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Original article

Percutaneous poking reduction and fixation versus open reduction and fixation in the treatment of displaced calcaneal fractures for Chinese patients: A systematic review and meta-analysis

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ABSTRACT

Purpose: To compare the efficacy of percutaneous poking reduction and fixation with open reduction and fixation in the treatment of displaced calcaneal fractures.

Methods: Reports of studies using case-controlled trials (CCT) to compare the percutaneous poking reduction and fixation with the open reduction and fixation in the management of calcaneal fractures were retrieved from the Cochrane Library, PubMed Database, CNKI, Chinese Biomedical Database, Wanfang Data (from January of 2005 to August of 2015). Methodological quality of the trials was critically assessed, and relevant data were extracted. Statistical software Revman 5.0 was used for data-analysis.

Results: Fifteen articles were included in the meta-analysis. Comparison of the efficacy of percutaneous poking reduction and fixation with open reduction and fixation in the treatment of calcaneal fractures revealed statistical significance in the incidence of complications after operation [$RR = 0.32$, 95% $CI (0.20, 0.5)$, $p < 0.05$]. However, there were neither statistical significance in the degrees of recovery for calcaneal Bohler angle [$WMD = -1.65$, 95% $CI (-3.43, 0.14)$, $p > 0.05$] and calcaneal Gissane angle [$WMD = -3.21$, 95% $CI (-6.75, 0.33)$, $p > 0.05$], nor statistical significance in the rate of good foot function after operation [$RR = 0.95$, 95% $CI (0.90, 1.00)$, $p > 0.05$].

Conclusion: For the treatment of calcaneal fractures, percutaneous poking reduction and fixation is superior to open reduction and fixation in terms of the incidence of postoperative complications. But both techniques can obtain satisfactory clinical function.

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Introduction

Calcaneal fractures account for approximately 2% of all fractures and are the most common fracture type of the foot tarsal bone in adults.^{1,2} Moreover, 70% of them are displaced intra-articular calcaneal fractures.³ The management methods for displaced intra-articular calcaneal fractures have been controversial for a long time. However most of the scholars believe that surgery is the best choice.^{4–6} The treatment goal is to restore the walking

ability and eliminate standing pain or even to enable the patient to wear a pair of normal shoes.

As for surgeries, a number of authors prefer open reduction and fixation in terms of shaping the anatomical structure of the whole bone and its surrounding joint surfaces, as well as calcaneal and subtalar joint. But the reported rate of wound edge necrosis varies from 2% to 11% due to the thin and vulnerable skin over the lateral calcaneal wall, and the infection rate of calcaneal nearby soft tissue varies from 1.3% to 7% after open reduction fixation via an extended lateral approach.⁷ However some clinical doctors suggest that considering the occurrence of complications, percutaneous poking reduction and fixation is a better way for intra-articular calcaneal fractures.^{8,9} In their reports, it is showed that there is a higher functional score and a lower incidence of posttraumatic subtalar arthritis after using the method of closed percutaneous poking reduction. So abundant case-controlled trials (CCTs) have been

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conducted to compare the outcomes and complications of two methods for the surgical treatment of intra-articular calcaneal fractures, but the clinical advantages and disadvantages of the two methods still remain debatable. There is a need to systematically review the available evidence for the two methods in treating displaced intra-articular calcaneal fractures so as to make an optimal treatment choice.

The aim of the present study was to perform a meta-analysis including all the CCTs on Chinese people in the last ten years to determine whether there were any significant differences in the incidence of postoperative complications, the recovery degrees of calcaneal Bohler angle and Gissane angle, and the rate of good foot function after surgery.

Materials and methods

Search strategy

We searched CCTs including randomized controlled study (RCT) and retrospective case study that compared closed percutaneous poking reduction with open reduction fixation in the treatment of calcaneal fractures for Chinese patients from the Cochrane Library, PubMed, CNKI, Chinese Biomedical Database, Wanfang Data (from January of 2005 to August of 2015). The searched key words were: calcaneal fractures treatment, percutaneous poking reduction, open reduction.

Inclusion criteria

The inclusion criteria were: (1) adults with calcaneal fractures; (2) CCTs; (3) comparison of percutaneous poking reduction and open reduction for the treatment of calcaneal fractures; (4) the outcome being measured by the incidence of postoperative complications, recovery degrees of calcaneal Bohler angle and Gissane angle, and the good rate of foot function after operation.

Exclusion criteria

The exclusion criteria were: (1) case-based reports or reviews; (2) study objective or intervention measures failed to meet the inclusion criteria; (3) the original documents of experimental design being not precise; (4) studied with incomplete data.

Data extraction and quality assessment

Inclusion decisions were made independently by two reviewers participated according to the pre-stated eligible criteria. Disagreement between the two reviewers was resolved by discussion or consulting to a third reviewer when necessary. The criteria for article quality assessment included five items as follows: (1) whether to adopt the random sequence generation; (2) whether to use the principle of allocation concealment; (3) whether to use the principle of blinding for the subjects, implementers and measurement; (4) whether to use incomplete data and selective reporting; and (5) whether there is any other bias. Relevant data were recorded in this analysis, including: first author's name, published year, sample size of closed percutaneous poking reduction and open reduction fixation in the treatment of calcaneal fractures, revised Jadad score, duration of follow-up, postoperative complications, the recovery degrees of calcaneal Bohler angle and Gissane angle, the rate of good postoperative foot function, etc.

Statistical analysis

Data were independently entered into the RevMan 5.0 software by two reviewers. Dichotomous outcomes were expressed in terms of relative risk (RR) and the weighted mean difference (WMD) was used for continuous outcomes, both with 95% confidence intervals (95% CI). Heterogeneity was tested using both chi-square test and I^2 test. A fixed-effects model was chosen when there was no statistical evidence of heterogeneity and random-effects model was adopted if significant heterogeneity was found. If the heterogeneity was found, we checked the study population, treatment, outcome and methodologies to determine the source of heterogeneity. If it could not be quantitatively synthesized or the event rate was too low to be measured, we used qualitative evaluation. A funnel plot was applied to assess the presence of publication bias.

Results

A total of 651 potentially relevant articles were identified. After screening of the titles and abstracts, 606 were excluded. Then the full-text of the 45 studies was read, which found 15 studies including 1056 patients met all the inclusion criteria (Fig. 1).^{10–24} There were 2 English articles and 13 Chinese articles, all on Chinese people. The article quality was evaluated by Jadad score.²⁵ The total score is 7 points: ≤ 3 points defined as low quality study and ≥ 4 points as high quality paper. There were 12 studies that are qualified as high quality papers and 3 as medium quality papers^{13,15,18} (Table 1).

Incidence of postoperative complications

Fourteen trials^{10–13,15–24} compared the incidence of postoperative complications. Results showed that there was a low evidence of heterogeneity among all these studies ($I^2 = 0\%$, $p > 0.05$), and the fixed model was performed. There was statistical difference between two technique groups [RR = 0.32, 95% CI (0.20, 0.52), $p < 0.05$, Fig. 2]. The results suggested that open reduction and fixation had a higher incidence of postoperative complications than the method of percutaneous poking reduction and fixation.

Recovery degree of calcaneal Bohler angle

Thirteen trials^{10–17,20–24} reported the recovery degree of calcaneal Bohler angle. Results showed that there was a high evidence of

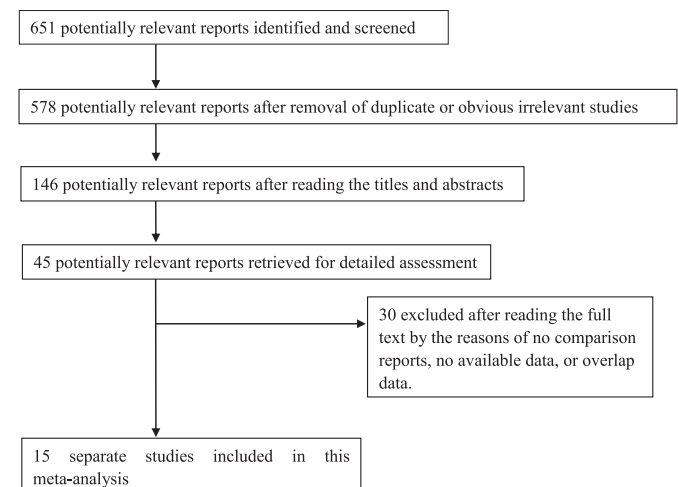


Fig. 1. Flow diagram of the study selection process.

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