

Achilles Tendon Rupture and our Experience with the Achillon Device

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ABSTRACT: **Background:** Open repair of the Achilles tendon is still the gold standard for treating rupture. This technique has the disadvantages of a long and problematic operative scar and thickly scarred Achilles tendon. To improve the surgical outcome minimally invasive techniques have been developed.

Objectives: To analyze our results of Achilles tendon repair using the Achillon® device and compare them with published studies.

Methods: We performed surgical repair of the Achilles tendon in 28 patients during a 4 year period (2004–2008): 14 patients were treated with the Achillon device, 12 with the open suture technique and 2 with the percutaneous method. Fourteen patients were available for follow-up: 9 patients with the Achillon device, 3 patients with open suturing and 2 patients with the percutaneous technique. Follow-up ranged from 1 to 4 years.

Results: The average score of the AOFAS Ankle-Hindfoot Scale for the group treated with the Achillon device was 95.6 points (range 84–100) and for the group treated with the open method, 90 points (range 84–98). The length of the scar in patients operated with a minimally invasive technique was 3.81 cm (range 1–6 cm) as compared to 9.16 cm (range 8–10.5 cm) with the open suture.

Conclusions: This is the first review on this procedure in Israel. Excellent functional results were achieved with this technique. Our outcomes were similar to those of two other studies.

IMAJ 2010; 12: 609–612

KEY WORDS: Achilles, Achillon™, percutaneous method, minimally invasive technique

in a battle outside the walls of the city of Troy due to being struck in the heel by a poisoned arrow. Since then, "Achilles' heel" has come to mean an individual's principal weakness.

The Achilles tendon, formed from tendinous contributions of the gastrocnemius and soleus muscles, is the largest and strongest tendon in the human body. The tendons converge approximately 15 cm proximal to the insertion at the posterior calcaneus [2]. The Achilles tendon is stiff but resilient, possesses a high tensile strength, and has the ability to stretch up to 4% before damage occurs. When stretch exceeds 8%, macroscopic rupture occurs [3,4]. The midsection of the Achilles tendon is markedly more hypovascular than the rest of the tendon, and the risk of rupture and surgical complications is therefore highest at its midsection. Individuals with particularly poor blood supply of the midsection may also be at increased risk of tendon rupture [5].

Although ruptures of the Achilles tendon are relatively common, the incidence in the general population is difficult to determine but has probably risen in the past decade due to the increased popularity of recreational sports. Leppilahit et al. [6] studied the incidence of ruptures of the Achilles tendon in the city of Oulu, Finland, over the 16 year period 1979–1994, during which 110 ruptures occurred. The incidence increased from 2 ruptures/10⁵ inhabitants in 1979–1986 to 12 in 1987–1994, with a mean of 7. The peak annual incidence of 18 was recorded in 1994. The incidence was highest in the age group 30–39 years. Male dominance was 5.5:1, and 81% of the ruptures were related to sports, with 88% occurring in ball games.

For many years conservative treatment was an option for Achilles tear. A known story from the Second World War is a good example of the rupture healing without suturing. British pilots who were captured by the German army made several attempts to escape; the German guards decided to cut their Achilles tendon to prevent their escaping but after a few weeks the tendons healed and the pilots succeeded to flee. Nevertheless, due to the paucity of data on the effectiveness of conservative treatment a surgery department in the Netherlands [7] undertook a randomized prospective study a few years ago to compare operative versus conservative treatment of Achilles tendon. A meta-analysis by Khan et al. [8] comparing operative versus conservative treatment in acute rupture of Achilles tendon concluded that open opera-

One of the central heroes of Homer's *Iliad* [1], a classic poem about the Trojan War written in ancient Greek, is Achilles. Epitomizing the perfect warrior, who is fearless, sincere, honest and willing to die in the service of his friends and allies, Achilles was the son of a goddess and a human. His mother, Thetis, plunged him into the river Styx to make him immortal. Unfortunately, she held him by the heel, which did not get immersed and thus remained the only vulnerable part of his body. This set of circumstances will lead to his death

tive treatment of acute Achilles tendon ruptures significantly reduces the risk of re-rupture compared with non-operative treatment. On the other hand, surgical treatment is associated with a significantly higher risk of complications. Advanced surgical methods have evolved, and surgery is now the preferred modality for treating ruptured Achilles tendons [9]. The optimal surgical method for ruptured Achilles tendon is still under debate and various techniques are recommended, but due to the lack of prospective randomized trials there is insufficient evidence to determine the best option.

PATIENTS AND METHODS

The use of the Achillon® device (Integra™ Newdeal, France) is recommended in acute ruptures (< 10 days from occurrence of closed injury and < 6 hours from open injury without skin defect), where the tear is in the middle of the tendinous portion of the tendon (2–8 cm proximal to the calcaneal tuberosity). Contraindications to Achillon usage include previous surgery, history of steroid injection, injury < 2 cm and > 8 cm from the calcaneal tuberosity, an uncooperative or pediatric patient, and open rupture > 6 hours or open ruptures with skin defect. The decision as to what method should be used during surgery was based on two key criteria. The first criterion was the location of the tear. This location was initially diagnosed based on a positive Thompson test and palpation of the tendon, further substantiated by ultrasound [10]. All patients underwent X-ray to exclude avulsion fracture and gross calcification. The second criterion was the surgeon's familiarity with the Achillon device.

The Achillon system, as described by Assal [11], comprises a main guiding instrument consisting of a pair of internal branches connected to a pair of external branches; each branch has holes at the same level allowing easy and accurate passage of the sutures through all four branches. Ideally, sutures should be placed as far from the ruptured area as possible to ensure good fixation within the undamaged tendon.

In our department we prefer to operate within 48 hours from a patient's admission. After selection of the operation procedure, the correct affected side is confirmed. A second-generation medication, cephalosporin, is administered prophylactically. Through a medial 4 cm longitudinal incision the tendon is revealed after subcutaneous dissection, taking care not to injure the sural nerve. The tendon stumps are identified and careful debridement is made on both ends. The Achillon device is then introduced in the proximal part of the paratenon, and three sutures are placed percutaneously. The Achillon device is then placed under the paratenon of the distal stump until it reaches the calcaneus, and another three sutures are passed. The foot is placed in an equinus position, and the sutures are tightened. Because most of the patients were young and mobile, usually using crutches soon after sur-

gery, the department policy was not to administer prophylactic anticoagulants post-surgery. Although very good results with early range of motion after surgery with the Achillon device have been published, we use a more conservative rehabilitation protocol. Immediately after surgery the foot is placed in a cast or below-knee orthotic in plantar flexion of 30 degrees for 2 weeks. After this interval the position is changed to neutral, and no weight bearing is allowed for another 4 weeks. During this period the patient begins physiotherapy for movements ranging between plantar and neutral positions. After 6 weeks, partial weight bearing is allowed.

During a 4 year period (2004–2008), 28 patients underwent surgical repair of Achilles tendon in our department: 14 were treated by the Achillon device, 12 by open suturing and 2 patients underwent percutaneous repair. The age in the Achillon group ranged from 30 to 62 years (mean 45), and in the open group from 16 to 62 (mean 44). Fourteen patients were available for follow-up: 9 treated by the Achillon device, 3 by open repair and 2 percutaneously. The follow-up ranged from 1 to 4 years, median 2.5 years.

Most of the patients ruptured their Achilles tendon during recreational sport, especially football, and one patient tore the Achilles tendon while dancing. It is worth mentioning that none of the patients were regular sports enthusiasts and some of them played only occasionally. One of the patients was not available for a physical examination and was interviewed by phone.

The AOFAS Ankle-Hindfoot Scale was used to evaluate the patients, and two more criteria, as suggested by Kitaoka and collaborators [12], were added: neurovascular status of the foot and strength of plantar flexion. There was a clear male predominance in this series, 12 of the 14 patients. Six of the patients were employed in jobs requiring physical labor. None of the patients felt pain or had problems in the affected side before the injury.

RESULTS

The average score of the AOFAS Ankle-Hindfoot Scale in the group with the Achillon device was 95.6 (range 84–100). Even though the open group was small, we looked at the score, which averaged 90 points (range 84–98). Our outcome with the Achillon was similar to the 96 points recorded in the study by Assal et al. [11] and 96.8 in the research of Aktas et al. [22]. The length of the scar in patients operated with a minimally invasive technique (Achillon device) was 3.81 cm (range 1–6 cm) compared to 9.16 cm (range 8–10.5) with open suturing.

All patients who underwent surgery with the Achillon device were neurovascular intact, and none had re-ruptured. Two patients suffered from hypercoagulability complications: one (age 44 years) had pulmonary embolism and the other (age 49) had deep vein thrombosis. Neither had previously known cardiovascular risk factors. Those complications

occurred in the third week postoperatively in both patients. All the patients have returned to their pre-injury level of activity; none had played sports professionally.

DISCUSSION

Various surgical techniques have been described for treating ruptured Achilles tendon. A review of the literature yielded the following procedures:

- The Open Method usually uses the Krackow suture [13] named after its inventor, Kenneth A. Krackow and published in 1986. Since then most open Achilles tendon repairs were performed this way. Other suture methods were suggested: "Gift Box" sutures by Labib et al. [14] were tested in a biomechanical study. Achilles tendons repaired with this Gift Box technique were more than twice as strong as those repaired with the traditional Krackow technique.
- Repairing Achilles tendon rupture with fibrin glue has been used since the 1980s. A recent study by Hohendorff and team [15] showed good results, with no difference for long-term evaluation if augmentation with the plantaris longus tendon was performed.
- In 1977, Ma and Griffith [16] were the first to describe a percutaneous technique for the repair of acute Achilles tendon rupture, and this technique became popular with modification as described by Blankstein and co-workers [17] using real-time sonography. In 1992, Delponte et al. [18] presented a new percutaneous technique with special material: a Dacron yarn with a 5 mm wide hook set on a 12 long flexible needle.
- Percutaneous repair of the Achilles tendon ruptures reportedly reduces the risk of re-rupture compared to non-operative treatment and reduces the risk of wound infection compared to open surgery [19]. However, using this surgical method carries a greater risk of injury to the sural nerve [20].
- A retrospective study by Maffulli and colleagues [21] suggested that percutaneous repair of the Achilles tendon is a suitable option for patients older than 65, producing similar outcomes when compared to percutaneous repair in younger patients.
- Recently, various apparatuses for minimal invasive repair of the Achilles tendon are being proposed.
- In 2002 the minimally invasive method using the Achillon device was developed by Assal et al. [12]. This method is a combination of the open and percutaneous method and essentially improved the suturing technique without incurring the disadvantages of those two methods. The open method uses a long longitudinal surgical approach, averaging 10 cm, which has been shown to encroach upon an area of poor vascularity, resulting in a higher rate of superficial and deep wound infection and

delayed wound healing. The percutaneous repair bears a high risk of sural nerve entrapment and rerupture. The Achillon device has the advantage of direct visualization of the repair site and a small incision, averaging about 4 cm. A prospective study by Aktas et al. [22] compared the clinical and functional results of patients who underwent open repair and those who underwent repair with the Achillon device. Theirs was the first prospective study since introduction of the minimally invasive method. There was no significant difference between the functional results of the two groups measured by the AOFAS score and no incidence of re-rupture in both groups. The complications encountered were mostly with the open method using Krakow sutures: one case of deep and three of superficial infection, one case of ankle stiffness, one case of deep vein thrombosis, and one large hematoma. In the Achillon group there was one minor complication (insertional tendinopathy). A biomechanical study on cadaveric specimens by Huffard et al. in 2008 [23] demonstrated that the Achillon repair is stronger than the Krackow repair using identical sutures.

Rupture of Achilles tendon is not a rare injury and many treatment options have been advocated. The relatively new minimally invasive surgical technique using the Achillon device has the advantage of the open method, which allows viewing of the adaptation of the tendon and suturing the paratendon envelope. Furthermore, this method does not have the disadvantage and complication of a large scar in a problematic hypovascular area and the associated higher infection rate, or the risk of causing damage to the sural nerve with the other percutaneous method. We began using this method in 2004 and have experienced very positive results. These outcomes and follow-up indicate that this is a safe method and it has an easy learning curve.

Since most of the patients suffering Achilles tear are young and active, post-surgery prophylactic anticoagulants were not administered as a rule. However on follow-up, two patients, 44 and 49 years old without cardiovascular risks, were found to have thromboembolic complications.

Although the results of our study were not statistically significant overall, we compared our Achillon device group to similar groups in the literature. In view of the positive outcome, we believe that a larger study on this issue is needed and, furthermore, suggest that prophylactic anticoagulation treatment be considered for those patients.

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