

Comparative Study Between the Minimally Invasive and Conventional Techniques Opened for Repair of Heel Bone Tendon Injury

René André Reinig Carvalho* and Cíntia Kelly Bittar

Pontifícia Universidade Católica de Campinas, São Paulo, Brazil

*Corresponding author: Carvalho RAR, Pontifícia Universidade Católica de Campinas, São Paulo, Brazil, Tel: +1936621634; E-mail: renekcond@yahoo.com.br

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Abstract

Objective: To compare the minimally invasive technique, using a short fibula tendon, with the conventional open technique, associated with semitendinous tendon reinforcement to repair calcaneus tendon injuries and present functional clinical results, degree of satisfaction and complications found.

Method: Retrospective study including 43 patients with traumatic or degenerative calcaneus tendon lesions, evaluating average age, laterality, surgical techniques used, clinical-functional evaluation with AOFAS questionnaire and complications.

Results: Sixteen patients were treated with a minimally invasive technique with a short fibula tendon graft and twenty-seven with an open technique with a semitendinous tendon graft, with an average age of 45.05 years. There were 86% male, 55.8% left lateral, 27.9% with degenerative lesions and 72.1% with traumatic lesions. The clinical functional results were obtained by the AOFAS questionnaire in the postoperative period, after an average time of two years. In cases of open suture, there were three complications in the donor area (11.1%), with complaints of pain and insensitivity, three complications in the recipient area (superficial skin necrosis, deep skin necrosis and suture dehiscence), totaling six patients (22.2%) with postoperative complications. In cases of minimally invasive suture, three complications occurred (18.8%), but all cases were solved early.

Conclusion: The minimally invasive technique using a short fibula tendon as a graft is a good option for the reconstruction of acute and chronic calcaneus tendon injuries, being considered superior to the open technique in both situations, since it causes lower rates of complications, especially late complications, and morbidity.

Keywords: Calcaneus tendon; Surgery; Tendon lesions; Minimally invasive surgical procedure

Introduction

The calcaneus tendon is the strongest of the human body. Its rupture is a common injury in orthopedic care and has been increasing, especially among young people due to sports practices [1]. Despite its strength, it is one of the tendons that most commonly suffer spontaneous ruptures, most of them during recreational activities in men between the ages of 30 and 40, mainly in sports such as football, basketball, tennis and squash. However, 25% of ruptures may occur in sedentary patients [2], usually due to chronic degeneration of the tendon [2]. Acute rupture of the calcaneus tendon can be easily diagnosed through a physical examination, including special tests such as Thompson's maneuver (patient lying flat on the examination table with his feet extended out of the table. The examiner then tightens the calf muscle. This movement should cause the foot to perform a slight plantar flexion in a normal patient. In people with a ruptured Achilles tendon, the foot will not move. This is called a positive Thompson test. However, 20% of acute lesions are not diagnosed due to several causes, such as incomplete physical examination and partial lesions, evolving to chronic ruptures, defined as those with a delay of six weeks for diagnosis or initiation of treatment [3].

The treatment of the chronic lesion is much more complex than the acute rupture due to the retraction of tendon stumps [4]. The primary repair of the chronic lesion is not always possible, due to the spacing between the stumps of the rupture [3]. Different treatments and techniques are described. There are even those who defend the conservative treatment of these lesions, showing results equivalent to those of surgical treatment based [4]. Surgical treatment minimizes the chances of rerupture and decreases the time of rehabilitation, but brings the risks inherent in any surgical procedure, especially necrosis and dehiscence [5]. Among the surgical treatments, there is a lack of studies that lead to a consensus on the treatment considered ideal [3]. Several surgical strategies have been described for the treatment of calcaneus tendon injuries, including primary repair, V-Y slip, bonding, fascia folding, autologous tendon free graft, synthetic material, allogeneic graft and platelet-rich plasma [6-14]. Techniques of mouth-to-mouth suture are also used and present fewer complications [10], when compared to tendon elongation techniques [10,11]. Open repairs require larger longitudinal incisions [12], consequently they bring a greater chance of cutaneous complications. Techniques involving transfer of short fibular tendon [3] or long flexor hallucis longus [3,13] are described to treat chronic calcaneal tendon injuries [3], as they help to preserve the integrity of the skin around the lesion because they are local grafts.

Maffulli et al. recognizes the long flexor of the hallux tendon transfers have good results but is not his preferred method, although

the strong long flexor tendon of the hallux is capable of filling large retractions. This author prefers not to use this tendon in athletes due to loss of pulling force due to the withdrawal of the long flexor of the hallux, but it can be used in patients without this demand, presenting excellent results [3,14]. For tendon losses, greater than 6 cm, with foot in maximal plantar flexion, the local tendons (short fibular, long flexor of the hallux and small plantar) are insufficient as donors, and another autologous graft [3,15], should be sought at a distance. The minimally invasive technique is performed percutaneously, usually with good appearance in the operative wound 16 and has been the preferred technique for the treatment of acute lesions [16,17], since then. The present study aims to compare and evaluate the functional results, as well as the satisfaction and complications of patients submitted to traditional open tendon reconstruction with semitendinous tendon graft and those submitted to reconstruction by a minimally invasive technique with short fibula tendon reinforcement, both in acute cases as in chronic cases.

Methodology

A retrospective study in which 43 patients with calcaneus tendon rupture, operated between 2008 and 2016 by the same surgeon, were evaluated. The average follow-up time was two years (ranging from 2 to 8 years), and those with diabetes mellitus were excluded. This study followed the institutional and governmental ethical regulations for studies in human beings and was approved by the Committee of Ethics in Research with Human Subjects under CAAE: 78565317.3.0000.5481. In 43 of the patients, 16 were treated with a minimally invasive technique, using short fibula tendon as a graft, and 27 operated with conventional open technique, using a semitendinous tendon as a graft. The following variables, available in the medical records of each patient, were analyzed: age, sex, smoking, injury mechanism, affected side and bilateral cases, local skin complications and neuromas, as well as complications in the donor area in the conventional technique. The average follow-up time was two years. The American Orthopedic Foot and Ankle Society (AOFAS) questionnaire, which analyzes pain data, activity limitation, need for support, gait distance and abnormalities, sagittal and hindfoot mobility, ankle stability, and of the hindfoot and its alignment, as well as degree of satisfaction and complications was used for clinical and functional analysis. Descriptive statistics were used to analyze the data, composed by means of the following variables: affected side, age, sex, smoking habit, trauma mechanism and type of injury.

Open surgical technique with semitendineous tendon reinforcement

The patient was placed in the ventral decubitus, under spinal anesthesia, with a tourniquet placed in the thigh. Before the surgery, the calcaneal tendon lesion and the incisions to be performed from 2.5 cm to 1 cm of the calcaneus tendon were demarcated. The short fibular tendon was visualized and isolated after performing a 2 cm incision in the region of the base of the fifth metatarsus where the insertion of the short fibular tendon is visualized, performing its tenotomy with posterior retinaculum divulsion and tracing it into the proximal incision. The short fibular tendon is passed inferiorly to the base of the calcaneus tendon, then makes another 2.5 cm incision, proximal to the calcaneus tendon. The sural nerve is isolated. After traction the short fibular tendon to the proximal region performing anchored points involving short fibular tendon and calcaneal tendon with nylon 2.0. Another suture is performed, similar to the anterior one in the distal

part again involving both tendons. Subcutaneous skin suture with vicryl 2.0 and skin suture with monocryl 3.0 (Figures 1-3).



Figure 1: Intraoperative aspect after suturing of the reinforcement with short fibular tendon.



Figure 2: Distal reinforcement suture aspect.

All patients were submitted to the same rehabilitation protocol described below: In the first week, the patients remained immobilized with a plaster cast in ten-degree plantar flexion without weight loss. In the second week partial weight discharge with removable orthosis brace. In the third week the points were removed and started muscle strengthening and stretching exercises, maintaining only ipsilateral crutch for locomotion. In the fourth week the removable immobilization was removed, the total load was released. The strengthening, stretching and proprioception exercises were intensified. In the twelfth week the patient was released for sports practices.



Figure 3: Donor area of the short fibular graft.

Results

In 43 patients selected, 37 (86%) were male and 6 were female (14%). As for laterality, there were 24 lesions on the left side (55.8%) and 19 on the right side (44.2%). The average age was 45 years, ranging from 35 to 65 years. Eight patients were smokers (18.6%), four were submitted to the minimally invasive technique and four to the open technique. Concerning to the mechanism of trauma, 31 were by traumatic mechanism (72%) and 12 by chronic degeneration (28%). Among the traumatized, 15 were playing soccer, seven stepping into holes, others from varied causes, such as falling roof, pushing broken vehicle and direct trauma at the area. Among the patients submitted to the minimally invasive technique there were 16 cases, 12 of them were male (75%) and 4 were female (25%), 7 were right lateral (43.7%) and 9 were left lateral (68%) and 5 (31.2%), the age varied between 35 and 65 years, with average of 46.8 years. Among those submitted to the open technique, 27 cases, 25 were male (92.5%), 2 female (7.5%), left laterality in 15 patients (55.5%) and right in 12 (44, 4 (4%), 4 smokers (14.8%) and 23 non-smokers (85.1%), 20 were traumatic (74%) and 7 were degenerative (25.9%). and 65 years (mean of 43.3 years).

The average follow-up time was two years (ranging from 2 to 8 years) and all patients were able to return to their normal life functions, just prior to the injury. The clinical-functional results of the postoperative AOFAS questionnaire after an average follow-up of 24 months were 92 points, ranging from 88 to 100 points. Regarding the complications, six (22.2%) occurred in patients submitted to the open technique, three with complaints in the recipient area (11.1%), superficial skin necrosis, deep skin and graft necrosis, and a suture dehiscence, and three with complaints in the donor area (11.1%), pain and insensitivity at the site, although none of the complaints represented functional clinical losses. However, the case of deep skin necrosis caused long-term complications, with loss of tendinous graft and subsequent need for skin grafting. In the patients submitted to the minimally invasive technique, three complications occurred (18.8%), two cases of neuroma due to adhesion in the surgery and one case of hyperelongation in the postoperative period due to load in the first week by the patient, who did not follow the recommendations given, all these complications were resolved in the rehabilitation quickly, without clinical or functional losses.

Discussion

The calcaneus tendon injury is frequent, usually related to sports practices and the importance of its reconstruction to return to normal activities of the foot and ankle is absolute, and the surgical techniques are still much discussed, with controversy regarding the most adequate technique. In the present study we opted to compare an open technique, a sort traditional, associated with a tendinous reinforcement, with a minimally invasive technique with graft, which has the aim of adding lower morbidity. In this study it was verified that the most affected age group was between 40 and 50 years of age; majority male, perhaps for the first being more related to sports and activities with greater morbidity, according to the literature. The surgical technique using semitendinous tendon for repair of calcaneus tendon injuries has shown good results [15], which can be confirmed in our study, even for patients with lesions greater than 6 cm [18], which the short fibular tendon is insufficient in size.

In the present study, two patients were submitted to open reconstruction of the calcaneus tendon using an association between the gracilis tendon and the semitendinosus, as they had a distance between the stumps greater than 10 cm, and it was a chronic lesion, with no functional difference for patients submitted to reconstruction only with semitendinosus, confirming studies that prove that combining semitendinous and gracile tendons is not necessary, for the reason that the semitendinous tendon guarantees the necessary force [3,18]. The treatment of already chronic injuries, usually due to negligence, requires a more complex surgical treatment, which may lead to greater complications of the soft tissue wrap [3,18]. In this study, the most severe soft-tissue complications occurred in patients with chronic and smoker lesions, with greater distance between stumps, who were treated surgically with open technique associated with semitendinous tendon reinforcement.

Minimally invasive techniques have been developed to minimize problems with the soft tissue wrap because they cause less surgical aggression [18,19]. First, the minimally invasive technique was developed using short fibular tendon reinforcement [20], with no significant evanescent functional loss at the ankle level [21-24], but without a gap greater than 6 cm intraoperatively, even with maximum ankle flexion and maximum traction of the ankles [18,21]. In this case, the use of short fibular reinforcement may not be suficiente. The semitendinosus tendon is robust and strong. It is recommended for these situations [3,18]. In this study, the minimally invasive technique was performed for patients with a distance of less than 6 cm, opting for an open technique with semitendinous reinforcement in the lesions with greater distance [3]. Studies suggest a higher rate of rebreak and neurological injury, especially of the sural nerve, of the minimally invasive technique, compared to the open technique [25]. In the present study, two cases of neuromas by adherence were completely resolved with physical therapy, with no rebreak, since a short fibular tendon graft was used. In chronic ruptures, the skin retracts over the weeks and remains in this position. In open surgery tends to draw this skin for accommodation of the tendon suture and may cause local vascular deficit [22]. After the surgery, the foot was maintained in a plaster cast with ten degrees of plantar flexion to protect the suture, in addition to prevention of acute rebreaks [18], knowing that the blood supply remained normal at up to 20 degrees of plantar flexion, presenting progressive reduction the greater the degree of flexion [18,22].

The preservation of a good soft tissues condition through the minimally invasive technique is clearly a great advantage in the

treatment of ruptures of the calcaneal tendon, especially the chronic lesions [18,22]. However, a greater technique and knowledge of the procedure by the surgeon is required. It is a good technique option for patients with a prone to skin complications, such as diabetics and vasculopathies. The choice of technique cannot be based only on the patient's demand, but also on the characteristics of the lesion, rupture conditions and intraoperative findings [3].

The limitations of this study are due to the small casuistic and a comparison made using different tendons, treatment of chronic lesions with distances between stumps greater than 6 centimeters and acute lesions with distance less than 6 centimeters, in addition, the literature is still quite limited, in relation to the cases by the minimally invasive technique with graft use as reinforcement.

Conclusions

The minimally invasive technique using short fibular tendon grafting is a good option for reconstruction of acute calcaneus tendon injuries, being considered superior to the open technique in both situations because it causes lower rates of skin complications and morbidity, considering the lesion has not a distance between stumps greater than 6 cm.

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