

# Minimally invasive treatment of acute Achilles tendon rupture with endoscopic flexor hallucis longus transfer

## Tratamento minimamente invasivo de rupturas agudas do tendão calcâneo com transferência endoscópica do flexor longo do hálux

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### ABSTRACT

**Objective:** To evaluate the clinical and functional outcomes of acute Achilles tendon rupture or rerupture repaired with minimally invasive surgery and reinforcement with flexor hallucis longus transfer via posterior ankle arthroscopy in patients with poor compliance with follow-up.

**Methods:** A retrospective study was conducted that evaluated five patients with more than 24 months of postoperative follow-up using the American Orthopaedic Foot and Ankle Society (AOFAS) scale, Victorian Institute of Sport Assessment-Achilles (VISA-A) scale, Achilles tendon total rupture score (ATRS), and visual analog scale (VAS) for pain, as well as the range of motion and flexion strength.

**Results:** The mean scores on the VAS, AOFAS scale, and VISA-A scale and the ATRS were 0.6, 98, 98.2, and 100, respectively. The mean dorsiflexion range of motion was 4.8° on the operated side and 7.6° on the contralateral side. The mean plantar flexion strength was 24.02 kgf on the operated side and 24.64 kgf on the contralateral side. The flexion strength of the interphalangeal joint of the hallux was 13.94 kgf on the operated side and 17.6 kgf on the contralateral side. The patients had no functional complaints.

**Conclusion:** The proposed surgical treatment had good clinical and functional outcomes in the evaluated patients. The surgical technique described may be a good alternative for treating patients with poor compliance diagnosed with acute tendon rupture or cases of rerupture.

**Level of Evidence IV; Therapeutic Studies; Case Series.**

**Keywords:** Rupture, Spontaneous; Achilles tendon; Arthroscopy.

### RESUMO

**Objetivo:** Avaliar os resultados clínicos e funcionais de pacientes de perfil pouco colaborativo com ruptura aguda ou rerruptura do tendão calcâneo tratados com reparo minimamente invasivo e reforço com transferência do tendão flexor longo do hálux por meio de artroscopia posterior do tornozelo.

**Métodos:** Estudo retrospectivo em que foram avaliados cinco pacientes com mais de 24 meses de seguimento pós-operatório, por meio dos questionários AOFAS, VISA-A, ATRS, escala visual analógica de dor, amplitude de movimento e força.

**Resultados:** Foram obtidas as médias de escala visual analógica de dor: 0,6; AOFAS: 98; VISA-A: 98,2 e ATRS: 100. A média de amplitude de movimento de dorsiflexão no lado operado foi de 4,8° e no contralateral de 7,6°. A média da força de flexão plantar no lado operado foi de 24,02 kgf e no contralateral foi de 24,64 kgf. A força de flexão da interfalangeana do hálux foi de 13,94 kgf no lado operado e 17,6 kgf no contralateral, porém os pacientes não apresentaram queixas funcionais.

Work performed at the Hospital de Clínicas da Universidade Estadual de Campinas, SP, Brazil.

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**Conclusão:** O método de tratamento cirúrgico proposto teve bons resultados clínicos e funcionais nos pacientes avaliados. A técnica cirúrgica apresentada pode ser uma boa alternativa para tratamento de pacientes pouco colaborativos com diagnóstico de ruptura aguda do tendão calcâneo ou casos de rerruptura.

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

**Descritores:** Ruptura espontânea; Tendão do calcâneo; Artroscopia.

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## INTRODUCTION

Acute rupture of the Achilles tendon causes significant functional loss. Treatment can be conservative or surgical, with three possibilities for repair: open, minimally invasive, or percutaneous<sup>(1)</sup>.

Historically, open surgery is associated with severe complications, including deep infection and skin and tendon necrosis<sup>(1)</sup>. Percutaneous and minimally invasive surgeries were developed to decrease the frequency and severity of these complications.

One of the criticisms of percutaneous surgery is the increased risk of rerupture because the suture is not visualized as in open surgery<sup>(2)</sup>. Patients with poor compliance, those who are immunocompromised, smokers, and those with difficulty in postoperative follow-up could benefit from minimally invasive surgery. A strategy to increase the strength of repair in this type of surgery is reinforcement with tendon transfer, such as with the flexor hallucis longus (FHL) or peroneus brevis tendon<sup>(3)</sup>. The present study performed a clinical and functional assessment of patients with acute Achilles tendon rupture treated with minimally invasive calcaneal tendon repair and reinforcement with FHL transfer via posterior ankle arthroscopy.

## METHODS

This study was approved by the Research Ethics Committee, with registration in the Brazil Platform (Plataforma Brazil) under CAAE No. 03875218.3.0000.5404.

This retrospective study evaluated five patients who underwent surgery between 2013 and 2014, were non-compliant with follow-up, suffered acute Achilles tendon rupture or rerupture, and underwent minimally invasive surgery for FHL transfer via posterior ankle arthroscopy. The diagnosis was based on the medical history and palpation during a physical examination, and the Achilles tendon rupture was between 2 and 8 cm from the insertion site.

The inclusion criteria were age older than 18 years, non-compliant behavior at preoperative assessment, follow-up period of more than 24 months, and acute rupture or rerupture of the Achilles tendon. The exclusion criteria were open injuries and loss to follow-up. The criteria used to define noncompliant behavior were noncompliance with postoperative follow-up due to limited access to transportation or residing in an area with limited access to rehabilitation facilities.

The patients were evaluated using the visual analog scale (VAS) for pain, American Orthopaedic Foot and Ankle Society (AOFAS) scale, Achilles tendon total rupture score (ATRS), and Victorian Institute of Sport Assessment-Achilles (VISA-A) scale, and function was assessed using the range of motion and plantar flexion strength. A goniometer was used to measure the range of motion, and a Lafayette® hand-held dynamometer was used to measure flexion strength<sup>(4)</sup>.

## Surgical technique

The patients were subjected to spinal anesthesia and sedation and placed in a prone position. A pneumatic tourniquet was placed on the thigh but was not initially inflated. A 3-cm horizontal dissection was performed at the site of the tendon rupture. Blunt dissection was performed with the index finger, detaching the skin from the paratenon proximally and distally, without the opening the tendon (Figure 1).

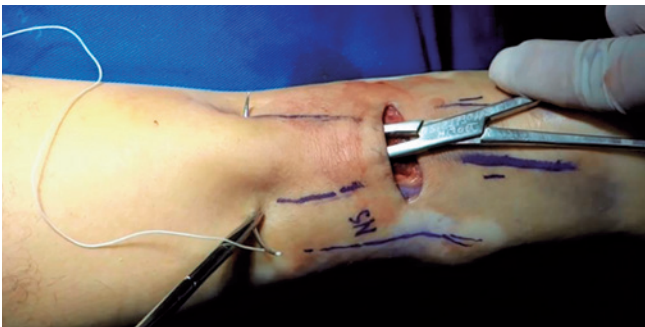
After securing and holding the proximal stump with holding (Collin) forceps, two Vicryl® 2-0 sutures were passed percutaneously from lateral to medial, to avoid damage to the sural nerve, while ensuring that the needle passed through the two rings of the forceps and crossed the thickness of the Achilles tendon (Figure 2).

The forceps were inserted through the access route, exposing the opposite ends of each suture, one medial and one lateral to the Achilles tendon. At this time, the pneumatic tourniquet was inflated, and posterior ankle arthroscopy was performed as described by van Dijk<sup>(5)</sup>. The posterola-

teral and posteromedial portals were constructed close to the tendon. The FHL, which passes medially to the Stieda process of the talus, was located. The FHL retinaculum was opened, and the ankle and hallux were positioned in maximal plantar flexion to perform tenotomy of the FHL using arthroscopic scissors as distally as possible to obtain a longer graft (Figure 3). A small opening was made in the fascia at the rupture site between the posterior superficial and deep compartments, and the muscle belly of the FHL was pulled, exposing it through the access route (Figure 4). Vicryl® 2-0



**Figure 1.** View of the access route.  
**Source:** Author's personal archive.



**Figure 2.** Passage of the needle through the tendon and holding forceps.

**Source:** Author's personal archive.



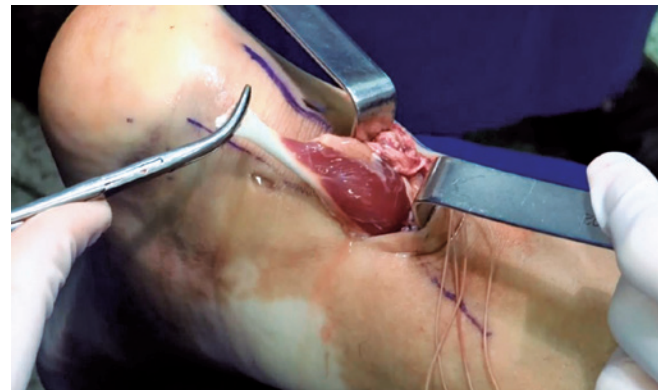
**Figure 3.** Arthroscopy with posteromedial and posterolateral portals.  
**Source:** Author's personal archive.

sutures were anchored to the tip of the FHL to allow pulling of the FHL with greater ease.

The FHL was pulled through the posteromedial arthroscopic portal. A tunnel was made across the Achilles tendon from medial to lateral using Halsted mosquito forceps, through which the graft was passed from medial to lateral and exited through the posterolateral portal. Two additional Vicryl® 2-0 sutures were passed through the distal stump of the Achilles tendon in the same manner as previously described for the proximal stump. The sutures were removed through the access route as described above.

With the ankle in plantar flexion, manual suturing was performed between the proximal ends of both stumps of the Achilles tendon through the rupture access route in the same manner used for the distal ends of each stump, completing the percutaneous suture (Figure 5).

The FHL tendon was pulled by the transverse route and closed with Vicryl® 2-0 sutures between the stumps.



**Figure 4.** Flexor hallucis longus tendon retrieved endoscopically.  
**Source:** Author's personal archive.



**Figure 5.** Tenorrhaphy of the proximal and distal stumps of the Achilles tendon.  
**Source:** Author's personal archive.



**Figure 6.** Reinforcement using the flexor hallucis longus tendon. **Source:** Author’s personal archive.

Double stitches were used through the two arthroscopic portals to reinforce the suture (Figure 6). The subcutaneous tissue was closed with clear Vicryl® 3.0 sutures, and the skin was closed with simple nylon 4-0 stitches.

During the postoperative period, the patients wore a plaster cast in a mild equinus position for 2 weeks, without weight-bearing. An orthopedic boot with a heel was used from the third to the sixth week for maintenance of the equinus and weight-bearing. Physical therapy rehabilitation began in the third week with passive exercises and more intense exercises starting at the sixth week, when the orthopedic boot was removed, and a silicone heel was used until four months after surgery.

**RESULTS**

**Patient 1**

The patient was a 51-year-old retired man who had no comorbidities or previous pain in the right Achilles tendon. The patient presented a history of rupture of the contralateral Achilles tendon 12 years prior. He was underwent surgery at another hospital, with good progression and without complaints. The right Achilles tendon ruptured on 12/21/2013 during a soccer game and was repaired 20 days after the trauma. Functional rehabilitation was performed, and a splint in the equinus position was used for 3 weeks; after the sutures were removed, physical therapy was started. An orthopedic boot was used for 1 week with elevation of the calcaneus starting with partial weight bearing. Total weight bearing was started in the fourth week, keeping the splint in equinus until 6 weeks postoperatively. Then, the patient wore shoes with heels for another 3 months. He had good progression throughout the postoperative period, with only mild pain during the first 3 months.

**Patient 2**

The patient was a 31-year-old man who was unemployed, a smoker, and had no comorbidities or previous pain in the Achilles tendon. The left Achilles tendon ruptured on 09/23 2013 during a soccer game and was repaired 7 days after the trauma. Functional rehabilitation was performed. The patient had no complications.

**Patient 3**

The patient was a 40-year-old man who was unemployed, had no comorbidities and experienced a rupture of the right Achilles tendon 4 months prior, which was treated conservatively. The tendon ruptured on 12/14/2013 during a fishing activity and was repaired 3 days after the trauma. Functional rehabilitation was performed. The patient had no complications. Eight months after the surgery, a partial rupture of the contralateral Achilles tendon occurred, which was treated conservatively.

**Patient 4**

The patient was a 36-year-old man who was an active worker and had no comorbidities or previous pain in the Achilles tendon. The tendon ruptured on 01/25/2014 during a soccer game and was repaired 9 days after the trauma. Functional rehabilitation was performed. The patient had no complications.

**Patient 5**

The patient was a 72-year-old retired man who was a former smoker (stopped smoking 20 years prior) and had no comorbidities or previous pain in the Achilles tendon. The tendon ruptured on 09/16/2014 while pushing a car and was repaired surgically 28 days after the trauma. Functional rehabilitation and physical therapy were not performed. The patient presented paresthesia in the sural nerve but without neuroma, pain, or hypersensitivity.

The mean VAS, AOFAS scale, and VISA-A scale scores and the ATRS were 0.6, 98, 98.2, and 100, respectively (Table 1). The mean dorsiflexion range of motion was 4.8° on the

**Table 1.** Mean VAS, AOFAS, and VISA-A scores and the ATRS.

Patient	Clinical evaluation method			
	VAS	AOFAS	VISA-A	ATRS
1	3	90	97	100
2	0	100	100	100
3	0	100	95	100
4	0	100	99	100
5	0	100	100	100
Mean	0,6	98	98,2	100

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

**Table 2.** Mean range of motion of the ankles (in degrees).

Patient	Range of motion			
	Dorsiflexion		Plantar flexion	
	Operated	Contralateral	Operated	Contralateral
1	8	4	40	34
2	2	10	20	20
3	4	4	20	20
4	4	10	20	30
5	6	10	30	30
<b>Mean</b>	4,8	7,6	26	26,8

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

**Table 3.** Mean plantar flexion strength (in kgf) of the ankle and interphalangeal joint of the hallux.

Patient	Plantar flexion force			
	Ankle		Interphalangeal joint	
	Operated	Contralateral	Operated	Contralateral
1	30.2	27.1	18	19.9
2	22.8	27.3	9.8	18.7
3	24.9	23.8	13.5	19.3
4	31	35.2	14.6	15.8
5	11.2	9.8	13.8	14.3
<b>Mean</b>	24.02	24.64	13.94	17.6

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

operated side and 7.6° on the contralateral side (Table 2). The mean plantar flexion strength of the ankle was 24.02 kgf on the operated side and 24.64 kgf on the contralateral side. The mean flexion strength of the interphalangeal joint of the hallux was 13.94 kgf on the operated side and 17.6 kgf on the contralateral side (Table 3). The reduction of the flexion strength of the hallux on the operated side did not cause any complaints or difficulty in performing physical activities.

## DISCUSSION

The repair of acute Achilles tendon injuries is controversial. The Clinical Practice Guideline of the American Academy of Orthopedic Surgeons makes a minor recommendation for conservative or surgical treatment<sup>(6)</sup>. Although controversial, a meta-analysis demonstrated that the rerupture rates of surgical repair (2.7-3.6%) were lower than those of conservative treatment (4.2-13.0%)<sup>(7,8)</sup>. However, suture infection and dehiscence occurred in 2.4-4.7% of operated patients and increased to 10.4% in the presence of risk factors, including diabetes, smoking, and the use of steroids<sup>(9)</sup>.

The rates of severe complications are reduced using minimally invasive surgeries, which result in rupture rates similar to those of open surgery and higher patient satisfaction<sup>(10,11)</sup>. Studies using specific instruments for minimally invasive procedures reported a mean postoperative AOFAS score of 93.00 to 96.81<sup>(12,13)</sup>, VISA-A score of 92, rerupture rate of 3.2% and 2%<sup>(12,13)</sup>, and rate of sural nerve injury of 0 to 3.3%<sup>(12-14)</sup>. A recent Brazilian study found no significant differences in isokinetic functional outcomes between open and percutaneous surgery<sup>(15)</sup>. In the present series, no cases of sural nerve injury or rerupture occurred, and the mean AOFAS score, VISA-A score, and ATRS were 98, 98.2, and 100, respectively, indicating satisfactory clinical and functional results, with minimal pain (VAS of 0.6).

FHL transfer has been shown to decrease the flexion strength of the interphalangeal joint; however, the function of this joint is not affected<sup>(16)</sup>. The patients in our series had an absolute decrease in flexion of the interphalangeal joint of the hallux, but a statistical analysis was not performed. The patients had no complaints related to hallux or ankle mobility and no difficulty in performing sports activities. Furthermore, the function of the repaired tendon was not affected in any patient.

The limitations of this study were its retrospective and cross-sectional design, the heterogeneity of the evaluated cases, and an inability to perform a statistical analysis because of the small sample size. With respect to the descriptive analysis, patients 3 and 5 represented the main indication of this technique. Patient 3 was a case of rerupture with the need for tendon graft transfer, and the chosen technique was minimally invasive surgery, which had an excellent outcome (AOFAS score, 100; VISA-A score, 95; ATRS, 100). Patient 5 was an elderly man with difficulty attending follow-up visits, a previous history of smoking, and low socioeconomic status, and he did not undergo functional rehabilitation or physical therapy. Minimally invasive surgery and strengthening with FHL transfer may have been critical for achieving favorable results.

A prospective study with control conditions consisting of conservative treatment and open surgery and inclusion of only cases of rerupture or cases of only noncompliant patients with comorbidities (diabetes and a history of smoking) may better demonstrate the results of the new surgical technique described.

## CONCLUSION

The described surgical technique may be effective for treating noncompliant patients with a diagnosis of acute rupture or rerupture of the Achilles tendon.

**Authors' contributions:** Each author contributed individually and significantly to the development of this article: TCPL \*(<https://orcid.org/0000-0003-1238-2475>) analysis of patient records, clinical examination, formatting of the article; RGP \*(<https://orcid.org/0000-0002-6064-2027>) conceived and planned the activities that led to the study; participated in the review process and formatting of the article; GENS \*(<https://orcid.org/0000-0003-2717-3609>) participated in the review process and formatting of the article; CL \*(<https://orcid.org/0000-0002-7595-3303>) data collection and participated in the review process; MCMD \*(<https://orcid.org/0000-0001-6572-1771>) conceived and planned the activities that led to the study, participated in the review process, formatting of the article and approved the final version. \*ORCID (Open Researcher and Contributor ID).

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