DOI: https://doi.org/10.30795/jfootankle.2020.v14.1169

Original Article

Minimally invasive repair of acute Achilles tendon injury: description of technique and evaluation of outcomes

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Abstract

Objective: Describe a minimally invasive surgical technique for acute repair of Achilles tendon injuries, and evaluate outcomes.

Methods: Nine subjects with primary Achilles tendon injury who underwent the minimally invasive repair technique between July and October 2018 were assessed. All subjects were followed up, and the SF-36 quality of life questionnaire was applied after the first postoperative year to evaluate treatment outcomes.

Results: The participants had average scores greater than 90 points in the SF-36 questionnaire, with widespread treatment adherence. Only one subject had an infectious complication in the postoperative period.

Conclusion: The technique described for acute Achilles tendon repair is simple, uses basic materials, is a low-cost method and, in this series, produced good clinical outcomes measured by the SF-36 Questionnaire.

Level of Evidence IV; Therapeutic Study; Case Series.

Keywords: Achilles tendon/injuries; Achilles tendon/surgery; Rupture/surgery; Tendon Injuries/surgery; Minimally invasive surgical procedures; Treatment outcome.

Introduction

An aging population together with the growing number of sports activities undertaken by the elderly has contributed to the high rates of Achilles tendon injuries[1]. This injury is one of the most common involving tendons, and can be observed in individuals who take part in sports such as: soccer, handball and tennis[2].

The techniques used to treat such an injury have been studied at length[3-8]. In theory, the ideal procedure involves low cost, short hospital stay, limited tissue damage from the surgery, and the possibility of the patient quickly resuming their daily activities, with functional results close to normal. However, the best form of treatment for Achilles tendon injuries is still controversial[8-10], ranging from conservative treatment to open repair and extending with newer techniques with minimally invasive surgical treatment possibilities[6,7,11-13]. The latter, despite showing excellent results[6,7,11-13], were mostly presented using specific instruments that have not yet been provided by the public health system.

Thus, the aim of the study is to describe a percutaneous surgical technique for acute repair of Achilles tendon injuries, using basic materials that are easily accessible in the public health network, and to evaluate the outcomes.

Methods

This study was approved by the Institutional Review Board and registered on the Plataforma Brazil database under CAAE (Ethics Evaluation Submission Certificate): 19432019.6.0000.5078. All the participants signed the Informed Consent Form (ICF).

Study performed at the Universidade Federal de Goiás, Goiânia, GO, Brasil.

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Conflicts of interest: none. **Source of funding:** none. **Date received:** February 02, 2020. **Date accepted:** April 04, 2020. **Online:** April 30, 2020.

How to cite this article: Oliveira RL, Martins JS, Silva PHM. Minimally invasive repair of acute Achilles tendon injury: description of technique and evaluation of outcomes. J Foot Ankle. 2020;14(1):62-7.

Nine participants aged over 18 years with primary Achilles tendon injury (traumatic or non-traumatic) occurring up to 21 days at the moment of surgery, were enrolled in the study. In addition, the lesion had to be located in the tendinous portion of the sural triceps, at a distance of least 2cm from its insertion in the calcaneus, with preoperative measurement by ultrasound and in the physical examination, methods used in the diagnosis and in the inclusion of sample cases. Injuries with a history of re-ruptures, cases with follow-up of less than 10 months, or patients who did not have details of the procedure or of adequate follow-up in their medical records were excluded.

Participants underwent surgery using the minimally invasive repair technique between the months of July and October 2018, and the sample size included all patients operated on in our department during that period, and who met the aforementioned inclusion criteria. This surgical technique is a variation of a procedure already solidly established in the medical literature, which uses specific and expensive materials[4].

Making use of surgical principles, the department developed a protocol with the application of basic surgical instruments, already existing in the unit, which could be re-sterilized for the treatment of patients with such an injury profile.

Basic and specific instruments were used during the surgical procedure. The basic instruments included: a box with hemostatic forceps, scalpel, scissors, Farabeuf retractors, suture material and grasping forceps, such as the Allis type. The specific materials were: three identical fenestrated metal tongue depressors (Figure 1), two arthroscopy guidewires (Figure 2), and six long-lasting absorbable suture threads (polyglactin nº 1). Materials for sterile dressings and a kit for making plaster casts were also needed.

The patient was placed in the prone position, after spinal anesthesia, with his or her feet hanging close to the table (about 10 to 15cm). After the aseptic procedures and placement of sterile drapes, the injury site was confirmed through physical examination by palpating the injury depression. A 2-3cm transverse incision was made in its center, and no tourniquet was applied on the lower limb to be operated. The stumps were identified and debrided, removing their most friable area. The tendon stumps were released from its sheath by blunt dissection with the surgeon's finger, and its excursion was observed. The proximal stump of the tendon was seized with grasping forceps, then two tongue depressors were positioned from the incision, laterally and medially to the stump. A third depressor, identical to the two used internally on the patient, was positioned externally on the skin on the medial side and in perfect alignment with the others, the latter serving as a template. Keeping the tension applied on the stump and the alignment of the tongue depressors, an arthroscopy guidewire with a suture thread transfixed at the end was passed through one of the holes in the tongue depressor from the medial position to the corresponding hole in the lateral tongue depressor. When passing the absorbable thread through the lesion, through the arthroscopy guidewire, each thread was doubled at the point of entry and exit of the skin. Before completing the passage with the guidewire, a test was performed to ascertain whether it had been passed correctly through the holes in the tongue depressors, in an attempt to remove the depressors (when the procedure is carried out correctly, the depressor is trapped by the guidewire). Two more sutures were passed through the proximal stump, using different holes in the tongue depressor, producing a total of three double-filament sutures, and the depressors were removed symmetrically under traction, to enable the absorbable sutures to accompany those trapped by the holes, and to exit the incision. The images of the surgical procedure are shown in Figure 3.

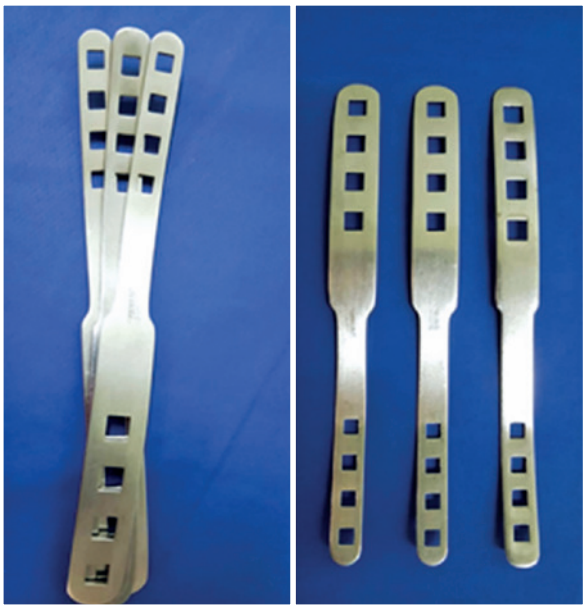

Figure 1. Metal tongue depressors.

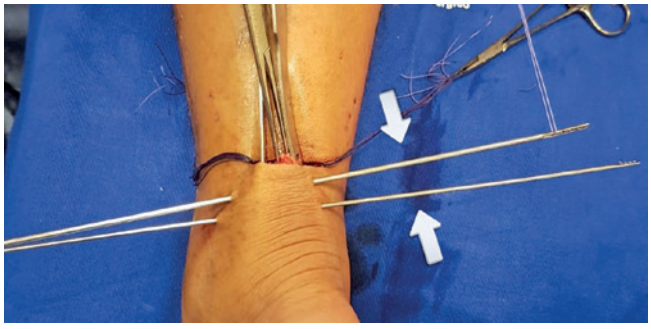

Figure 2. Arthroscopy guidewires.

All subjects who underwent this protocol had their surgical procedure noted down in their medical records along with their preoperative, postoperative, and outpatient follow-up assessment, with a specific rehabilitation protocol. The pa-

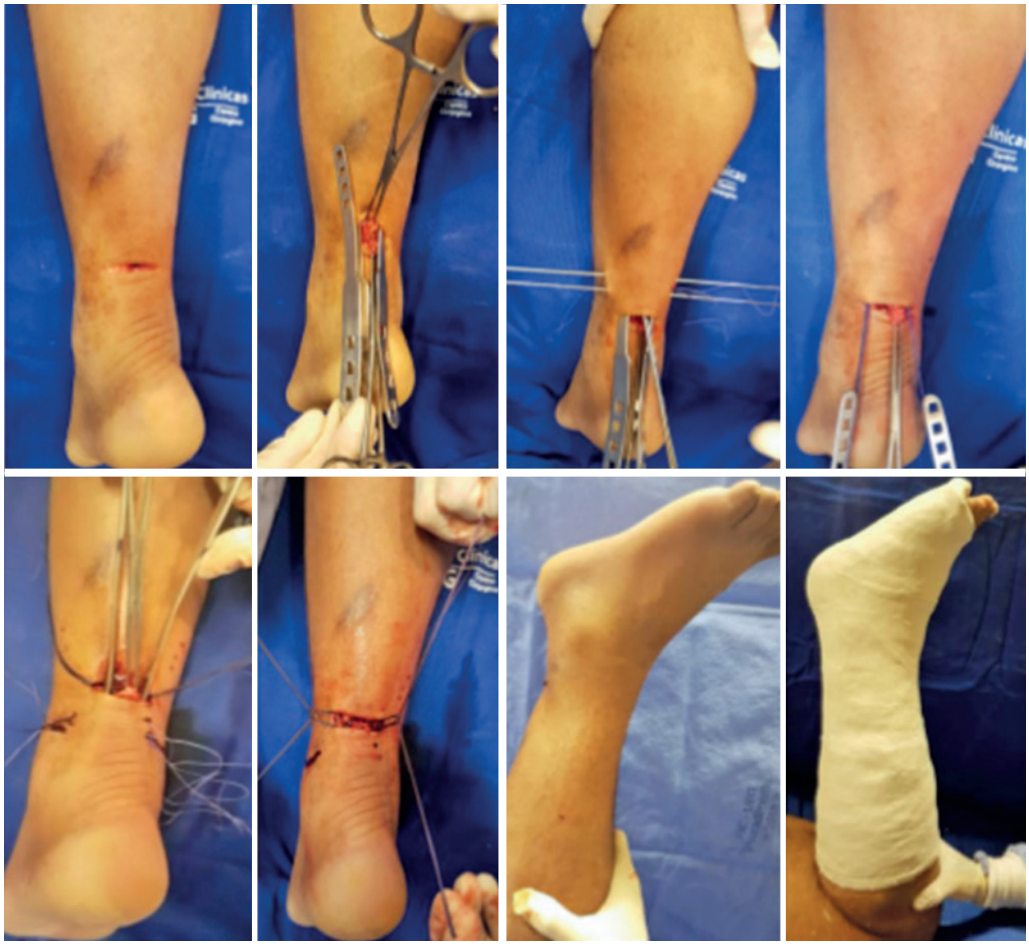

Figure 3. Sequence of images of the surgical procedure in order of occurrence.

tient was instructed to start walking in a plaster cast at 30 degrees of plantar flexion, made at the end of the surgery, and were allowed to bear their full bodyweight after the fourth postoperative day, taking care to use a rubber sole, with a heel measuring approximately 2cm in the hindfoot area, to protect the plaster from breaking. The patient was reassessed after two weeks to detect the presence of early complications and to evaluate his or her adherence to the rehabilitation protocol. After four weeks, at the second return visit, the plaster cast and surgical stitches were removed, the surgical wound was inspected, and a long walker boot was fitted to allow the patient to walk with the foot in a plantigrade position. This was continued for another four weeks until the time of a further assessment, when the patients were normally allowed to begin walking without the use of a protective orthosis. Physiotherapy sessions were started under the supervision of a qualified professional.

At the end of the first postoperative year, the attending physician applied the SF-36 quality of life questionnaire to assess treatment outcomes in the patients. The questionnaire contains 36 items grouped into 8 domains, and reflects a final score from 0 to 100 (zero is the worst and 100 the best health status)[14]. Information was also collected about the time to resumption of activities of daily living, early and late complications, subjective impression of the treatment, and epidemiological data. The patient's adherence to the rehabilitation protocol proposed by our technique was also assessed, computing use of the plaster cast, orthosis and the length of assisted physical therapy both adequately and in a timely manner, and having the attending physician note down this data in the patient's medical records.

Results

The mean age of the patients was 32 years, and the average follow-up time was 12 and a half months. Only one patient had less than one year of follow-up. A description of the epidemiological data can be found in Table 1.

Only one subject had an infectious complication, which was suspected at the return visit to the emergency room four days after surgery. This was the only case that developed sural nerve deficit (without a description of its status prior to

the procedure), and had the particularity of having been an open injury caused by direct trauma. The therapeutic approach had a good outcome, with removal of the cast, removal of alternate stitches, and oral antibiotic therapy for 14 days, and without any sign of infection during this period. A new cast was made to restart the four-week protocol.

Two subjects resisted weight-bearing as directed, claiming "fear of compromising the surgery". This was corrected by the third week, and did not compromise the treatment outcome.

The mean physical therapy treatment duration was 19 sessions, ranging from zero to 40 sessions. Two patients did not undergo rehabilitation, claiming lack of access via the Unified Health System, but there was no difference in the assessment of quality of life in comparison to the other patients at the end of one year of follow-up. Perioperative assessment is described in Table 2.

The data relating to the application of the SF-36 Quality of Life Questionnaire are presented in Table 3.

Table 1. Epidemiological data

Patient	Variables analyzed							
	Age	Sex	Laterality	Athletic Level	Systemic Diseases	Prodromes	Smoker	Trauma
1	38	M	Right	Recreational	No	No	No	Indirect
2	37	M	Right	Professional	No	Yes	No	Indirect
3	32	M	Left	Professional	No	No	No	Indirect
4	30	M	Right	Recreational	No	No	No	Indirect
5	18	M	Left	Sedentary	No	No	No	Direct
6	37	M	Right	Sedentary	No	No	No	Indirect
7	38	M	Right	Recreational	No	No	No	Indirect
8	41	M	Left	Sedentary	No	No	No	Direct
9	22	M	Left	Recreational	No	No	Yes	Indirect

Table 2. Perioperative assessment

Patient	Variables analyzed							
	TIS (months)	Intraoperative outcome	Postoperative protocol	Infection	PTP	Re-rupture	Pain - VAS	Follow-up (months)
1	15	Good	Followed	No	9	No	Absent	14
2	5	Good	Followed	No	20	No	Absent	14
3	12	Good	Followed	No	40	No	<3	12
4	11	Good	Followed	No	40	No	Absent	13
5	6	Good	Partial	No	No	No	Absent	13
6	16	Good	Followed	No	No	No	Absent	13
7	9	Good	Partial	No	15	No	Absent	12
8	3	Good	Followed	Yes	20	No	Absent	12
9	8	Good	Followed	No	30	No	Absent	10

TIS (Time from injury to surgery); PTP (Physical therapy sessions); VAS (Visual Analog Scale).

Table 3. Quality of life assessment (SF-36 Questionnaire)

Aspects analyzed	Subjects									Mean
	1	2	3	4	5	6	7	8	9	
Functional capacity	100	100	95	100	100	100	100	95	100	**98.88**
Physical limitation	100	90	95	100	100	100	100	100	100	**98.33**
Pain	100	100	85	100	100	100	100	100	100	**98.33**
General health	90	100	90	100	100	95	100	100	100	**97.22**
Vitality	80	100	90	90	100	90	100	90	100	**93.33**
Social aspects	95	95	100	100	100	100	100	100	100	**98.88**
Emotional aspects	100	80	100	90	100	100	100	100	100	**96.66**
Mental health	95	75	100	90	100	95	100	95	100	**94.44**

Discussion

Many articles address therapeutic approaches for the treatment of Achilles tendon injuries[3-8]. There are those that advocate in favor of open surgery[11,15], while others prefer less aggressive techniques with early limb mobilization[3,5,10-13]. The latter have shown low rates of re-rupture, with less muscle atrophy, fewer infectious complications and earlier walking, with early return to work. In the long term, functional results are similar to traditional repair techniques[4].

Accordingly, the surgical technique presented in this article represents a good treatment option, due to the use of basic, inexpensive and re-sterilizable materials, which facilitate its applicability because it does not represent a high cost for the department and does not entail sacrificing a high-quality surgical outcome. Furthermore, it introduces the use of the template to facilitate the identification of the correct guidewire trajectory, an innovation that has not previously been described in any study where a minimally invasive technique was used[5,7]. In addition, the passage of the double-filament suture through the guidewire, in theory, also represents a biomechanical advantage of greater resistance when compared to techniques that use percutaneous prethreaded sutures (consisting of a single thread).

Some challenges, however, must be highlighted. Of 12 cases treated and referred for the minimally invasive procedure, three were excluded in the intraoperative period, opting instead for traditional open surgery. This decision was made when the surgeon made the mini-incision and noted considerable tendon degeneration, with significant failure after debridement and inability to draw the stumps closer to one another without excessive tension. Since this is an unforeseeable event, it is crucial for the surgeon to be prepared instrumentally and technically for the conversion. In the latter case, we extended the incision longitudinally on opposite sides of the initial transverse incision, and had no local complications.

Care in the positioning of tongue depressors must also be considered. The two internal depressors must be in direct contact with the Achilles tendon stump, and must therefore be positioned inside the muscle fascia. Otherwise, when the sutures are pulled they will transfix the fascia, which can cause of difficulty in tendon excursion during gait and postoperative pain. It is advisable to apply traction on the tendon stump using forceps, and to produce detachment without the use of sharp instruments with the lateral finger and medially to the tendon, at the site where the depressors will be positioned. It is also necessary to ensure that these are placed in their positions under direct visualization.

Finally, a crucial step for the success of the procedure consists of passing the guidewire through the holes in the depressors, which entails a considerable risk of error. If an error occurs, when the depressors are pulled the sutures will not accompany them, making the subsequent stages of the surgery impossible. To correct the error, attention must be paid to the correct positioning of the tongue depressor outside the skin, as it must be in perfect alignment with the two internal depressors, and function as a template. It is considered essential to check this passage, made with the guidewire transfixed through the tendon, attempting to remove one internal tongue depressor at a time. If the guidewire is actually positioned inside the hole, the depressor will be fixed and will not come out under traction. The surgeon then completes the tendon transfixation and repeats these steps with each guidewire that is passed.

As regards the postoperative period, patients were provided with guidance on the protocol from the time of their admission, and encouraged to follow it, with good success in adherence. Care is needed when reinforcing the plaster, as the cast needs to be designed considering the fact that walking is encouraged in the postoperative period.

A frequent complication of percutaneous surgery is iatrogenic injury to the sural nerve, which is around 19%[16]. In this particular study, only one of the nine subjects developed this complication (representing 11% of the total sample), which would be below the values stated in the literature. However, due to the small number of cases studied, it is not possible to assert that this difference has statistical significance. It is also noteworthy that this particular case sustained a sharp force injury due to trauma, which raises the question whether this participant had already presented with the deficit as a result of the trauma, since there had been no reports of specific research on this deficit before the surgery.

The results of the application of the SF-36 questionnaire were high (average >90), demonstrating that this technique has a positive impact on the quality of life of individuals with this type of injury undergoing this treatment. It is worth mentioning that the questionnaire was applied about a year after the procedure, and not over the months of follow-up, making it impossible to record details of patient progress periodically. There is also a lack of studies that assess the quality of life of subjects with the same instrument used in this study. Furthermore, there are limitations to defining whether the technique described in this particular study really enabled an advantage over early rehabilitation and return to work activities. These study limitations include: small sample, short follow-up, and the fact that the sample size was not calculated, the results were not compared with a control group, and a functional evaluation of the tendon itself was not performed.

Conclusion

The minimally invasive surgical technique described for acute repair of the Achilles tendon in this study requires basic, inexpensive materials, and does not present major technical difficulty in its execution, facilitating its reproducibility. The results obtained confer a positive impact on the 1-year postoperative follow-up, and patients show good outcomes related to quality of life at the end of this period, according to the application of the SF-36 Questionnaire.

Authors' contributions: Each author contributed individually and significantly to the development of this article: RLO *(https://orcid.org/0000-0001-7222-1070) conceived and planned the activities that led to the study, wrote the article, interpreted the results of the study, approved the final version; JSM *(https://orcid.org/0000-0003-4742-1905) conceived and planned the activities that led to the study, participated in the review process, approved the final version; PHMS *(https://orcid.org/0000-0002-8970-4439) wrote the article, participated in the review process, approved the final version. *ORCID (Open Researcher and Contributor ID).

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