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The improved oval forceps suture-guiding method for minimally invasive Achilles tendon repair

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ABSTRACT

Objective: To discuss the effect and advantage of the improved oval forceps suture-guiding method combined with anchor nail in the treatment of acute Achilles tendon rupture.

Methods: A retrospective research was performed on 35 cases of acute Achilles tendon rupture treated with the improved oval forceps suture-guiding method from January 2013 to October 2016. Instead of the Achillon device, we perform the Achillon technique with the use of simple oval forceps, combined with absorbable anchor nail, percutaneously to repair the acute Achilles tendon rupture.

Results: All patients were followed up for at least 12 months (range, 12–19 months), and all the patients underwent successful repair of their acute Achilles tendon rupture using the improved oval forceps suture-guiding method without any major intra- or postoperative complications. All the patients returned to work with pre-injury levels of activity at a mean of 12.51 ± 0.76 weeks. Mean AOFAS ankle-hindfoot scores improved from 63.95 (range, 51–78) preoperatively to 98.59 (range, 91–100) at last follow-up. This was statistically significant difference ($P < 0.001$). Mean Achilles Tendon Total Rupture Score (ATRS) at final follow-up was 94.87 (range, 90–100).

Conclusion: The improved oval forceps suture-guiding method could make the advantage of minimally invasive repair with less complications, reduced surgical time and similar functional outcomes compared with the traditional open surgery. In addition, our new technique could save the cost of surgery with the compare of the Achillon device. At the same time for the cases which the remote broken tendon ends were within 2 cm from the calcaneal nodules, because of the less tendon tissue was left in the remote side, traditional percutaneous methods are incapable to ensure the reconstruction strength. By using the anchor nail, the improved technique has better repair capacity and expands the operation indication of oval forceps method.

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Introduction

Acute Achilles tendon rupture is a common clinical sports injury. Till now, there is no agreement on the most appropriate way for the Achilles tendon repair. Treating methods approximately include non-operative way which usually using plaster to make the ankle maintain plantar flexion position for about 6 weeks and operative ways. Ozsoy et al. [1] and Nilsson-Helander et al. [2] have shown similar functional results with nonsurgical treatment and open surgical repair but higher rerupture rate was found in nonsurgical treatment. The traditional open surgical repair methods have large invasion. Simultaneously a variety of postoperative complications, such as incision edge necrosis, incision cracking, infection, etc. accompanied by the traditional

open surgery, which limit its scope of application. Achillon technology representing a small incision minimally invasive repair technique can achieve a relatively accurate alignment of Achilles tendon, but also can be as percutaneous suture to reduce the surgical trauma and postoperative adhesions. However, it is undeniable that some patients find it difficult to accept the expensive costs. In addition, due to the less distal tendon tissue, particularly the remote broken tendon ends were within 2 cm from the calcaneal nodules, there is high failure rate on Achillon technology. Ngai [3] in 2010, reported minimally invasive technique for Achilles tendon repair using oval forceps for suture-guiding without any extra cost. In recent years, the technique of oval forceps has been widely used in hospitals at all levels. It has the advantages of small injury and easy access to instruments. However, it still has some limitations and cannot effectively repair the Achilles tendon rupture near the calcaneus nodules. To solve this problem, we have improved the oval forceps suture-guiding method with anchor nail in the treatment of acute

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Achilles tendon rupture. From January 2013 to October 2016, 35 cases of acute Achilles tendon injury were effectively cured and all patients had intact Achilles tendon at last control. No re-rupture was observed. The study was approved by the Ethics Committee of Wenzhou Medical University and all patients agreed to participate in this clinical trial by signing an informed consent form. The study was approved by the Ethical Board Review and was performed in accordance with the ethical standards of the Declaration of Helsinki of 1964.

Patients and methods

From January 2013 to October 2016, 35 patients (29 males and 6 females; left 11 cases and right 24 cases) with acute Achilles tendon rupture were treated with minimally invasive repair. The inclusion criteria consisted of acute closed Achilles tendon rupture with no calcaneal fracture or severe osteoporosis. The patients' characteristics were listed in Table 1. The average age of the patients was 32.15 years (range, 18–46 years). The reason for injury was a sport or traffic accident in 35 cases. All patients, with no fracture or dislocation, had a palpable gap in Achilles tendon and Thompson test was positive. Simultaneously MRI (Fig. 1-A) or ultrasound (Fig. 1-B) showed Achilles tendon rupture. The average period from injury to operation was 2.83 days (range, 1–5 days). The mean follow-up time was 18.61 months (range, 12–19 months).

Surgical methods

After the success of anesthesia, all patients were operated in a prone position with tourniquet. A 2-cm skin horizontal incision was performed at the level of palpable gap (Fig. 2-1). Instead of the Achillon device, we perform the Achillon technique with the use of simple oval forceps (Fig. 2-2). After the avulsion of the Achilles tendon stump exposed clearly, the oval pliers through the incision in the Achilles tendon sheath, from distal to proximal, inserted 5–7 cm. The distal part of the clamp was sensed under the skin and try to make oval pliers placed in the longitudinal axis of the Achilles tendon. Then make a puncture needle successively through the lateral skin, lateral hole of the ovarian clamp, Achilles tendon, medial hole of the ovarian clamp and medial skin, respectively (Fig. 2-3). Make a non-absorbable suture through the epidural needle hole and then remove the epidural needle. After align the ends of it, the suture is taken out from incision with the clamp. In this way, 3 non-absorbable sutures are passed from proximal to distal, approximately 1.5 cm apart. The oval clamps distally through the incision to the attachment point of the Achilles tendon, sense the orifice of oval forceps and an absorbable anchor nail is placed into each side of the calcaneus through the orifice of oval forceps (Fig. 2-4 and -5). Remain the anchor nail on both sides with two sutures, then make the anchor sutures through the oval forceps to the incision. According to the length of the distal Achilles tendon from the attachment point, make one non-absorbable suture through the distal tendon with the use of oval forceps suture-guiding method. Ankle plantar flexion locate at 30° position. The sutures are paired that the most proximal suture

in the proximal segment of the tendon is tied to the most proximal suture in the distal segment and so on (Fig. 3). The paratenon is then repaired with a continuous 2-0 absorbable suture. Rinse the wound with saline and suture to the skin layer by layer (Fig. 2-6). Long leg plaster is fixed with ankle plantar flexion 30° position. Protection of plaster should be taken for 6 weeks (long leg plaster for 3weeks, short leg plaster for 3weeks). Then active and passive exercise should be taken after the removal of plaster.

Data collection

The evaluations were performed in a standardized fashion by two examiners, who were not the operating surgeons and all patients were evaluated during 1 year follow-up period. A validated Achilles Tendon Rupture Score [4] (ATRS) and the American Orthopedic Foot and Ankle Society (AOFAS) ankle and hind-foot score system were used to evaluate patients preoperatively and postoperatively.

Results

Full demographic data and outcomes are listed in Table 1. The average time from injury to operation was 2.83 days (range, 1–5 days) and the mean duration of surgery was 28.56 min (range, 21–35 min). Our new technology has the advantage of small incision that the mean length of incision was 1.98 cm (range, 1.7–2.2 cm) and the mean blood loss of surgery was 9.50 ml (7–12 ml). Average follow-up was 18.61 months (range, 12–19 months), and all the patients underwent successful repair of their acute Achilles tendon rupture using the improved oval forceps suture-guiding method without any major intra- or postoperative complications. All the patients returned to work with pre-injury levels of activity at a mean of 12.51 ± 0.76 weeks. Mean AOFAS ankle-hindfoot scores improved from 63.95 (range, 51–78) preoperatively to 98.59 (range, 91–100) at last follow-up. This was statistically significant difference (P < 0.001). Mean Achilles Tendon Total Rupture Score (ATRS) at final follow-up was 94.87 (range, 90–100). No surgery-related complications, such as wound infection, deep infection, or sural nerve injury, occurred in any patient, and no re-rupture was found at any patient. Single affected-side leg hopping was easily performed by all patients at last follow-up. Subjective satisfaction was excellent in 31 patients, good in 4 patients.

Discussion

Surgical treatment of ruptured Achilles tendons includes two major categories of open surgery and percutaneous minimally invasive repair. Open surgery includes modified Kessler suture, Bunnell suture and Krackow [5] suture. Krackow suture method, because of its locking technology, is more solid. Open surgery usually requires about 8 cm incisions, which can fully expose the two ends for debridement repair. However, there are some downside such as muscle atrophy, ankle stiffness, delayed recovery, wound infections and other complications.

In 1977, Ma and Griffith [6] firstly designed 6 small incisions on both sides of the perforation to repair the ruptured Achilles

Table 1
Sample characteristics of patients.

Gender		Mechanism of injury			Injury side		Time from injury to operation (days)	Duration of surgery (min)	Length of incision (cm)	Blood loss of surgery (ml)
Male	Female	Football or basketball	Run	Traffic	Left	Right				
29	6	21	9	5	11	24	2.83 ± 3.19	28.56 ± 7.32	1.98 ± 0.57	9.50 ± 7.15

Values are expressed as the mean ± SEM.

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