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Review

Percutaneus repair in acute Achilles tendon rupture. Our experience in Chile

Perkutane Naht der Achillessehnenruptur. Unsere Erfahrungen in Chile

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KEYWORDS
Achilles tendon;
Rupture;
Acute;
Suture percutaneous;
Dresden Instrument

Abstract

Background: There is still no consensus in the literature regarding the ideal treatment of acute Achilles tendon ruptures.
Materials & Methods: We conducted a selective literature review and analyzed our own results.
Results: Open surgery offers good functional results, but presents high rates of surgical wound complications. Conservative treatment is also described as a good option, but rerupture rates are significantly higher than with surgical treatment. On the other hand, percutaneous treatment offers great functional outcomes with minimal soft tissue damage, making it for us our treatment of choice in this type of injury.
Outlook: In Chile, we have been developing some modifications to the original technique described by the Dresden Group in order to increase tensile forces of the repair and offer our patients a quicker and safer recovery.

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SCHLÜSSELWÖRTER
Achillessehne;
Ruptur;
Akut;
Naht;
Perkutan;
Dresdner Instrument

Zusammenfassung

Hintergrund: Bislang gibt es noch keinen Konsens in der Literatur bezüglich der idealen Therapie der akuten Achillessehnenruptur.
Material & Methoden: Wir führten eine selektive Literaturübersicht durch und analysierten unsere eigenen Behandlungsergebnisse.
Resultate: Die offene Achillessehnennaht führt zu guten funktionellen Ergebnissen, weist aber auch einen hohen Prozentsatz an Wundkomplikationen auf. Die konservative Therapie ist ebenfalls als gute Behandlungsoption mit geringerem Risiko, allerdins sind die Rerupturraten signifikant höher als bei operativer Therapie. Mit perkutaner Naht lassen sich ausgezeichnete Behandlungsergbnisse bei minimalem operativem Weichteiltrauma erzielen. Sie ist daher für uns die Therapie der Wahl bei diesen Verletzungen.
Ausblick: In Chile haben wir einige Modifikationen der Originaltechnik, wie sie von der Dresdner Gruppe beschrieben wurde, vorgebommen um die Zugkräfte der Naht zu verbessern und den Patienten eine schnellere Rehabilitation zu erlauben.

Introduction

Acute Achilles rupture is seen more often in recent years due to the increase of population practicing sport activities [9]. Although the cause of this injury is not well defined, it is known that the rupture occurs in tendons that already have accumulated degenerative changes, or due to the use of medications such as quinolones and steroids [7] The goal of treatment is to reestablish continuity of the gastrosoleus complex and normal length of the tendon, and that this repair resists the mechanical needs of our patients, allowing them a quick return to their daily and sport activities in a predictable and satisfactory manner. The way of achieving this results is still controversial today [5,11,13—16]. Treatment options include nonoperative orthopaedic treatment with cast or controlled active motion (CAM) boot, open surgery and percutaneous or minimally invasive surgery. Rerupture rates has been one of the main reasons orthopaedic surgeons prefer surgical treatment over conservative treatment, with publications that present reruptures rates high as 20% in conservative treatment [2,5,16].

On the other hand, patients who underwent open surgery presented surgical wound complication rates as high as 30% [5,16], this being the great disadvantage of this therapeutic option. Because of this, the idea of percutaneous and less invasive surgery was developed. In 1977, Ma & Griffith [8] described the first percutaneous technique for Achilles tendon rupture. Their technique included percutaneous cross-linking sutures, which presented a high risk of developing entrapment of the sural nerve, a complication also reported in subsequent studies [7,11,16]. Another problem described was the inability of a proper positioning of both ends of the tendon and the low resistance of the sutures, which resulted in elongated gastrosoleus complex with poor functional outcomes [5,7,11,12,16]. At the beginning of this century, the Universitätsklinikum Carl Gustav Carus Dresden Group, led by Dr. Michael Amlang designed a percutaneous technique, with important modifications from the previous techniques. A single surgical approach proximal to the tendon rupture, with a specially designed and reusable instruments, without multiple suture cross-linking, presenting reproducible results with low rates of re ruptures and sural nerve damage [1].

In the year 2004, after learning the technique from the original authors, we introduced it in our institution in Chile obtaining optimal results. As years passed by and after reporting our results [4], different public and private institutions in Chile have acquired and used the Dresden percutaneous technique as their treatment of choice for acute Achilles tendon ruptures.

However, in order to decrease variability in this surgical technique, and because of more demanding patients who looked for a quicker and functional rehabilitation period, our group has developed some modifications to the Dresden technique.

Surgical Indications

Our indications for this technique is for every patient with an acute Achilles rupture, 2 to 8 centimeters from the distal Achilles tendon insertion in the calcaneus, with less than 21 days from the injury. In athletic populations we also prefer the percutaneous technique, using in some cases a modified distal attachment, because we have seen isokinetic tests with ad integrum recovery of the articular torque and leg muscular strength,

avoiding the need for open surgery in this selected group of patients. In reruptures, injuries with more than 21 days of evolution and in open injuries we prefer classic open surgery. Conservative treatment is performed in very low demanding and older patients, and also when local skin conditions do not allow any kind of surgical treatment such as ulcers or burn sequelae.

Our modifications to the original technique

Our first modification was on the surgical instrument. We observed that the sutures were made in the proximal part of the tendon which was damaged and degenerative. Based on the first design, we decided to make it 5 centimeters longer, allowing us to perform a more proximal repair in healthy and non-degenerative tendon, decreasing the possibility of failure of the suture and subsequent Achilles tendon lenghtening during rehabilitation. Another modification applied was to eliminate the metallic tip in the edge of the instrument, as this part often ripped the tendon when pulling it out from the patient.

Another modification made was the choice of sutures used for the repair, selecting Fiberwire N2, (Arthrex, USA), because of its higher tensile force.

In 2012, a biomechanical study in bovine tendons was performed [12], in which we added a third non absorbable suture parallel to the previous two sutures described by Amlang, and we observed that the resistance to failure of the repair was increased more than 100% (675 N compared to 327 N in the two suture construct, $p < 0.001$). This finding obligated us to modify the instrument again, increasing 3 centimeters length of the buttonhole and providing it in an oval shape, allowing to cross-link the tendon with 3 parallel sutures at the same time without the need of removing the instrument for each suture pass.

Our last modification to the Dresden repair was to change the distal fixation to the tendon using sutures for a bone fixation in the posterior tuberosity of the calcaneus using two metallic anchors. A recent unpublished biomechanical study demonstrated that the weakest part of the repair is the suture crossing in the distal end of the tendon rupture, were the sutures ripped the tendon in the coronal plane thus permitting undesired gastrosoleus complex lengthening. Our indication for the use of anchors is in patients with highly demanding sports activities, body weight over 80 kilograms, and ruptures within 2 cm to the insertion in the calcaneus.

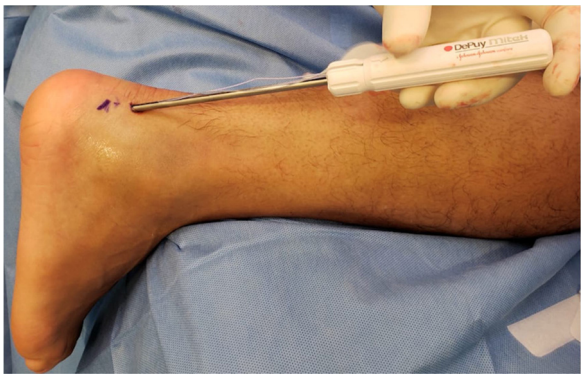

Fig. 1. Insertion of a 5.5 millimiter suture anchor (Healix TI® DePuy-Synthes, USA) through a stab incision at the calcaneus.

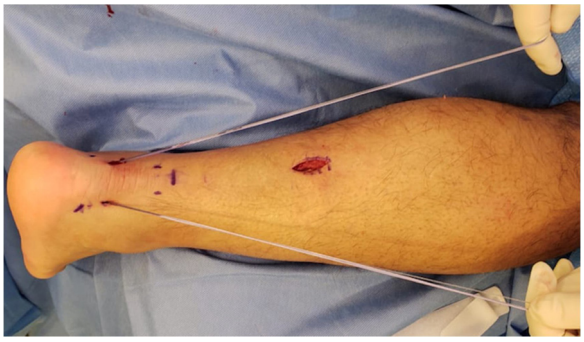

Fig. 2. Sutures from anchors at both sides of the Achilles footprint insertion.

For the insertion of the anchors a small stab incision is performed on both sides of the insertion of the Achilles tendon in the calcaneus, and through a blunt instrument the ventral part of the footprint is identified and then the two 5.5 milimiter anchors (Healix TI Depuy-Synthes, USA) are inserted, each one with four non absorbable sutures (Orthocord, Depuy-Synthes, USA) at both sides of the Achilles tendon. Then, through the proximal approach the modified Dresden instrument is inserted as usual, passing the buttonhole through the distals incisions, rescuing the anchorś sutures and taking them proximally. Then the proximal cross-linking is performed, achieving recovery of the physiologic heel equinus.)

Our preferred surgical technique is shown in figs. 1-4.

Rehabilitation

Prophylaxis against deep venous trombosis (dabigatran, ribaroxaban or Dalteparin, depending on surgeon preferences and patient comorbidities) is administered in all patients for 10 days. The ankle is kept in a CAM boot in equinus position with a 5 centimeters heel rise insole, allowing immediately

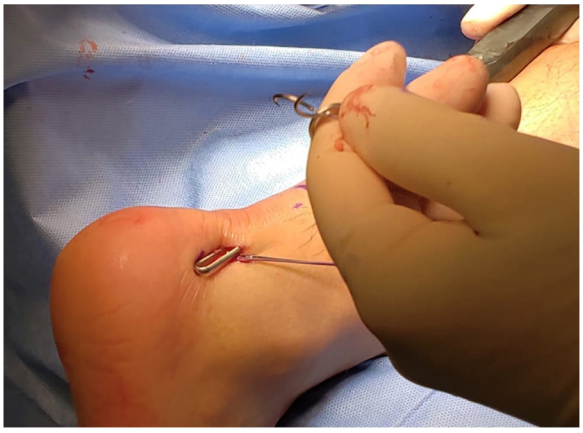

Fig. 3. Sutures from the anchors are retrieved from the lateral stab incision using the Dresden Instrument inserted through the proximal incision.

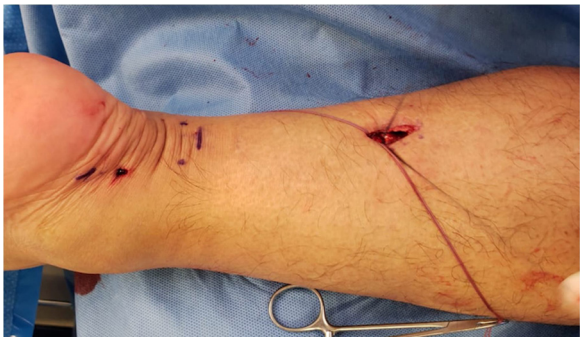

Fig. 4. All sutures at the proximal surgical wound, closing the gap and reestablishing the phisiological hindfoot equinus.

weight bearing using two crutches as tolerated. Passive ankle dorsiflexion up to 90 degrees is encouraged after 1 postoperative week, and active dorsiflexion and plantar flexion from the third postoperative week. Physical therapy also starts in the third postoperative week, and from that moment on the equinus provided by the boot is progressively removed weekly until the foot is in a completely neural position by the sixth week. Controlled jogging is allowed from the forth postoperative month, when patients are able to perform heel rise of the operated leg.

Our Results

The first review of our results was made in 2014 [4]. We included 100 patients, 91% men and 9% women, with a mean age of 42 years (± 11.9). Return to work was observed at a mean of 56 days (± 15.4), and return to sport activities was observed at a mean of 18,9 weeks (± 4.4), with 80% of our patients returning? to their previous sport level

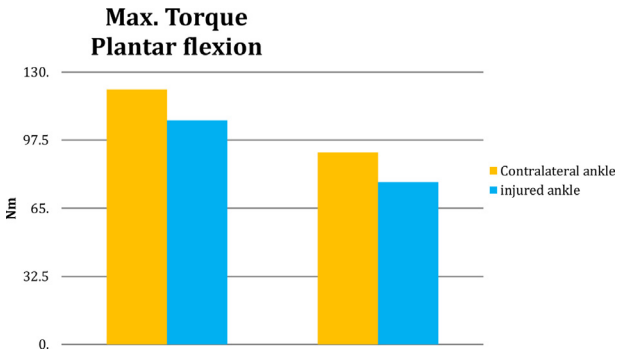

Fig. 5. Maximun torque in plantar flexion. No significant difference was observed between the operated side and the healthy contralateral side at 60°/seg ($p = 0.26$) and 120°/seg ($p = 0.14$).

prior their injury, and 5% of the patients returning to the same sport but in a lower performance. Only 8% of the patients decided to change their previous sport activity due to low confidence, fear of a new injury or persistent discomfort or pain. Only 7% of the patients did not return to perform sport activities.

No deep wound infections or complications were observed, or sural nerve neuritis. 2% of patients referred discomfort associated to palpable suture knots. Only 2 reruptures were observed, both occurred during the first ten postoperative weeks. An isokinetic evaluation was performed in 21 of these patients between 12 and 30 postoperative months, observing no difference compared to the uninjured ankle regarding plantar flexion torque at 60 deg/s (105.3 vs 116.8 Nm, respectively; $p = .32$) o a 120 deg/s (79.8 vs 90.6 Nm, respectively; $p = .051$). Also, no difference was observed total work in plantar flexion at 60 deg/s (157.0 vs 159.9 J, respectively; $p = .26$) o a 120 deg/s (100.2 vs 124.8 J, respectively; $p = .14$). The results are summarized in figs. 5 and 6.

To date, 24 Achilles tendon repairs using anchors for the distal fixation have been performed (unpublished data), presenting only one anchor pullout requiring surgical removal.

Discussion

Still there is no consensus on the best treatment for acute Achilles tendon ruptures [5,7,11,16]. Conservative treatment is more popular due to results from some authors that have shown functional results and rerupture rates similar to surgical treatment when a functional rehabilitation and early weigthbearing is applied [10,11,13], different from classical prolonged inmobilization periods. In our

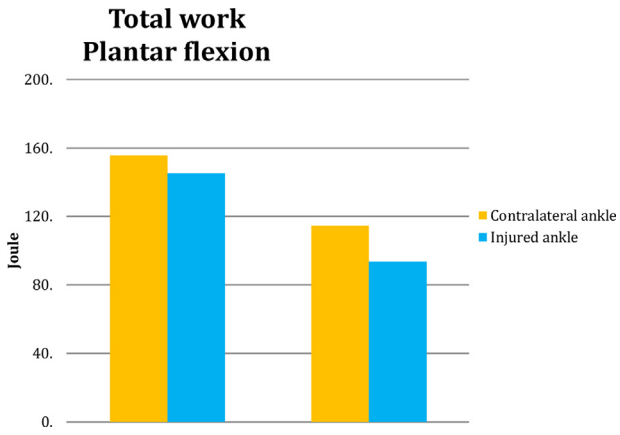

Fig. 6. Total work in plantar flexion. No significant difference was observed between the operated side and the healthy contralateral side at 60°/seg ($p = 0.32$) and 120°/seg ($p = 0.051$).

opinion, it is unlikely that espacio patients with low demands and activity will notice an elongated Achilles tendon after an orthopaedic treatment.

On the other hand, surgical treatment has presented higher return to sport activities and lower overall rerupture rates comparable to conservative treatment (3.2% vs 20%) [7,11,16]. However, the main problem of the classic open surgical approach is wound complications, soaring up to 29% in some systematic reviews with 18% of these corresponding to wound infections [5]. This was one of the reasons that percutaneous techniques were developed, with significantly lower surgical wound complication rates [5,7,11,16] Minimally invasive or percutaneous techniques also present problems, such as sural nerve damage with series up to 60% [3,6], and low strength of the tendon repair and therefore a higher risk of reruptures [5,7,11,16].

The Dresden group presented a good solution to the sural nerve problem, using a technique that does not cross-link between sutures and the surgical plane is located between the paratenon and the superficial fascia of the leg, in a different anatomic layer were the sural nerve is located [1]. In the original series, Amlang et al. did not report sural nerve problems, and only 1 case of wound dehiscense [1]. Also, keeping the paratenon unexplored preserves the injury hematoma, which is the base for a more biological repair. Similar to the Dresden group, in our series we did not present any wound dehiscenses or sural nerve problems [4].

The Dresden technique [1] has already demonstrated to be safe regarding wound complications and sural nerve problems, but the tensile strenght in percutaneous repair has been shown to be close to 50% less than open repairs in a biomechanical study [3]. In order to study its biomechanical behavior and increase in tensile strength, Ortiz et al [12], compared in vitro resistance to failure and gap formation of the Dresden technique vs open Krackow suture using Fiberwire N2 (Arthrex, USA), observing that the percutaneous technique presented a higher resistance regarding gap formation ($p = 0.007$), and resistance to failure similar to the Krackow technique. This same study described the Dresden technique using three sutures, showing better resistance to failure and less gap formation than any other suture compared, even 100% superior to the classic two technique Dresden suture (246 N in three sutures in vs 180 N two sutures for a 5 mm gap formation). Regarding function, even the 2 suture Dresden technique repair offers excellent results, showing no difference in isokinetic evaluations comparing the operated ankle to the healthy ankle [4].

In our opinion, the ideal Achilles tendon repair must allow patients to return to their previous functional condition, with low numbers of wound complications and sural nerve problems. Also, it must be resistant enough to offer a quick rehabilitation and avoid reruptures or undesired tendon elongation, at a reasonable economic cost. We believe that conservative treatment and open surgery don't fulfill all this objectives and therefore we prefer the percutaneous technique for most of our acute Achilles tendon ruptures.

We believe that the Dresden technique is a safe and reproducible treatment for acute Achilles tendon rupture, that decreases risk of wound complications and sural nerve problems, and with the modifications added by our group the tensile strength resistance increases enough to allow a quick and safe rehabilitation for our patients.

Conflict of Interest

The authors declare that there is no conflict of interest.

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