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Case Report

The Amniotic membrane burrito wrapping technique for surgical repair of closed rupture Tendoachilles - A case report

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Abstract

After surgical repair of TA rupture, peritendinous adhesions may arise with a potential to re-rupture. The best way to prevent peritendinous adhesions is not well known, even though they can occur after open, mini-invasive, or percutaneous repair procedures. This case report aims to document the efficacy of the human amniotic membrane burrito wrapping (AMBW) technique in repairing acute closed TA rupture over an extended follow-up period, considering tendon healing, gliding, and re-rupture prevention.

Level of evidence IV; Therapeutic studies; Case Report.

Keywords: Tendoachilles, amniotic membrane, stiffness, adhesions, wrapping.

Introduction

Following Tendoachilles (TA) injury repair, postoperative peritendinous adhesions, whether deep or superficial, may develop[1]. TA adhesions impair tendon mobility and gliding, which results in ankle stiffness and adversely affects the outcome of surgical repair. Adhesiolysis may be necessary for deep adhesions that do not improve with physiotherapy. They also have the potential to cause tendon re-rupture[2]. As peritendinous adhesions can follow any type of repair procedure as open, mini-invasive, or percutaneous repair, there is a lack of awareness regarding the best way to prevent them[1,3]. Considering tendon healing, gliding, and re-rupture prevention, the purpose of this study is to document the effectiveness of the human amniotic membrane burrito wrapping (AMBW) technique in repairing acute closed TA rupture over an extended period of follow-up.

Case report

A 43-year-old carpenter who had fallen while climbing stairs showed up in the emergency department with an injury to his left ankle. He didn't have any prior medical issues. The Thompson test was used to make a clinical diagnosis of a Tendoachilles injury. The patient was asked to lie prone and the degree of bilateral ankle plantarflexion was measured after the calf muscle was squeezed[4]. A gap was felt at the tendon insertion into the calcaneal tuberosity. There was no associated neurovascular injury. An avulsion fracture of the calcaneal tuberosity with a thin bony chip was visible on the lateral ankle radiograph (Figure 1A). Magnetic resonance imaging (MRI) confirmed a complete avulsion of tendon form its insertion and proximal retraction of fibers with a 39-millimeter gap (Figure 1). After being made aware of the potential advantages and disadvantages of the procedure, the patient gave his informed consent. The ethics committee of our institution approved the study.

AM preparation

The amniotic membrane was obtained with the written consent of a 33-year-old healthy female patient from our institution's Department of Obstetrics who was scheduled for an elective caesarean section (CS) for her first child, to guarantee its viability and sterility. Before CS, serological

Study performed at Mansoura University, Mansoura, Egypt.

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testing verified her negative status for AIDS, syphilis, and hepatitis B and C. Additionally, the cytomegalovirus test came back negative. Before delivery, the patient had not previously received or donated blood in the previous year.

At the CS, the amniotic membrane (AM) was processed and prepared in a sterile environment. The membrane was gently rinsed after the AM and was meticulously cleaned several times with sterile saline solution to remove any blood clots that adhered to its chorionic surface. After being thoroughly cleaned, the AM was covered in water in a balanced saline solution and treated with antibiotics (Amphotericin, Vancomycin, Neomycin, and Streptomycin) to cover anaerobic, Gram-negative, and Gram-positive bacteria and fungi. Following rinsing, the membrane was placed in an appropriately sized, sterile, airtight container that was filled with 50% glycerol in Dulbecco's Modified Eagle Medium (DMEM, Gibco), along with an equivalent combination of antibiotics. To enable the antibiotics to permeate the tissue and destroy any potential bacteria or other microorganisms, the tissue was then kept at -80°C for the following day[(5)]. The AM was defrosted at room temperature, rinsed with regular buffered saline solution, and kept ready for use before our surgical intervention.

Surgical technique

The patient underwent surgery on the 5th day of injury. The patient received spinal anesthesia. The two legs were prepped and dapped. A tourniquet was raised following the exsanguination of the injured limb. The patient was kept in a prone position. A 12cm vertical incision on the posteromedial side was made, going all the way to the paratenon. The tendon was then attempted to be approximated distally to the calcaneus, ineffectually. stepladder tendon lengthening was done to lengthen the tendon to reach its insertional site (Figure 2). After that, two stitches were used to weave the tendon's vertical limbs together, using non-absorbable sutures (Ethibond number 5).

Approximation of the distal tendon to its insertional site was rechecked compared to the contralateral limb, before taking the stitches. Every time, approximation was made easier by ankle plantarflexion. The distal tendon was debrided, and the edges were refreshened. Care was taken not to injure the sural nerve and the posterior tibial neurovascular structures.

Next, the amniotic membrane placement site was prepared on the bed of the Tendoachilles facing underlying muscles (Figure 3A). The AM was positioned with its smooth surface (amnion surface) facing the soft tissue and skin above and its rough surface (chorion surface) facing the Tendoachilles. The four suture ends of a double-loaded titanium Corkscrew® suture anchor, measuring 5.0 mm, were then ready to pass through the tendon after the suture anchor was inserted into the calcaneus. With the foot placed in plantar flexion, the restoration of appropriate tendon length was guided by the contralateral extremity. Subsequently, the sutures of the anchor were inserted into the tendon in an upward direction, and two knots were fastened to secure the repair.

Next, the AM that had been previously placed was stretched over the entire exposed length of the repaired tendon and wrapped around the Tendoachilles (Figure 3). Using absorbable Vicryl 2-0 sutures, the AM was carefully sewn into the tendon, stretching both the insertional site and the entire length of the exposed tendon. Any excess AM was then excised. Any paratenon remnants were then approximated with the same absorbable sutures. After the tourniquet

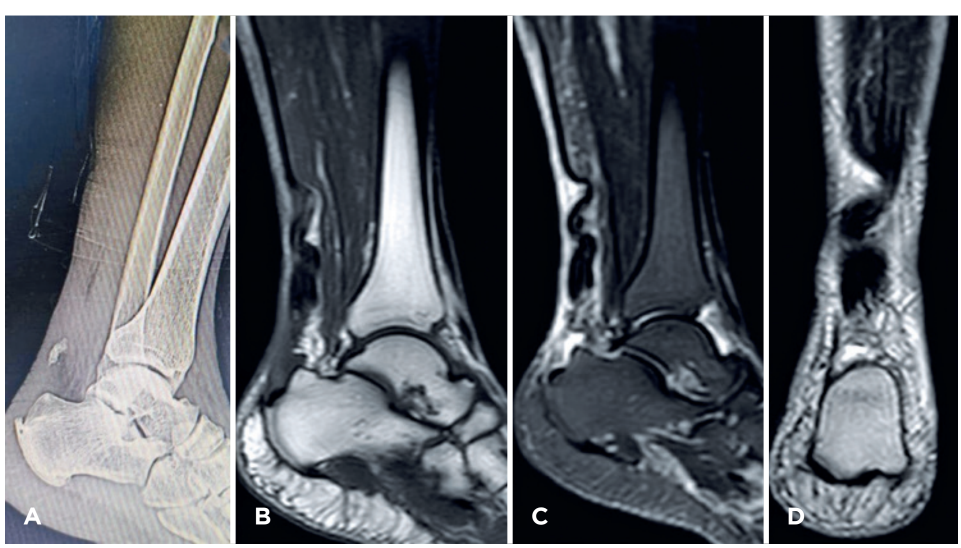

Figure 1. Lateral ankle radiograph (A) shows Tendoachilles avulsion injury from calcaneal insertion. MRI images: sagittal T1 (B), sagittal fat suppression (C), and coronal (D) slices reveal Tendoachilles insertional tear with tendon retraction.

was deflated, proper hemostasis was assured. Prolene 2-0 interrupted sutures were inserted into the skin layer to guarantee careful closure. There was no suction tube placed.

Postoperatively, a posterior back slab splint was applied with the foot at approximately 20 degrees of plantar flexion. Two weeks after surgery, a wound check was performed. Once full skin healing was evident, skin sutures were taken out. After four weeks, the splint was removed, and a controlled action motion (CAM) walker was used to achieve a neutral ankle position. The patient progressed with weight-bearing. Six weeks postoperative, isometric contractions of the gastrocnemius-soleus complex were initiated as the starting point of the rehabilitation program that focused on stretching and strengthening exercises. The patient commenced his daily heavy activities and running after 18 weeks, postoperatively.

The patient's 56-month follow-up was finished. No iatrogenic sural nerve injury, tendon re-rupture, wound infection, or dehiscence were observed during this time. There were no directories of deep or superficial adhesions through the plantar and dorsiflexion of the ankle or heel rise in comparison to the normal ankle (Figure 4). Visible subcutaneous tethering, tightness, or stiffness during tendon movement may be indicative of superficial adhesions. Additionally, deep tendon

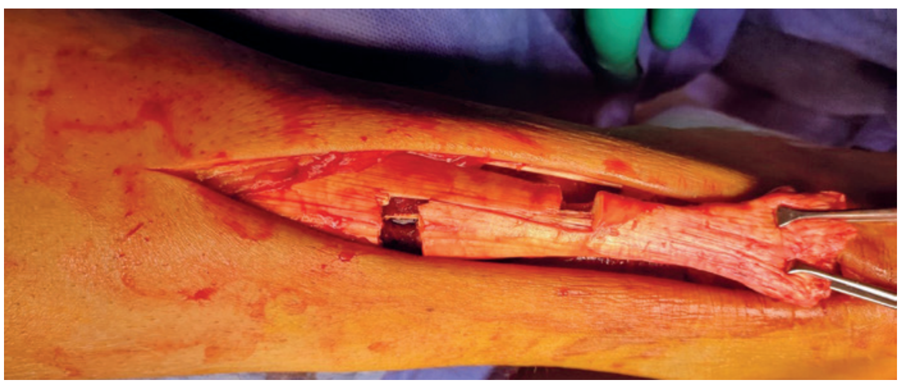

Figure 2. Intraoperative clinical photo after stepladder Tendoachilles lengthening.

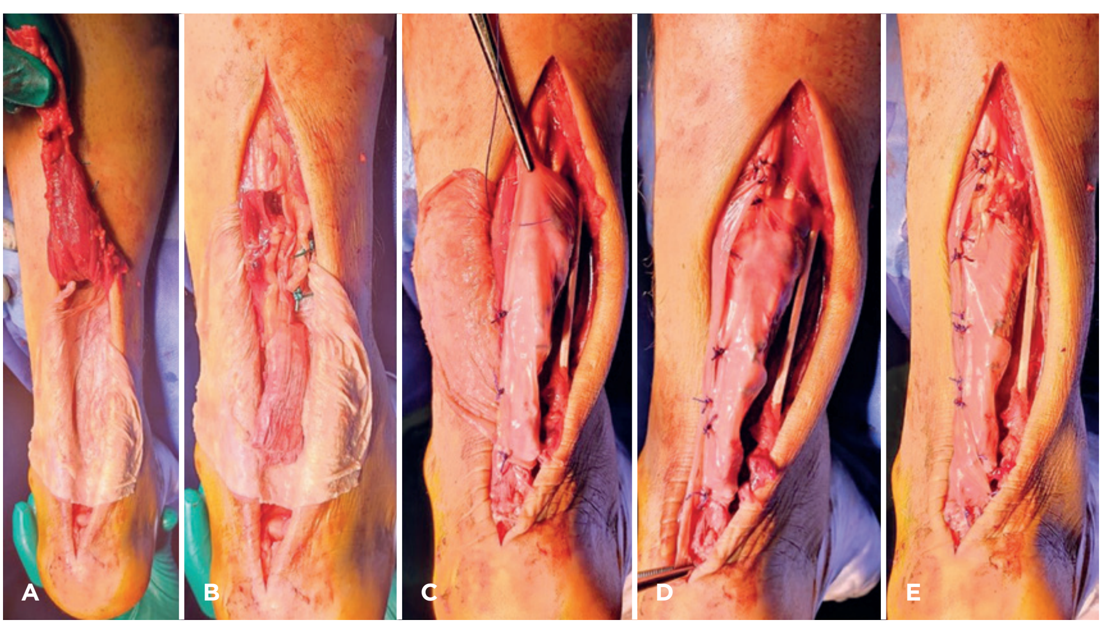

Figure 3. Intraoperative clinical photos demonstrate the AMBW technique: (A) The TA is displaced superiorly, and the AM is placed as a bed for the tendon such that its chorionic surface faces the TA and the amniotic surface faces the underlying tissues and overlapping skin, (B) TA is retained into its position, (C) Following reinsertion of TA into its calcaneal insertion, (D) AM is wrapped and stretched along the entire length of exposed TA, (E) AM is fashioned, secured, and stitched into the TA via absorbable vicryl sutures.

pain associated with decreased ankle range of motion (ROM) due to the tendon's decreased stretchability and elasticity may indicate the presence of deep adhesions[1].

At 6 months, 12 months, and the last visit, the functional status according to the American Orthopedic Foot and Ankle Society (AOFAS) Scale[6] was 78, 99, and 100, respectively. At the last visit, the Achilles tendon Total Rupture Score (ATRS)[7] was 96. The active non- weight bearing ankle (tibiotalar) motion using the orthopedic goniometer revealed active plantar- and dorsiflexion of 44° and 20°, respectively, lower than the contralateral normal tibiotalar motion by 1.5° and 2°. The ankle plantarflexion strength[8] measured with the microFET®2TM digital handheld dynamometer[9] (HOGGAN Industries, Inc., West Jordan, UT, USA) was 534.5 Newtons (N), or 96.4% of the normal side (554.5 N). The maximum calf circumference was assessed using flexible tape in a sitting position with the knee and ankle at a right angle and the feet resting on the floor, at 15 cm below the medial joint line. The calf circumference was 42.5 centimeters with 1.8 centimeters lower than the sound limb. One year after surgery, MRI imaging confirmed the TA integrity and full healing with increased diameter of the repaired tendon (Figure 5).

Figure 4. Clinical photos at final follow-up visit; (A) wound scar, (B) double heel rise revealing no visible subcutaneous tethering or bounce all over the tendon, (C and D) active ankle plantarflexion and dorsiflexion.

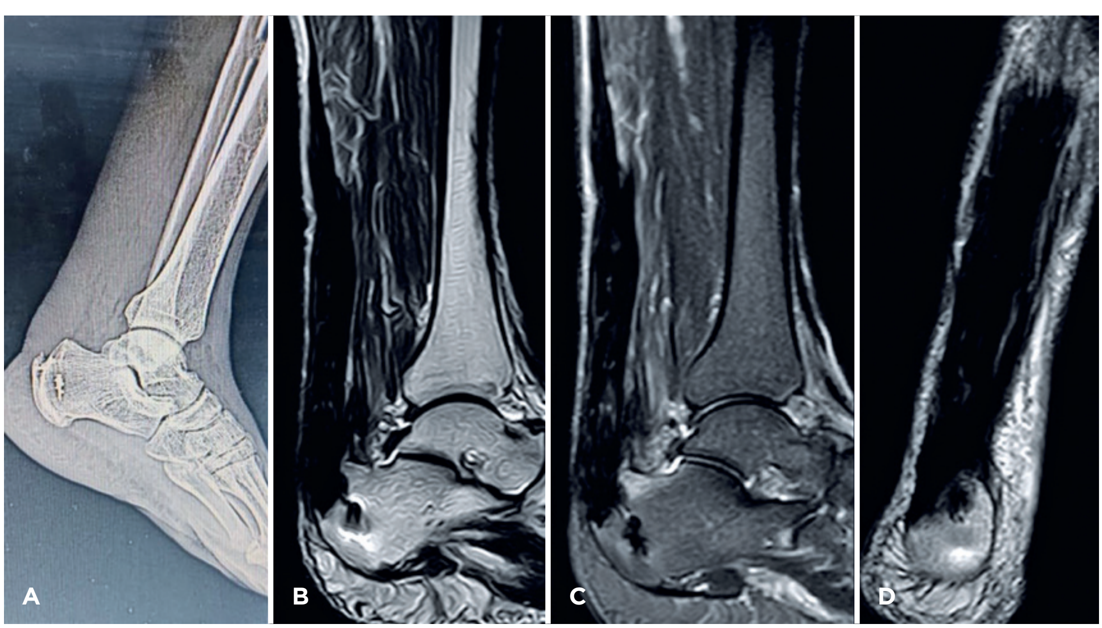

Figure 5. One year postoperative; Lateral ankle radiograph (A) shows restoration of TA continuity to its insertion via an inserted anchor. Sagittal T1 (B), sagittal fat suppression (C), and coronal (D) MRI slices reveal restoration of TA continuity with increased diameter.

Discussion

Peritendinous adhesions with the potential to re-rupture, and wound healing issues may occur after surgical repair of TA rupture[2]. The cuts made during repair to allow for the passage of needles and sutures may result in superficial adhesions. Nevertheless, deep adhesions develop slowly and are easily overlooked; they are frequently incorrectly identified as chronic regional pain syndrome, neurogenic leg pain, or deep vein thrombosis[10]. Deep adhesions primarily result from the tendon remodeling around non-absorbable suture material, which affects the thickness of the tendon[1]. Various surgical strategies, such as minimally invasive and percutaneous repair techniques, have been employed to prevent these postoperative complications[10]. These choices are still insufficient, though.

As previously noted, AM is used in many specialties, including Ophthalmology, Gynecology, Plastic surgery, Gastrointestinal, Neurosurgery, and Orthopedics, to treat a variety of ailments, including wounds, ulcers, burns, and adhesions[11]. Its application demonstrated encouraging outcomes in the healing of peripheral nerves and ulnar nerve transposition revision surgeries[12].

This study employed the AMBW technique as a viable approach to managing acute TA rupture, to functionally regenerate the tissue during the healing process, rather than replacing the defects with scar tissues[13,14]. Along with the excellent outcome in terms of AOFAS & ATRS scores, ROM, calf muscle strength, and an early return to daily activities, the lengthy follow-up period-especially with MRI confirmation of tendon healing-represents a strong point for evaluating this procedure. The healed Tendoachilles showed an increased diameter at MRI slices. This widening may be explained by the membrane circumference itself together with the healed fibers. Morphologically, a surgically repaired tendon can be larger and wider than an intact one[15]. In this case, there were neither postoperative superficial nor deep adhesions. Any surgical technique that allows for earlier tendon healing and mobility can guard against postoperative adhesions and tendon rupture. The AMBW technique is presumed to issue both early tendon mobility and healing.

The concept of using human AM is predicated on its potential for healing, its status as a fully functional biological scaffold, and its cellular composition[14]. Therefore, we can reduce the immune antibody response and the ensuing inflammatory reaction that causes scarring when comparing these advantages to the artificial AM[11]. The AMBW technique might be an option to provide a properly healed tendon within a reasonable postoperative period that permits for early tendon mobility with secure gliding without adhesions, subsequently, this might be beneficial to limit the re-rupture rate.

Conclusion

This case may pave the way for the wider application of the AMBW technique as a low-immunogenic, biocompatible, and affordable procedure, particularly in highly active patients -who refuse conservative management- with medical conditions that impede soft tissue healing. Future clinical studies including large number of patients, with a comparative nature to different surgical options could be more conclusive.

Author' contributions: The author contributed individually and significantly to the development of this article: JD *(https://orcid.org/ 0000-0002-9600-7754) Conceived and planned the activities that led to the study, interpreted the results of the study, participated in the review process, performed the surgeries, bibliographic review, survey of the medical records. The author read and approved the final manuscript.*ORCID (Open Researcher and Contributor ID) iD.

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