Acute Achilles Tendon Injury Treatment Using a Minimally Invasive Knotless Technique. Rehabilitation and Immediate Weight Bearing

Nicolás Raimondi,[*],[**] Sergio Massetti,[**] Andrés Villada[#]
[*] *Leg, Ankle and Foot Sector, Hospital Universitario Austral (Buenos Aires, Argentina)*
[**] *Leg, Ankle and Foot Sector, San Isidro Traumatology and Orthopedics Center (Buenos Aires, Argentina)*
[#] *Leg, Ankle and Foot Sector, Hospital Zonal General de Agudos "Dr. Ramón Carrillo" (Buenos Aires, Argentina)*

ABSTRACT

Introduction: Modern surgical techniques seek to rehabilitate early for recovery in less time. Minimally invasive techniques are one option to accomplish this. **Objective:** To evaluate the ability to start rehabilitation and weight bearing in the immediate postoperative period and the evolution at 6 months postoperative using a minimally invasive knotless technique. **Materials and Methods:** 10 surgical repairs of acute Achilles tendon injuries were performed with a minimally invasive technique. The original Arthrex combination system (PARS - SpeedBridge™) was used. After 48 hours, weight bearing was progressively allowed according to tolerance. The final outcome at 6 months was evaluated using the ATRS score. **Results:** On average, patients took 14 days to walk without crutches. All began rehabilitation with active and passive ankle range of motion during the first postoperative week. The average ATRS score was 79 points (between 60 and 90 points). **Conclusion:** This technique has proven to be an excellent surgical option in acute midsubstance Achilles tendon injuries. The patients were able to start rehabilitation within the first postoperative week, whereas immediate weight bearing was not possible, due to the patients' pain or fear.

Key words: Achilles tendon; minimally invasive technique; knotless technique; early rehabilitation.
Level of Evidence: IV

Tratamiento de la lesión aguda del tendón de Aquiles mediante una técnica mínimamente invasiva sin nudos. Rehabilitación y carga de peso inmediata

RESUMEN

Introducción: Las técnicas quirúrgicas modernas buscan rehabilitar en forma temprana para una recuperación en menor tiempo. Las técnicas mínimamente invasivas son una opción para lograrlo. **Objetivo:** Evaluar la capacidad de comenzar una rehabilitación y la carga de peso en el posoperatorio inmediato utilizando una técnica mínimamente invasiva sin nudos y la evolución a los 6 meses de la cirugía. **Materiales y Métodos:** Se realizaron 10 reparaciones quirúrgicas de lesiones agudas del tendón de Aquiles con una técnica mínimamente invasiva sin nudo. Se utilizó el sistema combinado (PARS – SpeedBridge™ original. A las 48 h se permitió la carga completa de forma progresiva, según tolerancia. Se evaluó el resultado final a los 6 meses utilizando el puntaje ATRS. **Resultados:** En promedio los pacientes tardaron 14 días en deambular sin muletas. Todos comenzaron la rehabilitación con movilidad activa y pasiva del tobillo durante la primera semana posoperatoria. El puntaje ATRS promedio fue de 79 (rango 60-90). **Conclusión:** Esta técnica ha demostrado ser una excelente opción quirúrgica en las lesiones agudas del tendón de Aquiles de media sustancia, pero no fue posible comenzar con la carga de peso inmediata debido al dolor o temor del paciente, pero sí con la rehabilitación dentro de la primera semana posquirúrgica.

Palabras clave: Lesión de Aquiles; técnica mínimamente invasiva; técnica sin nudos; rehabilitación temprana.
Nivel de Evidencia: IV

Received on July 5th, 2020. Accepted after evaluation on November 29th, 2020 • NICOLÁS RAIMONDI, MD • niraimon@cas.austral.edu.ar https://orcid.org/0000-0002-2561-8590

How to cite this article: Raimondi N, Massetti S, Villada A. Acute Achilles Tendon Injury Treatment Using a Minimally Invasive Knotless Technique. Rehabilitation and Immediate Weight Bearing. *Rev Asoc Argent Ortop Traumatol* 2021; 86 (3) :356-364. https://doi.org/10.15417/issn.1852-7434.2021.86.3.1153

INTRODUCTION

The incidence of acute non-insertional Achilles tendon injury is increasing in patients aged 30 to 50 years, and more than 50% of cases occur during recreational sports.[1]

The choice of treatment remains a controversial topic, it can be surgical or conservative.[2] During the last decade, surgical treatment has been considered the first option,[3] especially in high-performance athletes.

The incidence of re-rupture has been shown to be higher in conservatively treated patients, but the risk varies between different studies.[4] However, operated patients are at higher risk of infections and soft tissue problems.[5] According to the *American Academy of Orthopedic Surgeons* (AAOS) practice guidelines, minimally invasive techniques cause fewer overall complications than traditional open repair.[6] Modern surgical techniques seek to rehabilitate early, to achieve recovery and return to daily activities and sports in less time.

OBJECTIVE

To assess the ability to start rehabilitation and weight bearing in the immediate postoperative period using a minimally invasive knotless technique and the evolution six months after the intervention.

MATERIALS AND METHODS

A retrospective study was conducted in a healthcare facility in the province of Buenos Aires. 10 patients operated between January and March 2019 to treat an acute Achilles tendon rupture were included.

The inclusion criteria were: 1) age between 18 and 55 years, 2) acute midsubstance Achilles tendon injury, and 3) surgery using the same percutaneous knotless technique. The exclusion criteria were: 1) age >55 years and <18 years, 2) injuries of more than three weeks of evolution, 3) previous surgeries or conditions of the Achilles tendon.

All patients were operated on by the same leg, ankle and foot surgeon, with the same surgical technique. The original PARS - SpeedBridge ™ (Arthrex) combined system was used, with a minimally invasive knotless technique.

Surgical technique

The patient was placed face down with the leg in neutral rotation. Both feet were left hanging at the end of the table to allow the control of the plantar flexion of the ankle during surgery.

A 2 cm wide transverse skin incision was made on the proximal aspect of the palpable defect in the midsubstance Achilles tendon (Figure 1). The paratenon was opened, the proximal tendon stump was secured with an Allis clamp, and gentle distal traction was applied. A Percutaneous Achilles Repair System jig (Arthrex) was then inserted into the incision and advanced proximally into the paratenon. A passing needle was placed through the jig and tendon for preliminary fixation (Figure 2). Suture needles and No. 2 FiberWire sutures (Arthrex) were passed using numbered holes along the side of the jig (Figure 3). The jig was removed through the incision with all the sutures to ensure fixation and control of the proximal tendon (Figure 4). Then, two 5 mm longitudinal incisions were made on the posterior aspect of the heel, medial and lateral to the insertion of the Achilles tendon in the calcaneus. The drill (3.5 mm) and the drill guide were used through each incision, oriented slightly towards the midline (Figure 5). Each hole was drilled to receive the 4.75mm SwiveLock® Anchor (Arthrex). The Banana SutureLasso ™ (Arthrex) with inner nitinol wire was passed through the distal stump of the Achilles tendon distally (heel incision) to proximally (transverse incision), to retrieve a side of the proximal sutures (Figure 6). The sutures were passed through the distal stump of the Achilles tendon and the process was repeated for the other side. Ankle plantar flexion was performed to adequately tighten the Achilles tendon. Sutures were passed through the eyelet of the SwiveLock® anchor (Arthrex), and the anchor was gently inserted into the calcaneal drill hole up to bone level (Figure 7). The process was repeated for the insertion of another SwiveLock® anchor. The repair of the paratenon with absorbable sutures was followed by subcutaneous and skin closure. After the final repair, plantar flexion of the ankle at rest was assessed and the Thompson test was performed (Figure 8).

Figure 1. 2 cm transverse skin incision on the proximal aspect of the palpable defect in the midsubstance Achilles tendon.

Figure 2. Percutaneous Achilles tendon Repair System (Arthrex) in the incision, advanced proximally into the paratenon. A passing needle is placed through the jig and tendon for preliminary fixation.

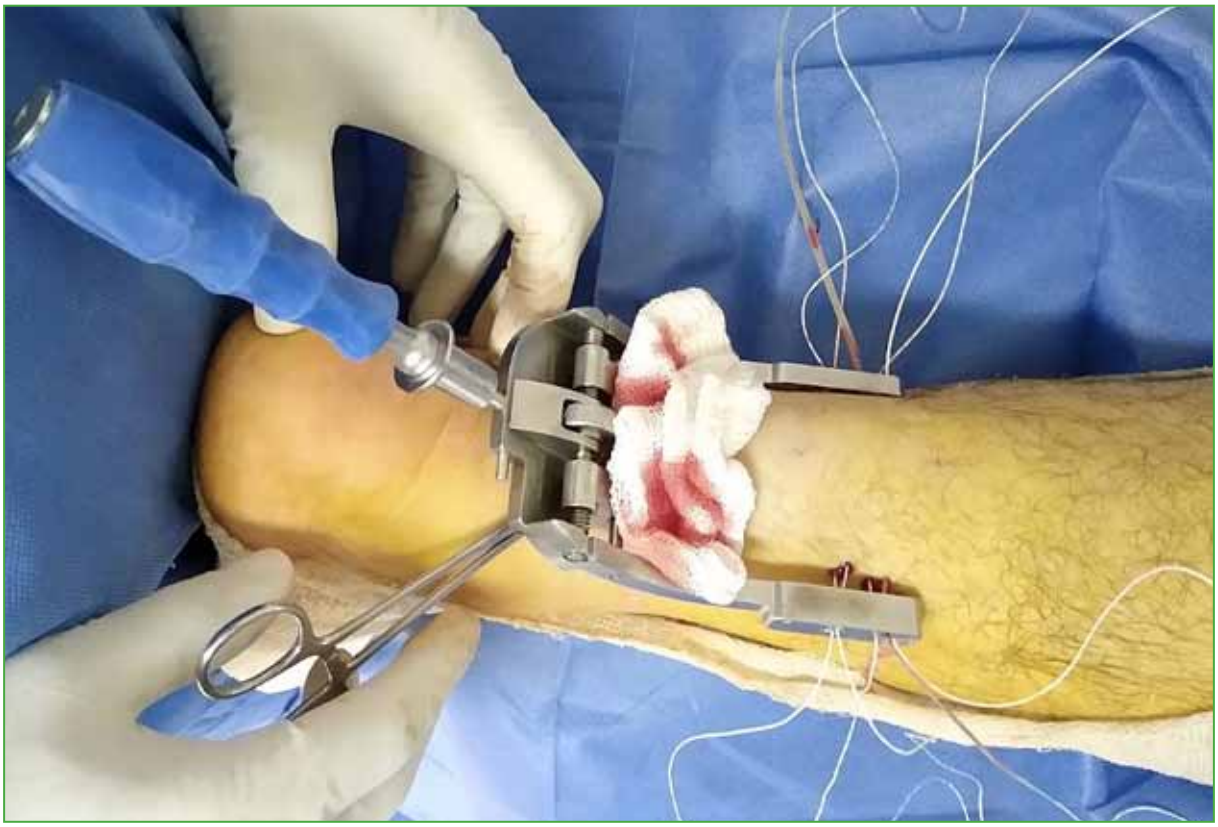

Figure 3. Suture needles and No. 2 FiberWire® (Arthrex) are passed using numbered holes along the side of the jig.

Figure 4. The clamp and jig are removed through the incision, and all pairs of sutures are pulled distally to ensure fixation and control of the proximal tendon.

Figure 5. Two 5 mm longitudinal incisions are made along the posterior aspect of the heel along the sides of the Achilles tendon insertion. The drill (3.5mm) and drill guide are used through each incision oriented slightly toward the midline.

Figure 6. The Banana SutureLasso ™ (Arthrex) with inner nitinol wire is passed through the distal stump of the Achilles tendon and through a proximal incision to retrieve one side of the proximal suture.

Figure 7. The ankle is plantar flexed to properly tighten the Achilles tendon and an assistant holds it in place. Sutures are passed through the eyelet of the SwiveLock® Anchor (Arthrex), and the anchor is gently inserted into the calcaneal drill hole and hand-tightened until it reaches bone level.

Figure 8. After the final repair, the plantar flexion of the ankle at resting position is evaluated and the Thompson test is performed.

A plantar flexion splint was placed for immobilization. After 48 h, the splint was removed and a walker boot with 2 heel wedges, each 1.5 cm high, was placed. Full weight bearing was allowed, progressively, according to tolerance. Rehabilitation was indicated, with a kinesiologist familiarized with the surgical technique used.

Follow-up visits took place weekly during the first month, every two weeks during the second month and once a month until six months. The final outcome was assessed at six months using the ATRS (*Achilles tendon Total Rupture Score*). It is a patient-informed instrument with high reliability, validity, and sensitivity to measure the outcome after treatment in patients with total Achilles tendon rupture.[7]

FINDINGS

Ten surgical repairs of acute Achilles tendon injuries were performed using a minimally invasive knotless technique in 10 patients (8 men and 2 women), of an average age of 40 years (range 21-50). Six procedures were on the right side and four on the left side. The minimum follow-up was 6 months (range 6-9). All patients had been injured during recreational sports (9 soccer and 1 volleyball).

A postoperative follow-up of up to 6 months was conducted in 9 of the 10 operated patients. A patient moved abroad a month after the surgery and it was not possible to contact him.

The average time elapsed between injury and surgery was 7.5 days (range 5-9). There were no intraoperative complications. The evolution of the wounds was very good and free of complications (infection, dehiscence or adhesion). There were no neurological injuries.

All patients had their splint removed 48 h after surgery, a walker boot with a 3 cm heel wedge was placed, and they were allowed to begin weight bearing progressively with assistance of crutches according to tolerance. They were told that they could leave the crutches the same day the splint was removed. A heel pad was removed after three weeks.

The patients took 14 days on average to walk without crutches (range 7-20). None of them did full weight bearing before day 7 after surgery, due to pain or fear of rupture of the fixation system of the tendon to the calcaneus. All patients began rehabilitation with active and passive ankle range of motion during the first postoperative week. They began walking without a walker boot, on average, at 6.6 weeks (range 6-8). The return to normal work activities occurred, on average, at nine weeks (range 4-12). One patient resumed sports activity (skiing) at three months and 10 days. The remaining eight did not start sports activity until five months after surgery.

Nine patients were discharged at 6 months. The average ATRS score was 79 (range 60-90). All patients said they were satisfied with the procedure and that they did not regret the decision of undergoing surgery. Two patients experienced mild to moderate pain at the SwiveLock® placement site when rubbing with footwear until the last follow-up appointment at 6 months.

DISCUSSION

Many minimally invasive techniques that achieve good functional outcomes and a low complication rate have been described. In a meta-analysis of 800 patients, percutaneous techniques reduced the rates of re-rupture and overall complications when compared to open surgical techniques.[5]

Compared to open techniques, the advantages of minimally invasive techniques in terms of complication rate are clear. However, in all of these techniques, knots are used to hold both ends of the Achilles tendon together and do not allow rehabilitation to begin immediately.

After a minimally invasive procedure using Dresden instruments, Amlang et al.[8] allowed patients to start physiotherapy at two weeks. Using the same technique, Joannas et al.[9] allowed active dorsiflexion of the ankle at three weeks and Arzac et al.[10] authorized physiotherapy and 50% weight bearing at five weeks.

In a prospective randomized study, De la Fuente et al. concluded that patients operated using a minimally invasive technique with Dresden instruments and who begin aggressive and immediate rehabilitation have better clinical outcomes and better Achilles tendon function at 12 weeks without increasing complications.[11]

A biomechanical study comparing the original Arthrex PARS (minimally invasive technique with knots without fixation to the calcaneus) with the open Krackow repair did not find significant differences in load and work, but did find a higher initial linear stiffness for open repair, which could potentially reduce the gap formation during postoperative rehabilitation.[12]

Tendon lengthening is a recognized complication of Achilles tendon rupture repair. This can worsen the functional outcome and has been shown to be more common with minimally invasive procedures than with open techniques.[13]

Using the technique presented in this study, the suture passes through the distal stump of the tendon in its entire length, before anchoring directly to the calcaneus at the anatomical insertion point; this avoids the risk of knot failure and cutting of the suture at the distal end of the tendon.[14] This can be contrasted to other minimally invasive techniques that do not anchor in the bone, which would allow rehabilitation and weight bearing to begin in the immediate postoperative period, with less risk of elongation and re-breakage.

The clinical outcomes of this technique are mainly limited to case reports,[15] but, like the results of this study, the initial reports are promising and support early rehabilitation and early return to sports. A preliminary report of 34 patients operated on with the same technique indicates that there were no complications and that the results were satisfactory.[16]

CONCLUSIONS

The minimally invasive knotless technique described and used in the nine patients monitored for six months was an excellent surgical option for acute midsubstance Achilles tendon injuries. There were no complications from the wounds nor neurological injuries. Weight bearing could not start until after 48 h after surgery, due to pain or fear of the patient, but rehabilitation started within the first week after surgery.

More studies with a larger number of patients operated with this technique are needed to compare it with other minimally invasive and open techniques in order to draw meaningful conclusions.

Conflict of interests: The authors declare they do not have any conflict of interests.

S. Massetti ORCID ID: https://orcid.org/0000-0001-8576-8091
A. Villada ORCID ID: https://orcid.org/0000-0003-0815-8307

REFERENCES

1. Raikin SM, Garras DN, Krapchev PV. Achilles tendon injuries in a United States population. *Foot Ankle Int*. 2013;34(4):475-80. https://doi.org/10.1177/1071100713477621
2. Bhandari M, Guyatt GH, Siddiqui F, Morrow F, Busse J, Leighton RK, et al. Treatment of acute Achilles tendon ruptures: a systematic overview and metaanalysis. *Clin Orthop Relat Res* 2002;400:190-200. https://doi.org//10.1097/00003086-200207000-00024
3. Cetti R, Henriksen LO, Jacobsen KS. A new treatment of ruptured Achilles tendons: a prospective randomized study. *Clin Orthop Relat Res* 1994;308:155-65. PMID: 7955677
4. Ingvar J, Tägil M, Eneroth M. Nonoperative treatment of Achilles ten- don rupture: 196 consecutive patients with a 7% re-rupture rate. *Acta Orthop* 2005;76:597-601. https://doi.org/10.1080/17453670510041619
5. Khan RJ, Fick D, Keogh A, Crawford J, Brammar T, Parker M. Treatment of acute Achilles tendon ruptures: a meta-analysis of randomized, con- trolled trials. *J Bone Joint Surg Am* 2005;87:2202-10. https://doi.org/10.2106/JBJS.D.03049
6. Chiodo CP, Glazebrook M, Bluman EM, Cohen BE, Femino JE, Giza E, et al. American Academy of Orthopaedic Surgeons clinical practice guideline on treatment of Achilles tendon rupture. *J Bone Joint Surg Am* 2010;92(14):2466-8. PMID: 20962199
7. Nilsson-Helander K, Thomeé R, Silbernagel KG, Thomeé P, Faxén E, Eriksson BI, et al. The Achilles tendon Total Rupture Score (ATRS): development and validation. *Am J Sports Med* 2007;35(3):421-6. https://doi.org/10.1177/0363546506294856

8. Amlang MH, Christiani P, Heinz P, Zwipp H. The percutaneous suture of the Achilles tendon with the Dresden instrument. *Oper Orthop Traumatol* 2006;18:287-99. https://doi.org/10.1007/s00064-006-1178-y
9. Joannas G, Arrondo G, Eslava S, Casola L, Drago J, Barousse R, et al. Percutaneous Achilles tendon repair with the Dresden instrument. Clinical and MRI evaluation of 90 patients. *Foot Ankle Surg* 2020;26(2):209-17. https://doi.org/10.1016/j.fas.2019.02.005
10. Arzac Ulla I, De Silvestri A, Fiorentini G. Roturas agudas del tendón de Aquiles tratadas con técnica mínimamente invasiva de Dresden. *Rev Asoc Argent Ortop Traumatol* 2016;82(1):48-53. https://doi.org/10.15417/539
11. De la Fuente C, Peña y Lillo M, Carreño G, Marambio H. Prospective randomized clinical trial of aggressive rehabilitation after acute Achilles tendon ruptures repaired with Dresden technique. *Foot (Edinb)* 2016;26:15-22. https://doi.org/10.1016/j.foot.2015.10.003
12. Lee SJ, Sileo MJ, Kremenic IJ, Orishimo K, Ben-Avi S, Nicholas SJ, et al. Cyclic loading of 3 Achilles tendon repairs simulating early postoper- ative forces. *Am J Sports Med* 2009;37(4):786-90. https://doi.org/10.1177/0363546508328595
13. Clanton TO, Haytmanek CT, Williams BT, Civitarese DM, Turnbull TL, Massey MB, et al. A biomechanical comparison of an open repair and 3 minimally invasive percutaneous Achilles tendon repair techniques during a simulated, progressive rehabilitation protocol. *Am J Sports Med* 2015;43:1957-64. https://doi.org/10.1177/0363546515587082
14. Demetracopoulos CA, Gilbert SL, Young E, Baxter JR, Deland JT. Limited-open Achilles tendon repair using locking sutures versus nonlocking sutures: an in vitro model. *Foot Ankle Int* 2014;35(6):612-8. https://doi.org/10.1177/1071100714524550
15. Byrne PA, Hopper GP, Wilson WT, Mackay GM. Knotless repair of Achilles tendon rupture in an elite athlete: return to competition in 18 weeks. *J Foot Ankle Surg* 2017;56(1):121-4. https://doi.org/10.1053/j.jfas.2016.07.007
16. McWilliam JR, Mackay G. The internal brace for midsubstance Achilles ruptures. *Foot Ankle Int* 2016;37(7):794-800. https://doi.org/10.1177/1071100716653373