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Original Article

Postoperative evaluation of patients undergoing minimally invasive treatment for acute Aquilles tendon rupture

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Abstract

Objective: To evaluate the clinical and functional outcomes of patients undergoing percutaneous repair of acute Achilles tendon rupture with the Tenolig® device, associated with a structured rehabilitation protocol with eccentric exercises adapted from Alfredson's principles.

Methods: Observational, retrospective, and descriptive study with 20 patients treated with rupture less than five days. Cases with clinical and ultrasound diagnosis and distal stump suitable for the device were included. Insertional injuries, re-rupture, previous surgeries in the affected limb, and comorbidities with potential functional or scarring impairment were excluded. The postoperative protocol included initial immobilization in plantar flexion, weight-bearing progression, protected physiotherapy, and eccentric exercises after week 12. The functional evaluation used the Achilles Tendon Total Rupture Score (ATRS) and timed monopodal exercise. The median follow-up was 24 ± 4.6 months.

Results: The sample included 20 patients, with a mean age of 39.7 ± 13.2 years. The mean ATRS was 98.1 ± 3.4 points, with a median of 100 and a range of 86-100. The mean monopodal exercise time was 31.8 seconds. There was a re-rupture (5%) without infection, scarring complications, or sural nerve paresthesia.

Conclusion: Minimally invasive repair with Tenolig®, combined with structured rehabilitation, showed favorable outcomes and a low complication rate in this case series. The interpretation is limited due to the small sample size, retrospective design, and absence of a comparison group.

Level of Evidence IV; Descriptive Observational Study.

Keywords: Achilles tendon; Rupture; Minimally invasive surgery; Rehabilitation; Eccentric exercise.

Introduction

Acute Achilles tendon rupture is one of the most frequent injuries to the lower limb[1], mainly affecting physically active individuals of productive age[2]. Despite advances in surgical and rehabilitative treatment, controversies remain about the best therapeutic approach, especially balancing early functional recovery with reduced postoperative complications[3].

In recent decades, minimally invasive techniques have gained prominence for reducing trauma to soft tissues, lowering rates of surgical wound-related complications, and enabling earlier mobilization compared with conventional open techniques[4]. Among these techniques, the Tenolig® device has been described as a promising alternative for percutaneous stabilization of tendon stumps, enabling adequate functional healing and accelerated rehabilitation[5].

Study performed at the Departamento de Ortopedia e Traumatologia, Hospital Santa Marcelina, São Paulo, SP, Brazil.

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However, despite the increasing use of percutaneous techniques, the literature still has limitations in standardizing rehabilitation protocols, evaluating postoperative function, and analyzing complications associated with Tenolig®. In addition, few national studies describe the clinical and functional outcomes of this technique when combined with the eccentric execution protocol of Alfredson et al.[6], especially in populations with varying levels of adherence to physiotherapeutic treatment.

Thus, the objective of this study is to evaluate the clinical and functional outcomes, complications, and degree of functional recovery in patients undergoing minimally invasive treatment of acute Achilles tendon rupture using the Tenolig® device, along with a structured rehabilitation protocol with eccentric exercises adapted from the principles described by Alfredson et al.[6].

Methods

This retrospective, descriptive observational study was conducted in accordance with Resolution No. 466/12 of the National Health Council and approved by the Institutional Review Board.

Patients with acute Achilles tendon rupture were included if the time from injury was less than five days, the diagnosis was confirmed by clinical and ultrasound assessment, and the tendon stumps could be identified to assess suitability for the percutaneous technique. All patients underwent minimally invasive surgical treatment using the Tenolig® device. Exclusion criteria included cases of previous re-rupture, previous surgery on the affected limb, insertional Achilles tendon injuries, and comorbidities potentially associated with worse functional or scar evolution, including decompensated diabetes mellitus, decompensated or clinically significant peripheral vasculopathies, neuropathies, rheumatologic diseases, chronic renal failure, active infection, and chronic use of corticosteroids.

All patients who fully met the inclusion criteria during the analysis period were included, resulting in a final sample of 20 participants. All underwent the same postoperative protocol, structured in progressive phases based on the clinical evolution observed during outpatient follow-up.

In the first two weeks, they remained non-weight-bearing, using crutches and ankle immobilization in plantar flexion. Between the second and sixth weeks, an orthosis with wedges was used, and progressive partial weight-bearing and protected physical therapy were initiated, including active mobility up to the neutral position and isometric exercises. In the sixth and eighth weeks, the wedges were progressively removed, with increased weight-bearing, gait training, and isometric and concentric strengthening. Between the eighth and tenth weeks, the orthosis was gradually removed as mobility, strength, balance, and proprioception improved. After the tenth week, eccentric exercises adapted from the principles of Alfredson et al.[6] were introduced, and patients returned to physical activities progressively and individually, according to clinical and functional progress.

The Tenolig® device was not routinely removed postoperatively. All patients were properly oriented to the proposed surgical procedures and postoperative follow-up, both during hospitalization and at subsequent outpatient follow-up.

All surgical procedures and initial postoperative follow-up were completed before including patients in the study. After Institutional Review Board approval, eligible participants were invited to participate during outpatient follow-up. The Informed Consent Form (ICF) was presented, read, and discussed individually, with all questions clarified before signing. Consent was obtained before the application of the Achilles Tendon Total Rupture Score (ATRS) questionnaire and the performance of the functional exercise. Medical assistance was fully ensured during all stages of treatment. The data on the surgical procedure and the postoperative progress were obtained retrospectively by reviewing medical records, while preserving the identity and confidentiality of the participants.

The variables analyzed included age, sex, affected side, body mass index, smoking, and physical activity, which were organized in an electronic spreadsheet in Microsoft Excel 2016.

This technique is based on established anatomical principles and is widely used in foot and ankle surgery. The following describes the step-by-step surgical technique used: the patient is in a prone position under spinal anesthesia. Then, asepsis and antisepsis of the affected lower limb are performed. Sterile fields are positioned, and a sterile pad is placed in the anterior region of the ankle to initially maintain it at 90º. The surgical preparation materials are organized: the Tenolig kit, consisting of polyester suture wire, needles, harpoons, and washers (Figure 1).

The proximal and distal stumps of the ruptured tendon are marked by simple palpation (Figure 2).

The proximal entry points, located 5 cm above the injured region, were defined on the posteromedial and posterolateral surfaces of the tendon, as well as the distal exit points, 5 cm below the injury, also on the posteromedial and posterolateral surfaces (Figure 3).

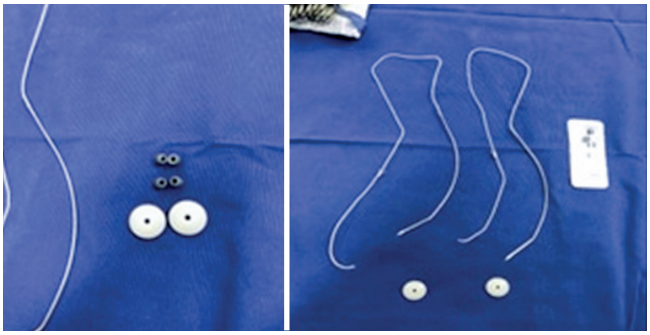

Figure 1. Materials used in the technique with Tenolig®.

The surgeon makes a small incision at the entry point and inserts the first Tenolig® using forceps. The needle penetrates the tendon perpendicularly, and the surgeon notices its path crossing the space beneath the finger (Figure 4). The needle then passes through the distal stump and emerges at the previously marked exit point. The surgeon then pulls the needle until the anchor is positioned at the level of the proximal entry point (Figure 5).

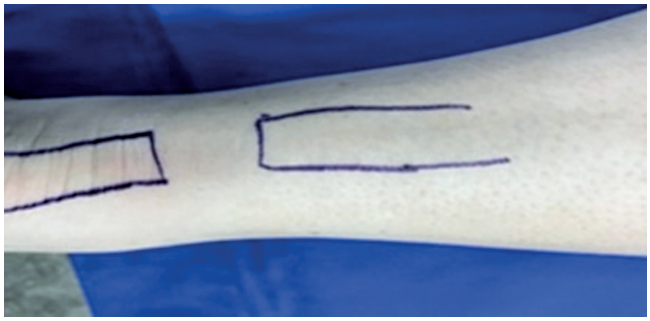

Figure 2. Identification of injured tendon stumps.

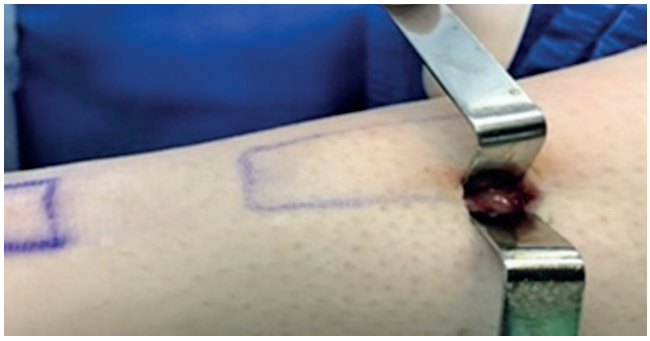

Figure 3. Small incision at entry site viewing proximal Achilles tendon stump.

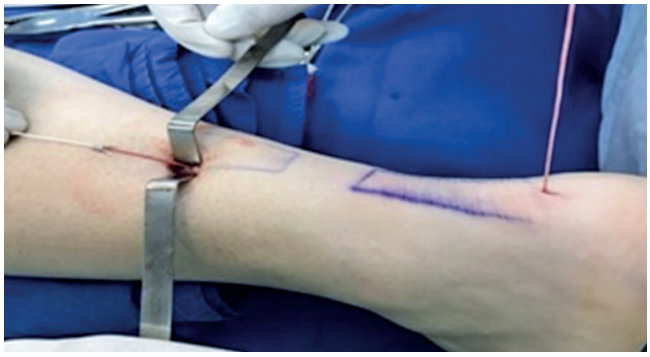

Figure 4. Technique of passage of Tenolig® devices.

The second Tenolig® is inserted in the same way, on the opposite side. To tension the implant, remove the pad and position the ankle in maximal plantar flexion. Tighten both wires simultaneously to ensure the anchors are properly secured. The plastic discs are threaded with the convex surface facing the skin, and washers are secured using a crimping instrument. The implant is tested after tension relaxation of the wires.

The distal ends of the threads are cut 3 cm from the washers, and proximal sutures are performed. A molded compress is positioned under the discs, followed by sterile dressing. At the end of the procedure, a cast boot is applied to keep the ankle in plantar flexion.

The same team specialized in foot and ankle surgery performed the procedures and postoperative follow-up to standardize technique, minimize treatment-related variables, and ensure greater uniformity in clinical and functional patient evaluation.

Figure 6 illustrates the postoperative period for one patient in the study. During the clinical evaluation, Thompson's test was performed, revealing that compression of the triceps surae muscles elicited plantar flexion of the foot. This finding demonstrates the adequate coaptation of the tendon stumps and suggests the restoration of the anatomical and functional continuity of the Achilles tendon (Figure 7).

Figures 8 and 9 show active heel-lift exercises at two months postoperatively, performed with bipodal and monopodal support, without passive stretching or forced dorsiflexion. The images were used solely to illustrate the functional progression observed during outpatient follow-up and were not used as an objective method to evaluate muscle strength. Until the tenth week, rehabilitation was based on protected mobility, gait training, and isometric and concentric strengthening; eccentric exercises were adapted from Alfredson et al.[6] and were introduced later. Because the evaluation was qualitative and lacked dynamometry or standardized functional tests, it was not possible to measure residual deficits in the strength or resistance of the gastrocnemius-soleus complex.

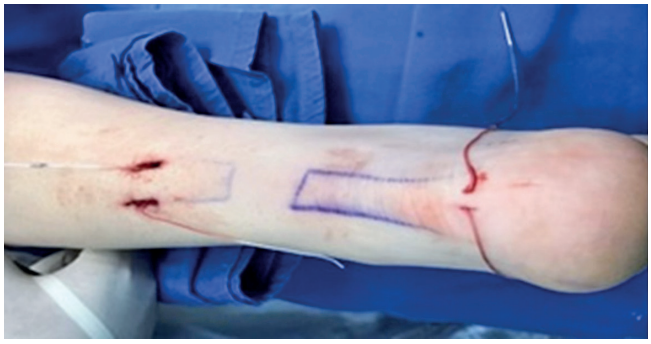

Figure 5. Wire passages and insertion in the proximal and distal tendon stumps.

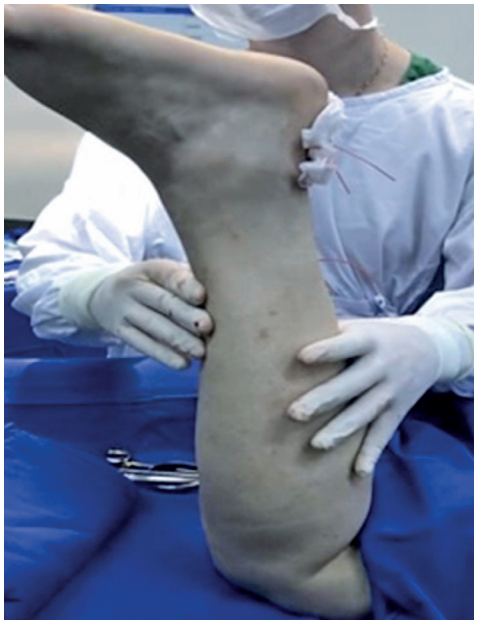

Figure 6. Immediate operative image, in which the patient was placed in prone position, with ankles out of the stretcher, with knees in 90º flexion. Slight plantar flexion of the ankle was observed.

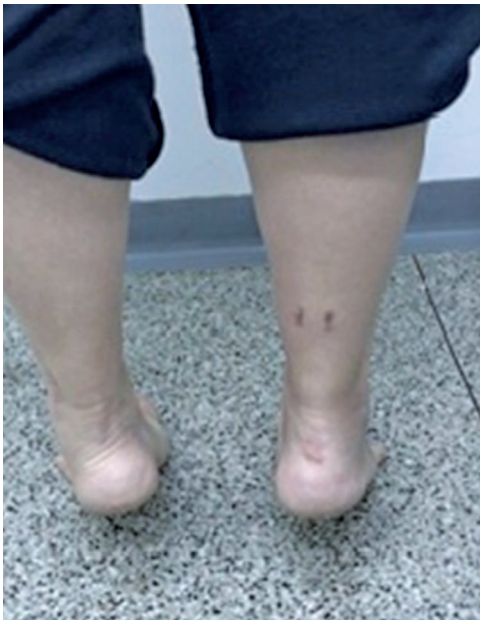

Figure 8. Patient after two months of surgical treatment, performing bilateral elevation of the heels during the functional progression of rehabilitation. The image is illustrative and does not represent a passive stretching exercise or an objective method for evaluating muscle strength.

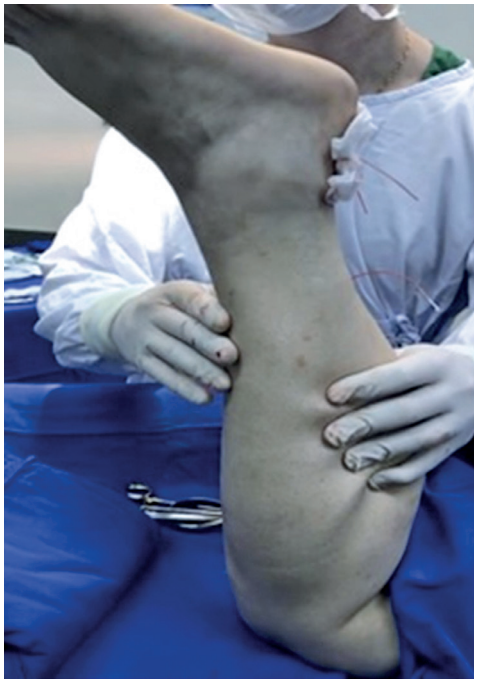

Figure 7. Thompson's test performed in the immediate postoperative period, showing plantar flexion of the ankle after compression of the triceps surae, a result compatible with the restoration of anatomical continuity and functional integrity of the Achilles tendon.

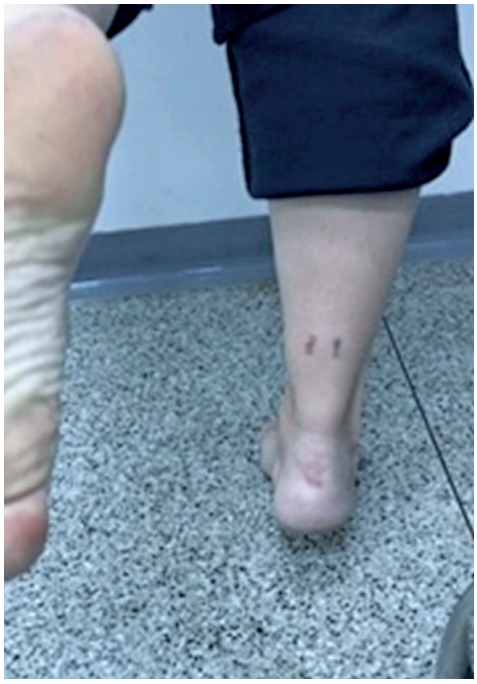

Figure 9. Patient two months after surgical treatment, performing monopodal support with heel elevation during supervised outpatient evaluation. The execution of the movement was recorded qualitatively, without objective measurement of strength, elevation height, or muscle work.

The findings suggest adequate healing and restoration of Achilles tendon integrity, with satisfactory recovery of gastrocnemius-soleus complex function.

Functional assessment was performed using the ATRS, a specific instrument for patients with Achilles tendon rupture[7]. The questionnaire consists of ten items, each scored from 0 to 10, with 0 indicating the greatest limitation and 10 the absence of limitation. The sum of the ten items yields a total score of 0 to 100 points, with higher values indicating better function. The mean, standard deviation, median, and minimum and maximum values of the total ATRS were calculated.

The protocol of Alfredson et al.[6], adapted to the postoperative context, was incorporated into the strengthening phase of rehabilitation because it is clinically applicable, reproducible, and well understood by patients, especially those who have greater difficulty adhering to more complex physiotherapeutic programs. Its use was based on the possibility of persistent residual pain and tendinopathic symptoms after open surgical repair of the Achilles tendon. Thus, progressive eccentric weight-bearing exercises were used in patients undergoing minimally invasive repair, and tolerance to monopodal exercise was evaluated during outpatient follow-up to guide individualized rehabilitation progression. The timed monopodal exercise served as a complementary clinical evaluation of the gastrocnemius-soleus complex's tolerance to weight-bearing and is not a validated test for objectively measuring muscle strength or diagnosing tendinopathy.

All questionnaires and functional assessments were applied during outpatient follow-up by the team responsible for postoperative follow-up of patients.

No postoperative complications related to healing, superficial infection, surgical wound dehiscence, or sural nerve paresthesias were observed during follow-up.

Results

Table 1 shows the sociodemographic and clinical profile of the 20 patients included in the study.

Twenty patients undergoing minimally invasive treatment of acute Achilles tendon rupture with the Tenolig® device were evaluated. The sample consisted of 15 men (75%) and five women (25%), with a mean age of 39.7 ± 13.2 years. The right side was the most affected, corresponding to the majority of the cases evaluated.

The mean body mass index was 27.3 ± 3.3 kg/m^2, ranging between 22.3 and 33.3 kg/m^2. Four patients (20%) reported active smoking, and eight patient reports regular physical activity (40%)

The mean postoperative follow-up was 24 ± 4.6 months, performed on an outpatient basis by the same team responsible for the surgical procedure and physiotherapeutic follow-up.

Table 2 shows the results by each ATRS domain. Each item is scored on a scale from 0 to 10, in which 0 corresponds to the greatest limitation and 10 to the absence of limitation. The sum of the ten items yields a total score of 0 to 100 points, with higher values indicating better function.

Table 3 shows the descriptive measures of the total ATRS score. The mean score was 98.1 ± 3.4 points, with a median of 100 points and a range of 86 to 100 points. Eleven patients (55%) reached the maximum score of 100 points.

Table 1. Sociodemographic and clinical characteristics of the patients included in the study

Patient	Sex	Age	Side	BMI	Smoking	Physical activity	Injury date
1º	M	24	D	27.7	Yes	Yes	08/28/2021
2º	M	26	D	23.5	No	No	01/23/2019
3º	M	27	D	26.9	No	No	04/03/2020
4º	M	28	D	24.8	No	No	09/11/2021
5º	M	28	D	25.2	No	Yes	10/03/2018
6º	M	29	D	27.4	No	Yes	05/01/2021
7º	M	31	D	25.1	No	No	03/20/2018
8º	M	33	D	30.2	Yes	No	04/22/2021
9º	F	35	D	22.3	No	No	10/06/2020
10º	M	37	D	31.4	No	No	11/13/2019
11º	F	39	D	30.4	No	Yes	07/27/2021
12º	M	40	D	29.8	No	Yes	07/25/2020
13º	F	42	D	26.7	No	Yes	04/02/2018
14º	F	43	E	30.6	No	Yes	01/30/2021
15º	M	46	E	32.4	Yes	No	06/19/2020
16º	M	48	D	26.3	No	No	05/21/2021
17º	F	55	E	33.3	No	No	09/25/2020
18º	M	57	D	23.7	Yes	Yes	05/26/2018
19º	M	63	D	23.6	No	No	05/08/2018
20º	M	64	D	25.3	No	No	09/18/2018

BMI: Body mass index.

In the pain and heavy physical activity domains, all participants scored 10 points, indicating no limitation. For the item on decreased calf and Achilles tendon strength, 15 patients (75%) had the maximum score, while five (25%) showed some intermediate limitation. In the other domains, 18 patients (90%) obtained the maximum score.

Overall, the results showed low overall functional limitation. Residual limitations were observed mainly in strength, muscle fatigue, stiffness, activities of daily living, and sports activities with greater functional demands. Thus, patients who underwent minimally invasive treatment had high functional scores on the ATRS evaluation.

According to Table 4, the mean time to perform the exercise was half a minute, with no pain component during the movement.

In the complementary functional evaluation, based on an adaptation of the principles of the protocol of Alfredson et al.[6], each patient performed a monopodal heel lift exercise with an eccentric phase of controlled descent, maintaining the position for the longest time tolerated. The maintenance time was individually timed, with a mean of 31.8 seconds. No relevant pain complaints were reported during the evaluation, and all patients completed the proposed exercise.

Table 2. Result of the application of the Achilles tendon total rupture score questionnaire

Item	N*	Ten (without limitation)	Zero (with limitation)	Other measurements (1-9 points)
Are you limited because of decreased strength in the calf/Achilles tendon?	20	15	0	5
Are you limited because of fatigue in the calf/Achilles tendon?	20	18	0	2
Are you limited because of stiffness in the calf/Achilles tendon?	20	18	0	2
Are you limited because of pain in the calf/Achilles tendon?	20	20	0	0
Are you limited during activities of daily living?	20	18	0	2
Are you limited when walking on uneven surfaces?	20	18	0	2
Are you limited when walking quickly uphill or on a slope?	20	18	0	2
Are you limited during activities that include running?	20	18	0	2
Are you limited during activities that include jumping?	20	18	0	2
Are you limited when performing heavy physical work?	20	20	0	0

Table 3. Achilles tendon total rupture score at final assessment

ATRS domain	Mean ± SD	Median	Minimum-maximum	Maximum score, n (%)
Diminuição da força	9.5 ± 1.1	10	7-10	15 (75%)
Fadiga	9.9 ± 0.5	10	8-10	18 (90%)
Rigidez	9.8 ± 0.8	10	7-10	18 (90%)
Dor	10.0 ± 0.0	10	10-10	20 (100%)
Atividades da vida diária	9.7 ± 1.0	10	6-10	18 (90%)
Caminhada em superfícies irregulares	9.9 ± 0.5	10	8-10	18 (90%)
Caminhada rápida em subida ou ladeira	9.8 ± 0.6	10	8-10	18 (90%)
Atividades que incluem corrida	9.8 ± 0.6	10	8-10	18 (90%)
Atividades que incluem saltos	9.9 ± 0.5	10	8-10	18 (90%)
Trabalho físico pesado	10.0 ± 0.0	10	10-10	20 (100%)
ATRS total	**98.1 ± 3.4**	**100**	**86-100**	**11 (55%)**

Note: Each ATRS item ranges from 0 to 10, with 0 corresponding to the greatest limitation and 10 to the absence of limitation. The sum of the ten items yields a total score of 0 to 100 points, with higher values indicating better function. In the last column, the maximum score corresponds to 10 points in each domain and 100 points in the total ATRS.
Abbreviations: ATRS: Achilles Tendon Total Rupture Score; SD: Standard deviation.

Table 4. Results of the timed monopodal functional assessment, based on the principles of Alfredson et al.[6]

N = Total	Exercise total time	Mean time per patient
20	637 segundos	31.85 segundos

A case of re-rupture (5%) was observed approximately two months after the initial procedure, with significant functional limitation at follow-up. No postoperative complications related to healing, superficial infection, surgical wound dehiscence, or sural nerve paresthesias were observed during follow-up.

One patient had previously been diagnosed with peripheral obstructive arterial disease, clinically controlled and monitored by a specialist. Because the patient did not have decompensated vasculopathy or documented scarring, the patient did not meet the exclusion criteria and was retained in the analysis. However, during follow-up, the patient presented limitations in fully completing the physiotherapeutic protocol.

There was greater difficulty in adhering to the rehabilitation protocol in patients with less socio-educational support, especially in relation to the understanding and regularity of home exercises.

Discussion

This study evaluated the clinical and functional outcomes of patients undergoing minimally invasive treatment of acute Achilles tendon rupture with the Tenolig® device, along with a rehabilitation protocol based on the principles described by Alfredson et al.[6]. The main findings were favorable functional outcomes on the ATRS score, a low re-rupture rate, and no neurological or healing-related complications during the mean follow-up of two years.

The small sample size is a limitation of this study. The final sample consisted of 20 patients, and the small number of participants was related to the unicentric nature of the research, the selective use of the Tenolig® device in a highly complex hospital institution, the limited number of cases that fully met the eligibility criteria, and the availability of patients to participate and perform functional evaluations. No sample selection was performed, and all eligible patients were included during the analysis period.

The epidemiological profile of the patients evaluated was similar to that described in the literature, with a predominance of physically active males of productive age. Previous epidemiological studies have shown a progressive increase in the incidence of Achilles tendon ruptures, especially among recreational sports practitioners[8].

In recent decades, minimally invasive techniques have become a prominent option in the surgical treatment of acute Achilles tendon rupture. Comparative studies show that these approaches cause less soft-tissue trauma and have lower rates of surgical-wound complications, such as infection, skin necrosis, dehiscence, and scar adhesions, than conventional open techniques[9]. Consistent with these findings, no complications related to healing, superficial infection, or skin injury were observed in patients in this series.

Among the percutaneous techniques described for treating this injury, including Ma and Griffith, Dresden, PARS, and Achillon, the Tenolig® device offers features that favor clinical use, such as shorter tissue dissection, shorter surgical time, and the potential for early functional mobilization. Although implant cost and the need for technical familiarity may limit its use in some services, specific studies on the Tenolig® device support its use as a minimally invasive alternative for treating acute Achilles tendon ruptures[5]. Less invasive techniques have also been described in other clinical contexts, including treatment of chronic Achilles tendon ruptures[10].

The observed re-rupture rate was 5%. In a comparative study of patients with acute complete Achilles tendon rupture, Cretnik et al.[11] reported re-rupture rates of 3.7% after percutaneous repair and 2.8% after open repair, with no statistically significant difference between techniques. Although the reduced sample size limits direct comparisons, the observed result was close to that reported for percutaneous treatment of acute ruptures.

Despite its low incidence, re-rupture remains one of the most relevant complications of this injury, which can significantly compromise functional recovery and prolong the rehabilitation process.

Another aspect frequently discussed in the literature refers to the risk of sural nerve injury during percutaneous procedures. Buchgraber and Passler[12] reported a potentially higher incidence of sensory alterations than with open approaches. However, no cases of persistent paresthesia or neurological deficits were observed in this series. This result may reflect standardized surgical technique, adequate anatomical knowledge, and the team's experience performing the procedures.

The ATRS score showed satisfactory recovery of Achilles tendon function. These findings corroborate previous studies showing that minimally invasive techniques can deliver functional outcomes similar to or better than those observed with open techniques, especially when combined with structured rehabilitation protocols.

Early functional rehabilitation is an important component in the treatment of acute Achilles tendon ruptures. In a randomized clinical trial, Metz et al.[13] compared minimally invasive surgical treatment with non-operative treatment, both associated with functional rehabilitation and immediate weight-bearing. No statistically significant differences were observed between the groups regarding the occurrence of complications or re-rupture. However, the return to work activities occurred earlier in the group undergoing minimally invasive treatment.

In the present study, the principles based on the protocol of Alfredson et al.[6] were chosen for their broad clinical applicability, ease of execution, and good reproducibility in the outpatient setting. The association between minimally invasive repair and progressive eccentric strengthening of the triceps surae muscles contributed to the satisfactory functional outcomes observed during follow-up.

This protocol was also incorporated because pain and functional limitation can persist after open repair of an Achilles tendon rupture. Strauss et al.[14], in a series of open repairs, observed that, despite favorable overall outcomes, 22% of patients still had some degree of pain and 26% reported

limitations in activities during late follow-up. In addition, the postoperative complication rate was 16.8%. Sikorski and Czamara[15] showed that 15 weeks of physical therapy after open repair were necessary to restore independent, painless ambulation; however, plantar flexion and supination of the operated limb remained reduced compared with individuals without injury, suggesting incomplete functional recovery even after structured rehabilitation.

In this context, the principles of eccentric weight-bearing described by Alfredson et al. [6] were adapted and incorporated into the strengthening phase for patients undergoing percutaneous repair with the Tenolig® device, to improve tendon tolerance to weight-bearing, reduce pain, and promote range-of-motion recovery. This strategy was adopted based on the literature, which describes residual pain, functional limitation, reduced mobility, and tendinopathic symptoms after open repair. This series showed good exercise tolerance and low pain-related limitation, although the lack of a comparator group does not allow establishing the superiority of the percutaneous technique over the open technique. Although the original protocol was developed for patients with chronic tendinosis of the middle portion of the Achilles tendon, its 12-week application significantly reduced pain during activities and improved muscle strength and return to the previous level of activity, providing a clinical basis for the progressive use of eccentric training. In the present study, this adaptation aimed to gradually increase tendon weight-bearing tolerance, reduce residual pain, and promote functional recovery during the postoperative period.

All patients performed the proposed monopodal functional exercise without relevant pain complaints, with a mean execution time of 31.8 seconds. These findings suggest good clinical tolerance for tendon weight-bearing after percutaneous repair, consistent with the rehabilitation protocol employed. However, because no group underwent open repair, the results cannot be attributed solely to eccentric strengthening or used to establish the percutaneous technique's superiority. Thus, the outcomes should be interpreted as descriptive evidence of the protocol's feasibility and clinical tolerability.

It was also observed that patients with less social support had greater difficulty in adhering to the physiotherapeutic protocol, a factor potentially related to functional recovery. Visser et al. [16], in a study of patients with Achilles tendinopathy, identified an association between low socioeconomic status and less favorable therapeutic outcomes. Although tendinopathy and acute Achilles tendon rupture are clinically distinct conditions, these findings can be considered, in an exploratory way, to understand how socioeconomic factors influence treatment adherence and functional recovery.

Overall, the results of this series suggest that minimally invasive repair using Tenolig®, combined with a structured rehabilitation protocol, provides adequate functional recovery, low complication rates, and reduced incidence of re-rupture in the treatment of acute Achilles tendon ruptures.

The present study has important limitations, including a small sample size, a retrospective design, no control group, single-center performance, and the predominant use of subjective instruments for functional assessment. In addition, no complementary objective evaluations were performed, such as dynamometry, serial ultrasound, or comparative biomechanical analysis. Thus, interpret the results with caution; prospective, comparative studies with larger patient numbers are needed to better validate the findings.

Conclusion

The minimally invasive treatment of acute Achilles tendon rupture with the Tenolig® device, combined with a structured rehabilitation protocol with eccentric exercises adapted from the principles described by Alfredson et al.[6], showed satisfactory functional outcomes and low complication rates in this case series. However, comparative prospective studies with larger patient numbers are needed to better validate the technique.

Authors' contributions: Each author contributed individually and significantly to the development of this article: JMM *(https://orcid.org/0000-0001-6039-4599) Conceived and planned the activities that led to the study and data collection; SDSP *(https://orcid.org/0000-0002-8677-3981) Conceived and planned the activities that led to the study, interpreted the results of the study, participated in the review process, bibliographic review; MAGR *(https://orcid.org/0000-0002-7424-9074) Data collection; LGSL *(https://orcid.org/0000-0002-1343-3687) Data collection, interpreted the results of the study, participated in the review process; GCPA *(https://orcid.org/0009-0000-3343-5201) Data collection, revision of the selected references. All authors read and approved the final manuscript. *ORCID (Open Researcher and Contributor ID).

References

1. Bullock M, Pierson Z. Achilles tendon rupture. Clin Podiatr Med Surg. 2024;41(3):535-49.
2. Patel MS, Kadakia AR. Minimally invasive treatments of acute Achilles tendon ruptures. Foot Ankle Clin. 2019;24(3):399-424.
3. Tejwani NC, Lee J, Weatherall J, Sherman O. Acute Achilles tendon ruptures: a comparison of minimally invasive and open approach repairs followed by early rehabilitation. Am J Orthop. 2014;43(10):E221-5.
4. Khan RJK, Fick D, Keogh A, Crawford J, Brammar T, Parker M. Treatment of acute Achilles tendon ruptures: a meta-analysis of randomized, controlled trials. J Bone Joint Surg Am. 2005;87(10):2202-10.
5. Lacoste S, Feron JM, Cherrier B. Percutaneous Tenolig® repair under intraoperative ultrasonography guidance in acute Achilles tendon rupture. Orthop Traumatol Surg Res. 2014;100(8):925-30.
6. Alfredson H, Pietilä T, Jonsson P, Lorentzon R. Heavy-load eccentric calf muscle training for the treatment of chronic Achilles tendinosis. Am J Sports Med. 1998;26(3):360-6.
7. Nilsson-Helander K, Thomeé R, Silbernagel KG, Thomeé P, Faxén E, Erikson BI et al. The Achilles Tendon Total Rupture Score (ATRS): development and validation. Am J Sports Med. 2007; 35(3):421-6.
8. Lemme NJ, Li NY, DeFroda, SF, Kleiner J, Owens BD. Epidemiology of Achilles tendon ruptures in the United States: athletic and nonathletic injuries from 2012 to 2016. Orthop J Sports Med. 2018;6(11):2325967118808238.
9. Attia AK, Mahmoud K, D'Hooghe P, Bariteau J, Labib AS, Myerson MS. Outcomes and complications of open versus minimally invasive repair of acute Achilles tendon ruptures: a systematic review and meta-analysis of randomized controlled trials. Am J Sports Med. 2023;51(3):825-36.
10. Maffulli N, Oliva F, Maffulli GD, Buono AD, Gougolias N. Surgical management of chronic rupture of the Achilles tendon using less invasive techniques. Foot Ankle Surg. 2018;24(2):164-70.
11. Cretnik A, Kosanovic M, Smrkolj V. Percutaneous versus open repair of the ruptured Achilles tendon: a comparative study. Am J Sports Med. 2005;33(9):1369-79.
12. Buchgraber A, Passler HH. Percutaneous repair of Achilles tendon rupture: immobilization versus functional postoperative treatment. Clin Orthop Relat Res. 1997;(341):113-22.
13. Metz R, Verleisdonk E-JM, van der Heijden GJMG, Clevers GJ, Hammacher ER, Verhofstad MHJ, van der Werken C. Acute Achilles tendon rupture: minimally invasive surgery versus nonoperative treatment with immediate full weightbearing: a randomized controlled trial. Am J Sports Med. 2008;36(9):1688-94.
14. Strauss EJ, Ishak C, Jazrawi L, Sherman O, Rosen J. Operative treatment of acute Achilles tendon ruptures: an institutional review of clinical outcomes. Injury. 2007;38(7):832-8.
15. Sikorski Ł, Czamara A. Assessment of effectiveness of 15 weeks of physical therapy on biplanar ankle mobility, gait and pain level in patients following operative repair of the Achilles tendon. Ortop Traumatol Rehabil. 2021;23(1):33-44.
16. Visser TS, Brul S, Deng J, Bonsel J, van Es E, Eugendaal D et al. Low socioeconomic status is associated with worse treatment outcomes in patients with Achilles tendinopathy. Br J Sports Med. 2024;58(11):579-85.