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Review

Outcomes and complications of percutaneous versus open repair of acute Achilles tendon rupture: A meta-analysis

Bo Yang, MD [1], Yang Liu, MD [1], Shunli Kan, MD, Di Zhang, MD, Hong Xu, MD, Feifei Liu, MD, Guangzhi Ning, MD, PhD *, Shiqing Feng, MD, PhD **

Department of Orthopedics, Tianjin Medical University General Hospital, 154 Anshan Road, Heping District, China

HIGHLIGHTS

- Operative treatment has a tendency for treatment of Acute Achilles tendon rupture.
- Percutaneous repair can reduce the risk of deep infection, lead to higher risk of sural nerve injury.
- Total functional outcomes are similar except AOFAS score in percutaneous and open groups.

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ABSTRACT

Background: Acute Achilles tendon rupture (AATR) is a frequent injury occurring dominantly in young to middle-aged males. Outcomes and complications between percutaneous and open repair are still controversial. Thus, the purpose of this meta-analysis is to evaluate the outcomes and complications of these two operative methods.

Materials and methods: We searched multiple databases: PubMed, Web of Science, EMBASE and the Cochrane Library up to October 2016. Two reviewers independently screened the studies for eligibility, evaluated the quality and extracted data from eligible studies, with confirmation by cross-checking. The major results and conclusions were concluded, and the different complication rates and functional outcomes were compared. Meta-analysis was processed by Rev Man 5.3 software.

Results: Five randomized controlled trials (RCTs) and seven retrospective cohort studies involving 815 patients met the inclusion criteria. The sural nerve injury rate in the percutaneous group was significantly higher (RR = 3.52, 95%CI 1.45 to 8.57, P = 0.006). However, deep infection rate in the open group was higher (RR = 0.33, 95%CI 0.11 to 0.96, P = 0.04) and subgroup analysis of five RCTs showed no significant difference (RR = 0.42, 95%CI 0.09 to 2.10, P = 0.29). No significant difference was seen regarding the rate of re-rupture. The time of operation in the percutaneous group was shorter (RR = −1.99, 95%CI -3.81 to −0.80, P = 0.001). American Orthopedic Foot and Ankle Society (AOFAS) ankle-hindfoot score showed statistically different in the two groups. Other functional outcomes were similar in the two groups.

Conclusions: Percutaneous repair has the advantages of operation time, deep infection and AOFAS score. The functional outcomes were similar in two treatment groups except AOFAS score. Despite the higher incidence of sural nerve injury, we still believe that percutaneous repair is superior to open repair for treating AATR.

1. Introduction

The Achilles tendon is the largest and strongest tendon in human body [1]. Acute Achilles tendon rupture is a frequent injury and it can result in severe functional impairment. The incidence of AATR in North America was 5.5–9.9 ruptures per 100,000 people and is thought to be rising [2,3].

* Corresponding author.
** Corresponding author.
E-mail addresses: yangbo209@foxmail.com (B. Yang), liuyang_orthopedics@foxmail.com (Y. Liu), 153391132@qq.com (S. Kan), 462570672@qq.com (D. Zhang), xiaoranxuhong@163.com (H. Xu), sindy_1127188@163.com (F. Liu), ninggz_tmu@foxmail.com (G. Ning), sqfeng@tmu.edu.cn (S. Feng).
[1] Both authors contributed equally to this work.

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However, the best treatment for AATR is still controversial. Generally speaking, treatment strategies can be divided into operative (open or percutaneous) or conservative (cast immobilization or functional bracing) [4,5]and they have been reported with variable results. Although there is still no consensus on the best method, operative treatment has been a tendency reported by several literature. Some surgeons prefer open surgical repair. Because it can directly restore normal continuity and tension of the ruptured tendon, lead a low incidence rate of re-rupture and offer the possibility of early functional treatment compared to conservative treatment [6], whereas other surgeons advocate conservative treatment because open repair leads a significant number of complications as well as high costs. Percutaneous suturing, first described in 1977 by Ma and Griffith [7], seems to combine the advantages of other methods. However, this method is criticized because it supplies approximately 50% of the initial strength, shows high risk for sural nerve and demonstrates a higher rate of re-rupture than does open repair [8,9].

Previous reviews have reported the relatively clinical outcomes and complications of operative and non-operative treatment. The aim of this meta-analysis was to summarize the outcomes and complications of the percutaneous suturing technique of Achilles tendon ruptures compared with open repair.

2. Methods

2.1. Publication search

PubMed, Web of Science, EMBASE and the Cochrane Library were searched up to October 2016. To identify search terms, searches were performed using medical subject headings (MeSH) combined with following free words: “percutaneous”, “open repair”, “Achilles tendon ruptures”, “Achilles tendon lesion” or “Achilles tendon tear”. The reference lists of retrieved studies and recent reviews were also manually searched to identify additional relevant studies.

2.2. Inclusion criteria

The inclusion criteria were as follows: (1) studies including patients with acute Achilles tendon ruptures; (2) randomized controlled trials (RCTs) and cohort studies comparing percutaneous versus open repair; and (3) studies that recorded the incidence of re-rupture, sural nerve injury, deep infection, deep vein thrombosis, AOFAS score, circumference of calf, ankle range of motion and time of operation. Ankle range of motion contains dorsiflexion and plantar flexion after surgery of acute Achilles tendon ruptures.

2.3. Data extraction and quality assessment

Data extraction was performed to retrieve the following information: the publication date, the first author, the study design, surgical procedures, the incidence of re-rupture, sural nerve injury, deep infection, deep vein thrombosis, AOFAS score, circumference of calf, and ankle range of motion and time of operation.

RevMan software was used to assess the quality of the included RCTs. Parameters assessed include: sequence generation (selection bias), allocation concealment (selection bias), blinding (performance bias), incomplete outcome data (detection bias), selective outcome reporting (reporting bias) and ‘other issues’. Every trial was scored as “low risk”, “high risk” or “unclear”.The quality of the other cohort studies was assessed via the Newcastle–Ottawa Scale (NOS). Two reviewers independently assessed the quality of the studies. Disagreements were resolved by discussion or by seeking the opinion of a third reviewer.

2.4. Statistical analysis

Statistical analysis was performed with Review Manager (Version 5.3. Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2014).The effect sizes were computed by a random effects model or mixed effects model according to the heterogeneity between different groups. Dichotomous effect sizes (the incidence of re-rupture, sural nerve injury. deep infection, and deep vein thrombosis) were expressed as ERs (event rates). Continuous effect sizes (time of operation, AOFAS score; Ankle range of motion; and circumference of calf) were expressed as Mean ± SD. All results are presented as forest plots. A 95% confidence interval (CI) was determined for each effect size. According to the method developed by Higgins et al.[4], heterogeneity is expressed as I^2. This value ranges from 0% (complete consistency) to 100% (complete inconsistency).Moreover, we did a subgroup analysis of deep infection including five RCTs. Subgroup analysis of calf circumference has been consistent with the outcome in our meta-analysis. Other complications or outcomes occur in only one article, so we didn't show the results.

3. Results

3.1. Study characteristics

A total of twelve studies [10–21] including 815 ankles were included in our meta-analysis in Fig. 1 (flow graph). Among these twelve studies, five were RCTs, and the other seven were retrospective cohort studies. Firstly, the differences of time of operation between percutaneous repair and open surgery were determined in three articles, which were the primary concern of us. As the most serious postoperative complications, all of included studies recorded the incidence of re-rupture comparing percutaneous repair with open surgery. Complications excluding re-rupture, such as sural nerve injury and deep infection and deep vein thrombosis, were also discussed in nine or eleven studies, respectively. To evaluate postoperative recovery more objectively, we also pay attention to the indicator of some functional restorations AOFAS score, range of motion and circumference of calf). The details of the included studies are shown in Table 1.

3.2. Bias assessment

A bias assessment was applied to the five RCTs by the two reviewers separately (according to the Cochrane Handbook for Systematic Reviews of Interventions 5.0). Any disagreement was resolved by a third reviewer. The included RCT was evaluated for risk of bias. There were three studies [10,11,21] at high risks of bias respectively in random sequence generation, blinding of participants and personnel and the blinding of outcome assessment. For all trials, the other biases were unclear (Figs. 2 and 3).Besides, as shown in (Table 1), total scores of seven cohort studies ranged from 5 to 7 for cohort studies.

3.3. Time of operation

One RCT [15] and two retrospective control studies [14,19] compared percutaneous repair with open surgery about the length of operation. The duration of surgery was 24–54.55 min in the percutaneous group and 45.9–68.8 min in the open group. Compared with open surgery, percutaneous repair showed a significant reduction in the duration of surgery (SMD = −1.99, 95% CI, −3.18 to −0.80, P = 0.001; I^2 = 85%) (Fig. 4).