

Comparison between the open and minimally invasive repair technique in acute Achilles tendon injuries

Comparaç o entre a t cnica de reparo aberto e a minimamente invasiva nas les es agudas do tend o de Aquiles

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ABSTRACT

Objective: To compare the functional results of patients submitted to open repair of the Achilles tendon in relation to those treated with the minimally invasive technique using PARS, with a minimum period of 1 year, as well as the complication index of the two techniques.

Methods: Between 2011 and 2016, 31 patients were reviewed, including 20 cases (10 PARS X 10 Open technique). Patients with chronic Achilles tendon rupture, insertional or bilateral, patients with a history of surgery or previous ankle pathology that could mask the functional results were excluded. The open technique was performed through a posteromedial incision to the ankle, repairing the tendon associated with the myotendinous transfer of the flexor hallucis longus, which was fixed with a biotenodetic screw. The minimally invasive technique was performed with the PARS (percutaneous Achilles repair system) of the company Arthrex, through a small transverse incision on the site of rupture of the Achilles tendon. Functional outcomes and complications were collected after at least 1 year of follow-up.

Results: Both groups presented similar AOFAS scores (PARS: 95.3 ± 5.1 , Open: 96.5 ± 5.1 , $P=0.604$), showing similar functional results. Regarding the complications, the PARS obtained a greater number of complications in relation to the Open technique (PARS: 20% X Open: 10%), but without statistical relevance ($P=0.383$).

Conclusion: We conclude that for the treatment of acute Achilles tendon injuries, the PARS and Aberta techniques have similar functional results after 1 year of follow-up.

Level of Evidence IV; Therapeutic Studies; Cases Series.

Keywords: Achilles tendon; Rupture /complications; Minimally invasive surgical procedures.

RESUMO

Objetivo: Comparar os resultados funcionais dos pacientes submetidos ao reparo aberto do tend o de Aquiles em rela o aos tratados com a t cnica minimamente invasiva, utilizando o PARS, com per odo m nimo de 1 ano, assim como o  ndice de complica es das duas t cnicas.

M todos: Entre 2011 e 2016, 31 pacientes foram revisados, sendo includos 20 casos (10 PARS X 10 t cnica Aberta). Foram exclu dos pacientes com ruptura cr nica do tend o de Aquiles, insercionais ou bilat rias, pacientes com hist ria de cirurgia ou patologia pr via no tornozelo que pudessem mascarar os resultados funcionais. A t cnica Aberta foi realizada atrav s de uma incis o posteromedial ao tornozelo, sendo realizado o reparo do tend o associado   transfer ncia miotendinosa do flexor longo do h lux, que foi fixada com parafuso de biotenodese. A t cnica minimamente invasiva foi realizada com o PARS (*percutaneous Achilles repair system*) da empresa Arthrex, atrav s de uma pequena incis o transversa sobre o local de ruptura do tend o de Aquiles. Os resultados funcionais e complica es foram colhidos ap s pelo menos 1 ano de seguimento.

Resultados: Ambos os grupos apresentaram score AOFAS semelhantes (PARS: $95,3 \pm 5,1$, Aberta: $96,5 \pm 5,1$; $P=0,604$), demonstrando resultados funcionais parecidos. Em rela o  s complica es, o PARS obteve um maior n mero de complica es em rela o   t cnica Aberta (PARS: 20% X Aberta: 10%), por m sem relev ncia estat stica ($P=0,383$).

Work performed at the Hospital Cl nica Ortop dica e Traumatol gica, Salvador, BA, Brazil.

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Conclusão: Concluímos que para tratamento das lesões agudas do tendão de Aquiles, a técnica PARS e a Aberta possuem resultados funcionais semelhantes após 1 ano de acompanhamento.

Nível de Evidência IV; Estudos Terapêuticos; Série de Casos.

Descritores: Tendão de Aquiles; Ruptura/complicações; Procedimentos cirúrgicos minimamente invasivos.

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INTRODUCTION

Achilles tendon ruptures may occur from the second to the eighth decades of life, with a peak of incidence in the third to fifth decades⁽¹⁻⁵⁾. They are especially found in recreational athletes from the age of 40-49 years⁽⁶⁾. The mechanism of rupture is most commonly indirect trauma (eccentric contraction of the muscle) associated with tendons with some degree of degeneration⁽⁷⁾.

The management of these lesions ranges from conservative treatment, which presents lower rates of soft tissue complications with a higher risk of re-rupture (12.5%)⁽⁸⁾, to surgical management. In a randomized study, the treatments were not significantly different in terms of functional outcomes after 6 months of follow-up⁽⁹⁾.

Recently, a minimally invasive repair technique was developed, yielding similar functional outcomes and fewer surgical wound complications compared with the open technique⁽¹⁰⁻¹³⁾. It consists of a combination of the percutaneous technique and a small incision at the site of Achilles tendon rupture⁽¹⁴⁾, requiring modern and proper equipment⁽¹⁵⁾.

The Percutaneous Achilles Repair System (PARS; Arthrex) is a modern, minimally invasive repair technique that has been available in the market since 2010. Good biomechanical results are observed compared with the previous technique (Achillon)⁽¹⁶⁾.

The objective of the present study was to compare the functional outcomes of patients submitted to open repair of the Achilles tendon with those of patients treated with the minimally invasive technique using the PARS after 1 year of follow-up, as well as to compare the complication rates of the two techniques.

METHODS

This study was approved by the Research Ethics Committee with registration in the Brazil Platform under CAAE number: 93879818.9.0000.5606.

Our study is retrospective and included a total of 31 patients who underwent surgical treatment of acute Achilles tendon injury and who underwent surgery by 4 experienced surgeons, who were specialists in foot and ankle surgery, between February 2011 and June 2016. Of the total of 31 patients, 17 underwent open treatment, and 14 underwent minimally invasive repair. Only patients with unilateral acute Achilles tendon rupture were included. We considered acute Achilles tendon ruptures as those with an evolution time of up to 15 days.

Patients with chronic insertional or bilateral Achilles rupture were excluded from the study. Patients with a history of surgery (fracture, ligamentous lesions) or previous pathology (rheumatoid arthritis) in the ankle, which may mask functional outcomes, were also excluded.

A total of 11 patients (3 patients from the minimally invasive technique and 7 from the open technique groups) who refused to participate in the study were excluded. Thus, 20 patients were included in the study. A total of 10 patients underwent open surgical treatment, while the remainder were submitted to the minimally invasive technique. The open technique was performed through an incision posteromedial to the ankle, and the repair of the tendon with a modified Kessler stitch and 3 levels of suture using Arthrex® FiberWire® wire (Naples, Florida, USA) was performed and combined with the muscle tendon transfer of the flexor hallucis longus, which was fixed with a biotenodesis screw. Tendon transfer was performed due to tendinous degeneration, requiring debridement intraoperatively, increasing the gap. The minimally invasive technique was performed with the PARS from Arthrex® through a small transverse incision over the site of the Achilles tendon rupture. FiberWire® wire was used, and suturing with 3 wires was performed. In both techniques, we did not cross the knots in the gap. Prophylaxis for deep venous thrombosis (DVT) was instituted in all cases. All patients had a minimum follow-up of 1 year to observe complications.

All patients underwent the same rehabilitation protocol. Patients left the surgical center using a plaster splint with the ankle in the equine position. After 7 days, this splint and dressing were changed and the splint was replaced by a Robofoot-type orthosis, which kept the foot in the equine position with the aid of a heel positioned at the back foot for another 2 weeks. At the end of 3 weeks, the stitches were removed, the partial load with a Robofoot in the equine position was released, and plantar flexion was stimulated during physical therapy. Weaning of the equine position was performed at the end of the 6th week. At the end of the 9th week, the plantigrade foot was achieved, the orthosis was removed, and the total load was released. Patients underwent physical therapy rehabilitation and monthly outpatient follow-up up to 1 year postoperatively. Then, the patients were followed-up annually. The minimum follow-up time was 1 year, and the maximum follow-up time was 5 years (mean, 3.0 years).

The functional outcomes of the patients, after at least 1 year of follow-up, as well as the possible inherent complications (re-rupture, infection, wound dehiscence, sural nerve injury, and suture wire reaction: granuloma) of each procedure were compared and analyzed. We used the American Orthopaedic Foot and Ankle Society (AOFAS) scoring system⁽¹⁷⁾, translated into Portuguese, for functional analysis.

Granuloma was observed intraoperatively, and material was sent for culture to determine whether it was due to a reaction to the wire or to an infection, without further growth of microorganisms.

Statistical Package for Social Sciences (SPSS), version 14.0 for Windows was used for the elaboration of the database and descriptive and analytical analyses. The normality of the variables was verified through the Shapiro-Wilk test, descriptive statistics and graphical analysis. The results are presented in tables and graphs. Categorical variables are expressed as absolute and percentage values, n (%). Continuous variables with a normal distribution are expressed as the means and standard deviations (\pm SD).

The independent samples Student T test was used to compare the following variables: age, body mass index, and AOFAS score. Categorical variables, such as comorbidities and complications, were compared using the chi-square test, while the variables sex and laterality were compared using Fisher's exact test. For all analyses, a value of $p \leq 0.05$ was established as significant.

RESULTS

The group that underwent the PARS technique had a mean age significantly lower than that of the group that

underwent the open technique. There was no difference in sex, laterality, or comorbidities between the groups, as shown in table 1.

When comparing the AOFAS score, both groups presented similar means: 95.3 ± 5.1 for those who underwent the open technique and 96.5 ± 5.1 for those who underwent the PARS technique. The AOFAS score in the open technique group varied from 87 to 100, while that in the group that underwent the PARS technique ranged from 88 to 100.

Only one complication was observed in the group that underwent the open technique (DVT); however, those who underwent the PARS technique presented two complications: reaction to the FiberWire[®] wire and superficial wound infection. The reaction to the wire required debridement and removal of the wire. The superficial infection was treated with the use of oral antibiotics, without the need for debridement. The patient who developed DVT underwent anticoagulation treatment, which resolved the problem. The AOFAS scores and complications are summarized in table 2 and figure 1.

DISCUSSION

There is still no consensus regarding the best management of acute Achilles tendon ruptures or the best surgical technique for their repair. The results of a randomized controlled trial comparing conservative and surgical treatment

Table 1. Comparison of the sociodemographic and clinical variables of patients submitted to Achilles tendon repair.

Variables	Open Technique (n=10)	PARS Technique (n=10)	p-value
	Mean \pm SD	Mean \pm SD	
Age	48.5 \pm 8.8	38.2 \pm 7.9	0.013*
BMI	28.7 \pm 5.3	28.9 \pm 3.1	0.929*
Sex	n (%)	n (%)	
Male	06 (60.0)	10 (100.0)	0.087 [§]
Female	04 (40.0)	00 (00.0)	
Laterality			
Right	04 (40.0)	06 (60.0)	0.656 [§]
Left	06 (60.0)	04 (40.0)	
Comorbidity			
No comorbidity	06 (60.0)	08 (80.0)	0.306 [¥]
Hypertension	01 (10.0)	02 (20.0)	
Hypothyroidism	02 (20.0)	00 (00.0)	
Diabetes Mellitus	01 (10.0)	00 (00.0)	

n: number of participants, SD: standard deviation, BMI: body mass index.

*: Independent Student's t test; §: Fisher's exact test; ¥: Chi-square test.

Source: Prepared by the author based on the results of the research.

Table 2. Comparison of AOFAS score and number of complications in patients subjected to Achilles tendon repair.

Variables	Open Technique (n=10)	PARS Technique (n=10)	p-value
	Mean±SD	Mean±SD	
AOFAS Score	95.3±5.1	96.5±5.1	0.604*
Complications	n (%)	n (%)	
There were no complications	09 (90.0)	08 (80.0)	0.383 ^y
Superficial infection	00 (00.0)	01 (10.0)	
Reaction to wire	00 (00.0)	01 (10.0)	
DVT	01 (10.0)	00 (00.0)	

N: number of subjects, SD: standard deviation, DVT: deep venous thrombosis
 *: Independent Student's t test; ^y: Chi-square test.

Source: Prepared by the author based on the results of the research.

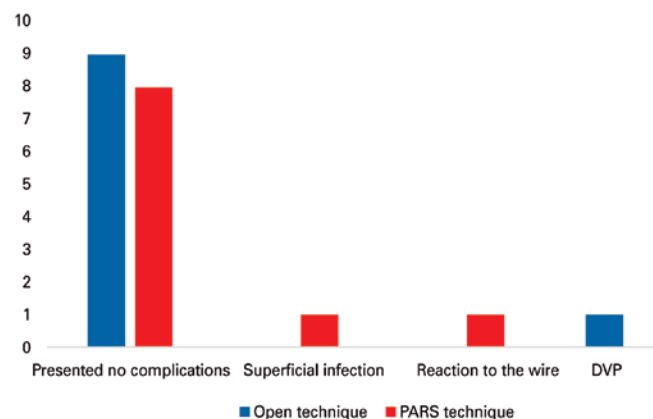


Figure 1. Description of the number of complications in patients subjected to Achilles tendon repair.

Source: Prepared by the author based on the results of the research.

of acute Achilles tendon ruptures did not demonstrate statistically significant differences in clinical outcomes between treatments, but the clinical outcomes of patients undergoing surgery were better within 6 months⁽⁹⁾.

A Cochrane review article demonstrated lower rates of re-rupture with higher rates of complications, including operative wounds, associated with surgical treatment⁽⁸⁾. Although studies show a good functional outcome with this technique, it is associated with superficial and deep surgical wound complications, and retreatment may be necessary^(8,9,18).

Surgical treatment can be performed by open repair, combined or not with muscle tendon transfers, minimally invasive techniques, and percutaneous technique⁽¹⁹⁾. Ma & Griffith⁽²⁰⁾ initially described the percutaneous technique; however, this technique has a greater chance of

causing iatrogenic sural nerve injury (13%), according to Klein et al.⁽²¹⁾.

The percutaneous technique of Webb and Bannister shifts the suture lines more to the medial area to avoid sural nerve lesions. In their series of patients, they did not describe any lesion of the sural nerve⁽²¹⁾.

The minimally invasive technique combines the advantages of the open and percutaneous techniques⁽²²⁾. The Achillon^(23,24) (Integra Lifesciences Corporation, USA) and PARS are examples of minimally invasive techniques. Both techniques use a special material: a template for the passage of wires. A study that followed-up 68 patients who underwent repair of an acute Achilles tendon injury with Achillon for 25 months showed a mean AOFAS score of 96 and no soft tissue or neurological complications. Two patients experienced re-rupture, but it was due to poor adherence to the rehabilitation protocol⁽²⁵⁾.

Our study showed similar AOFAS scores (95.3±5.1 for the open technique and 96.5±5.1 for PARS). There was no statistically significant difference between the groups, demonstrating that both techniques showed similar functional outcomes after 1 year of follow-up.

Andrew and colleagues⁽²⁵⁾ reviewed 270 patients with acute Achilles tendon rupture who underwent surgical treatment (101 PARS x 169 open technique) between 2005 and 2014. They reported that patients subjected to PARS resumed their physical activities 5 months earlier than the patients subjected to the open technique. The PARS complication rate was 5%, with no cases of iatrogenic sural nerve injury. Three percent of the cases were associated with superficial surgical wound dehiscence and were treated with topical care, and 2% corresponded to a reaction to the suture wire without infection and were retreated. The open technique had a complication rate of 10.6%: 3%, sural neuritis; 4%, suture dehiscence, which was treated with topical care; 1.8%, superficial infection, which was treated with oral antibiotics; and 1.8%, deep infection of operative wounds, which required a surgical approach.

In our study, we observed a greater number of complications in patients submitted to PARS (PARS: 20% - 2 patients, open technique: 10% - 1 patient). However, the difference was not significant (P=0.383). This fact did not affect functional outcomes after 1 year of follow-up. This greater number of complications in patients submitted to the minimally invasive technique differs from previous studies^(25,26), in which the open technique yielded more complications. However, we must highlight the small number of patients who participated in our study.

The group that underwent the PARS technique had a significantly lower mean age than that of the group that underwent the open technique. This was not intended by the authors but can be characterized as selection bias.

As a critique of the study, we should mention the fact that the flexor hallucis longus transfer was performed as a result of tendinous degeneration visualized intraoperatively to improve the quality of repair in patients subjected to open repair of acute Achilles tendon rupture. As in the percutaneous technique, there is no possibility of performing an accurate assessment of the quality of the “healthy” tendon, and no transfer was performed, which can be interpreted as though cases with a previous tendinopathy of greater severity were selected for the open technique. Several authors consider that the rupture of the Achilles tendon occurs only in abnormal tendons, i.e., with some degree of degeneration⁽²⁷⁻²⁹⁾. Because the PARS is a recent technique, a reference is needed with which to compare its results. Thus, we chose the conventional technique because it is the technique previously performed for the treatment of acute Achilles tendon ruptures.

Some limitations of the study are its retrospective nature and the limited number of patients who participated. The mean time to resume work activities was not investigated. In addition, complaints related to decreased flexor hallucis longus strength in patients who underwent the open technique were not analyzed. Prospective studies with a larger number of patients are necessary to confirm the conclusions.

This work will serve as a basis for formulating future studies with a greater number of patients and that can better confirm conclusions.

CONCLUSION

We can conclude from our work that the PARS technique and the open technique for the treatment of acute Achilles tendon injuries yield similar functional outcomes after 1 year of follow-up.

We cannot conclude the superiority of either technique in relation to the number of complications because the sample is small. Prospective and larger studies will be needed for this purpose.

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