRP regenerative potential.

The present case reported a patient with a partial Achilles tendon rupture was treated successfully with autologous PRP-derived exosomes

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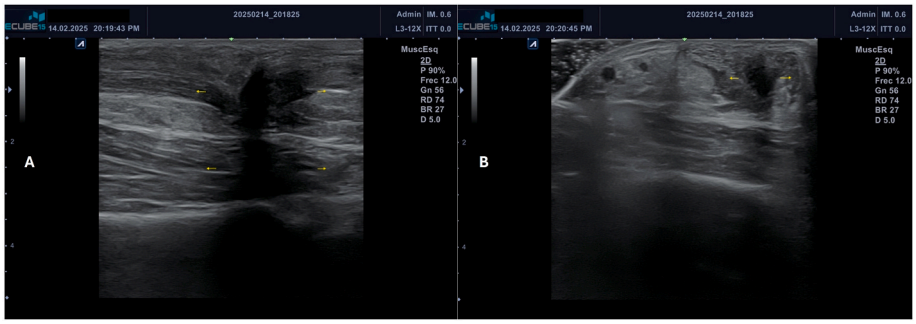

Fig. 1. The longitudinal (A) and transversal (B) ultrasound images for diagnosis revealed a partial discontinuity of the Achilles tendon, measuring 5.5 mm in width, along with a similarly sized discontinuity of the soleus.

obtained using this system.

2. Case report

A 43-year-old Spanish male presented severe Achilles tendon pain following a trauma sustained on the same day while performing sports. The patient was prescribed rest, and an imaging assessment was scheduled to rule out a tendon rupture.

Given the nature of this clinical case, which required prompt intervention, the data is presented anonymously and is not part of a larger investigation; approval from an ethics committee is not a prerequisite in Spain.

2.1. Clinical findings

At examination, the patient presented pain and swelling.

2.2. Diagnostic assessment

Three days later, an image analysis was performed using an Ecube15 Platinum real-time ultrasound (Alpinion Medical Systems Co., Ltd., Korea) with a 12 MHz linear probe. The ultrasound image revealed a partial discontinuity of the Achilles tendon, measuring 5.5 mm in width, along with a similarly sized discontinuity of the soleus (Fig. 1).

2.3. Therapeutic intervention

Following a week-long observation period, infiltration in the tendon was performed with autologous PRP-derived exosomes obtained from autologous PRP preconditioned with the MCT System (Meta Cell Technology, Spain). This platform, certified under the Medical Devices Regulation (MDR), includes the MCT Unit, a device classified as a Class IIb medical device with three specific presets for preconditioning autologous cells for regenerative purposes. The platform also includes the MCT Kit, a sterile, single-use Class IIa medical device for placing the sample during the preconditioning. The MCT Kit has specific optical properties to optimize light scattering and transmittance. MCT Unit presets include specific energy combinations, wavelength, temperature, and time to precondition any autologous cells. The preset selected for this treatment was the Exosome preset, specially designed to prime autologous platelets/cells to promote exosome release. This preset applies blue light with a wavelength of 467 nm, energy (1 J/cm^2) while the sample is heated at 37 °C for 10 minutes.

2.3.1. Sample collection and processing

To obtain the autologous PRP-derived exosomes, 15 mL of the patient's peripheral blood was collected using a BD Vacutainer Safety-Lok (Becton Dickinson, US) and placed in a 15 mL PRP. SBL.3 tube (Solutions Biomedical Lab S.L.U., Spain), a Class IIa medical device designed for the PRP obtention. The tube was centrifuged at 4000 rpm for 8 min with

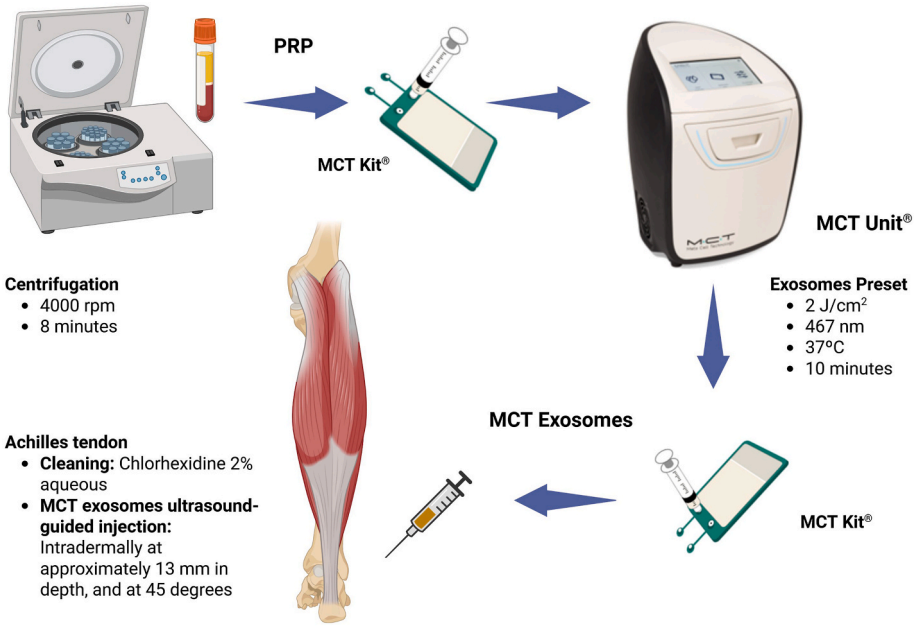

Fig. 2. Procedure for obtaining the autologous platelet-rich plasma (PRP)-derived exosomes using the MCT Unit and MCT Kit.

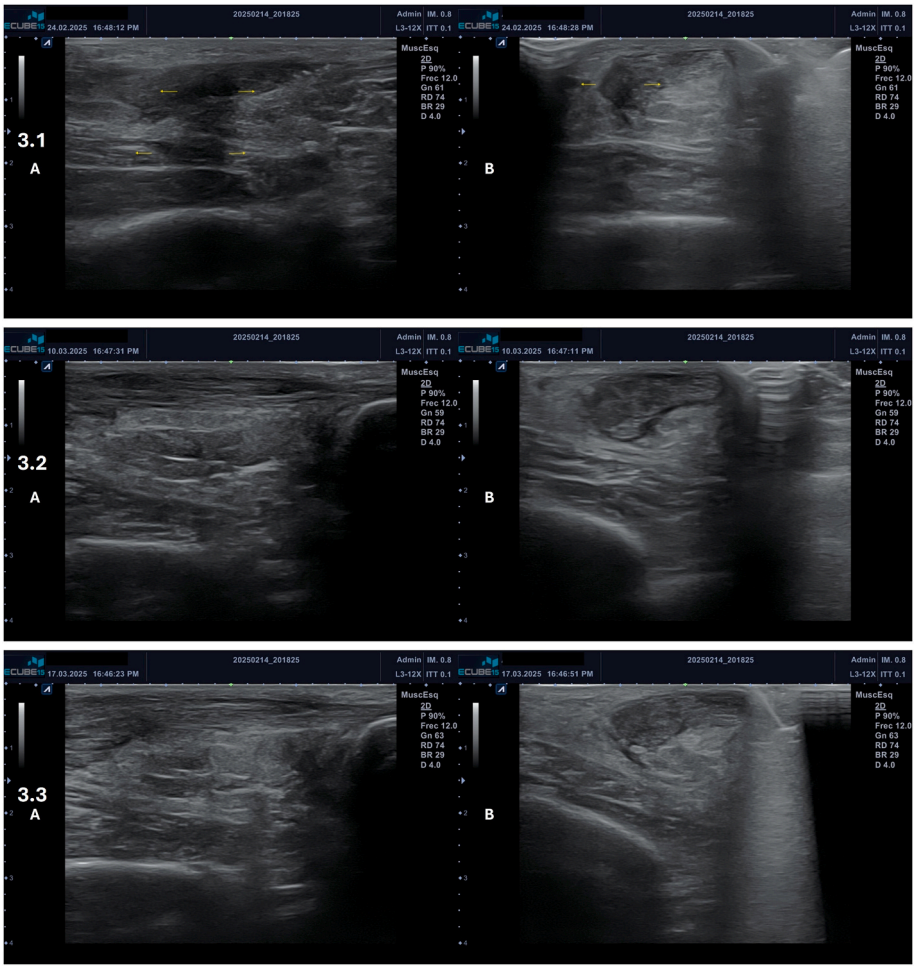

Fig. 3. Follow-up visits ultrasound images: **3.1** Follow-up visit 1 (1 week after injection): Longitudinal (A) and transversal (B) views where the ultrasound images showed a partial, almost complete recovery of the affected structures, with evident signs of tissue regeneration of the broken fibers of the Achilles tendon and the disappearance of the soleus disruption (proliferative phase). **3.2** Follow-up visit 2 (2 weeks after injection): Longitudinal (A) and transversal (B) views where the ultrasound images showed complete recovery of the affected fibers, with a density and composition different from healthy tissue, but no rupture was observed. **3.3** Follow-up visit 3 (3 weeks after injection): Longitudinal (A) and transversal views (B) where the ultrasound images showed the beginning of tendon fiber alignment, indicating the start of the remodeling phase.

a 2615/1 centrifuge (Nahita-Blue, Spain), yielding approximately 10 mL of autologous PRP for the treatment session. Following the manufacturer's instructions, the 10 mL of autologous PRP was transferred into the MCT Kit and inserted into the MCT Unit (Fig. 2).

2.3.2. *PRP-derived exosome application*

After preconditioning, the sample was extracted from the MCT Kit using a 10 mL BD Vacutainer Safety-Lok (Becton Dickinson, US) syringe with a 27G 0.4 × 40 mm needle (Braun Sterican, Germany). Before the injection, the skin was cleaned and disinfected with chlorhexidine 2 % aqueous (Lainco, Spain). The 10 mL of autologous PRP-derived exosomes were injected in the distal third of the tendon via ultrasound guidance, at a depth of approximately 13 mm and at an angle of 45° (Fig. 2). The treatment session lasted approximately 5 min. After the infiltration, the patient was prescribed relative rest and local ice.

2.4. *Follow-up and outcomes*

a) **Follow-up visit 1 (one week after injection):** The pain and inflammation persist. The ultrasound revealed partial, almost complete recovery of the affected structures, with clear signs of tissue regeneration of the broken fibers of the Achilles tendon and the resolution of the soleus disruption (proliferative phase) (Fig. 3.1).

b) **Follow-up visit 2 (2 weeks after injection):** The pain and inflammation subsided, and the ultrasound showed complete recovery of the affected fibers, with a density and composition different from healthy tissue, but no rupture was observed (Fig. 3.2).

c) **Follow-up visit 3 (3 weeks after injection):** The ultrasound image showed the beginning of tendon fiber alignment, indicating the start of the remodeling phase (Fig. 3.3). After this visit, the patient initiated a controlled loading regimen, starting with cycling before resuming running. Since the tear caused significant fibrosis in the area surrounding the injury, two electrolysis sessions.

d) **Follow-up visit 4 and first electrolysis session (5 weeks after injection):** The electrolysis was performed using a portable multi-option percutaneous electrotherapy equipment, APS-4 (Agupunt, Barcelona, Spain).

e) **Follow-up visit 5 and second electrolysis session (6 weeks after injection):** The second electrolysis was performed with a significant improvement in fibrosis was observed (Fig. 4).

Given the favorable results, the patient was allowed to resume his normal sports activities. He was able to do so, albeit with some discomfort, which is understandable given the extent of the injury. The treatment was well-tolerated, and no complications or adverse effects were reported. Fig. 5 shows the timeline and clinical outcomes.

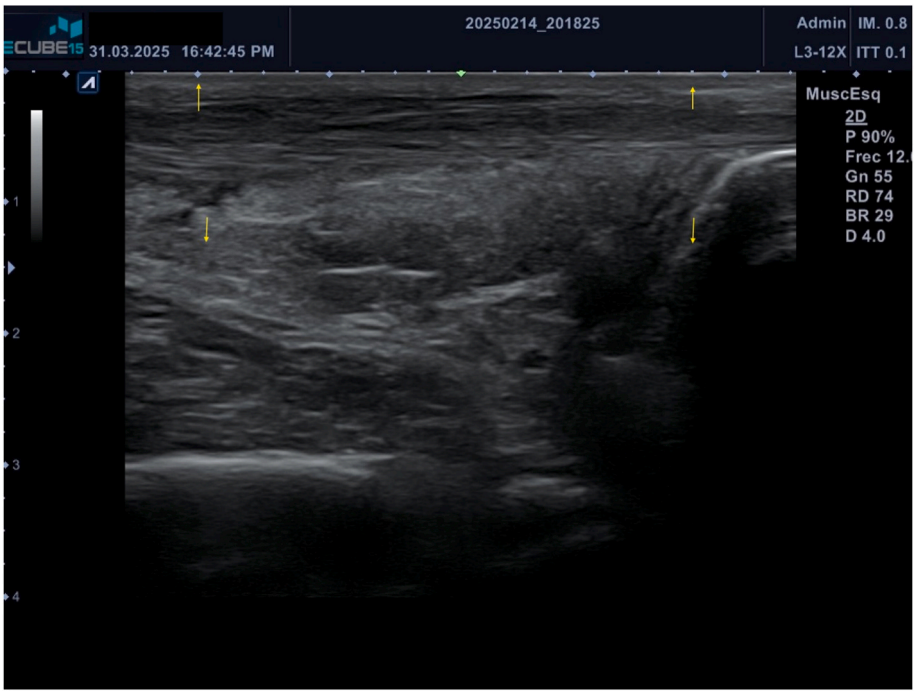

Fig. 4. Follow-up visit 5 (6 weeks after injection): Ultrasound image showing significant improvement in fibrosis after 2 electrolysis sessions using a portable multi-option percutaneous electrotherapy equipment. The yellow arrows mark the tendon thickness.

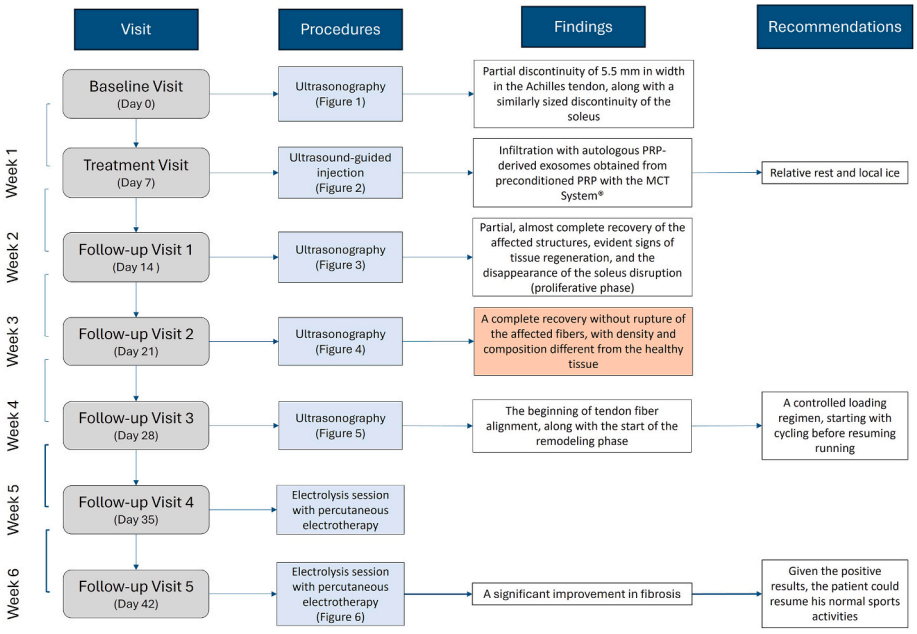

Fig. 5. Timeline and clinical outcomes.

3. Discussion

Growing evidence on the regenerative potential of autologous PRP-derived exosomes, combined with recent technological advances such as the Meta Cell Technology (MCT) platform,[15] motivated the use of this novel approach in the present case. The patient achieved complete structural recovery within three weeks, as confirmed by ultrasonography, without adverse effects. This rapid improvement suggests that preconditioned autologous products enhance tissue repair and support faster return-to-sport timelines in athletic populations.

Conservative, noninvasive strategies for partial Achilles tendon rupture typically involve prolonged rehabilitation protocols lasting three to four months, with or without adjunct therapies such as low-power laser, therapeutic ultrasound, transcutaneous electrical nerve stimulation, or extracorporeal shock wave therapy (ESWT).[4] In a previously reported case of a partial rupture treated with ESWT, pain improved only after two months, and ultrasonographic abnormalities persisted after three months.[8] PRP injections have also been investigated. In one case, a basketball player treated with three weekly PRP injections returned to sport after 64 days and resumed full play by day 75.[16] Another series of 27 patients with Achilles tendinopathy treated with three PRP injections showed significant improvement at 2 months,

with continued gains through 6 months and sustained benefit at 4.5 years.[17] Surgical treatment may be indicated in selected cases, but meaningful symptomatic improvement typically requires 6–12 months.[1]

Despite increasing interest, exosome- and EV-based therapies for tendon repair remain in the early stages, with findings derived exclusively from in vivo animal models, underscoring the need for human clinical trials. A PRISMA-based systematic review by Kasula et al.[18] identified 18 preclinical studies involving 800 subjects and reported strong preliminary evidence supporting stem cell–derived EVs for tendon healing without safety concerns. Similarly, Zou et al.[12] reviewed 46 heterogeneous preclinical studies and found that exosomes enhanced tendon and tendon–bone healing, improved biomechanical properties, and strengthened the tendon–bone interface. Collectively, current evidence suggests that exosomes may facilitate tendon repair by promoting cell proliferation and differentiation, modulating inflammation, enhancing the repair microenvironment, increasing type I collagen expression, and reducing type III collagen deposition.[12]

Several limitations must be acknowledged. Evidence regarding partial Achilles tendon ruptures remains scarce, limiting the ability to define standardized diagnostic or therapeutic protocols. Most data on exosome therapy for tendinopathies originate from animal studies, making direct comparison challenging due to differences in anatomy, physiology, and study design. The present report describes a single patient, limiting generalizability. Additionally, a longer follow-up period is required to assess the durability of healing and the risk of recurrence.

In summary, this case report demonstrates the potential of autologous PRP-derived exosomes preconditioned with the MCT System as a safe, minimally invasive treatment to accelerate healing of partial Achilles tendon ruptures. The rapid three-week recovery documented by ultrasonography suggests that this emerging regenerative approach may reduce rehabilitation time and facilitate earlier return to activity compared with conventional conservative treatments. Further clinical studies are warranted to define standardized protocols and evaluate long-term outcomes.

Informed consent

Written informed consent was obtained from the patient for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

Authors contribution

The author carried out all the work related to the manuscript.

Ethical statement

All procedures were performed in compliance with relevant laws and institutional guidelines. Given the nature of this clinical case, which required prompt intervention, the data is presented anonymously and is not part of a larger investigation; approval from an ethics committee is not a prerequisite in Spain.

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Meta Cell Technology S.L. paid the article processing charges and provided the machine and the necessary kits to precondition the sample for treatment.

Declaration of competing interest

The author did not receive any personal fees and has no financial disclosures to declare.

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