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Review

A meta-analysis of external fixation versus open reduction and internal fixation for complex tibial plateau fractures

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HIGHLIGHTS

- We aimed to evaluate the effectiveness of external fixation and open reduction and internal fixation in treating complex tibial plateau fractures.
- ExFx had some advantages when compared with ORIF, but there were no statistically significant differences.
- We strongly recommend that selection of definitive fixators and time of intervention should base on the fracture patterns, soft-tissue condition and the injury stages in clinical practice.
- Also, we recommended further researches were needed to achieve high quality and credible results.

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ABSTRACT

Purpose: Both external fixation (ExFx) and open reduction and internal fixation(ORIF) were used to treat complex tibial plateau fractures, but it was not sure which one was better. So we did this meta-analysis to evaluate the outcomes of ExFx and ORIF in managing complex tibial plateau fractures.
Methods: Articles published before August 5, 2016 were selected from PubMed, Cochrane library, and some other electronic database. Relevant journals were also searched manually with no language limited. Two independent reviewers searched and assessed the literature. A fixed effect model was initially used for meta-analyses with RevMan 5.3.
Results: When compared with ORIF, cases undergoing ExFx were more likely to return to the preinjury state at the early stage, but no difference in the later period of follow-up. However, ExFx group had higher infection rate (OR 1.98, 95% CI 1.08–3.63, P = 0.03), higher venous thromboembolism rate (OR 1.56, 95% CI 0.49–4.96, P = 0.45), higher re-operation rate (OR 0.87, 95% CI 0.47–1.62, P = 0.66) and lower compartment syndrome rate (OR 0.61, 95% CI 0.12–3.22, P = 0.56), lower TKA rate (OR 0.51, 95% CI 0.20–1.34, P = 0.17). There were no statistically significant differences in the rate of deep infection, venous thromboembolism, compartment syndrome and VTE between the two groups.
Conclusion: Although external fixation may offer some advantages, both were acceptable strategies in managing complex tibial plateau fractures. According to our analysis results, we strongly recommend that selection of definitive fixators should base on the fracture patterns, soft-tissue condition as well as the injury stages in clinical practice. More important, further multicentered, randomized controlled studies should be implemented to get a more reliable and clear result.

1. Introduction

Tibial plateau fractures accounted for 1–2% of all the fractures, approximately 8% of them occured in elderly [1] and over a half of cases were male [2]. They constitute high-energy injuries with associated insult on the soft tissue envelope [3]. Due to the complex

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anatomy of the tibial plateau, intra-articular lesions, severe soft-tissue damage, osseous compromise of the proximal tibia and high risk of complications, most scholars regarded the Schatzke type V and VI [4] or the AO/OTA type C (C1, C2, C3) [5] as the complex tibial plateau fractures, which remained a challenge to the surgeons even the most experienced [6].

All kinds of treatment, from conservative treatment to surgical management, were aimed at anatomic reduction of the articular surface, restore of tibial length and alignment and prevent secondary displacement of the fracture fragments [1]. Open reduction and internal fixation (ORIF) with plates and screws through a extensile anterior approach was the first choice to achieve this goal [7], which can direct reduction of fracture and offer an optimal visualization [8]. However, as complex tibial plateau fractures associated with severe soft tissue damage, ORIF often led to higher rate of complications over the past two decades [9]. Despite the evolution of treatment strategies and quality of fixation implants, a poor outcomes were reported continuously [10].

Adequate fixation and early motion were important for a good prognosis and satisfied postoperative rehabilitation, so fire-wire external fixation, like Taylor spatial frame, Ilizarov circular frame, Monticelli-Spinelli circular fixator were good alternative interventions, which allowed for early and adequate initial weight bearing without limitations related to skin condition, was considered as an ideal method to these cases, who cannot use internal fixation due to trauma of the soft tissue envelop, deficiency of bone stock, and bony comminution [11,12].

We performed this meta-analysis to discuss whether the external fixation (ExFx) provided better radiological and clinical outcomes and fewer post-operative complications than open reduction and internal fixation (ORIF) for managing complex tibial plateau fractures.

2. Materials and methods

2.1. Literature search strategy

Electronic searches were performed by using PubMed, Cochrane library, Cochrane Central Register of Controlled Trials (CCTR), China national knowledge internet database, Wan Fang database without restriction for publication date and languages in August 5th, 2016. The following medical subject headings (MeSH) and terms were used to achieve broad and specific searches: “internal fixation”, “external fixation”, “complex tibial plateau fracture”, “Schataker 6”, “Schataker VI”, “Schataker 5”, “Schataker V” with the Boolean operators AND or OR. Additional records were identified through google search engine or other available databases according to the Cochrane Collaboration guidelines.

2.2. Inclusion and exclusion criteria

A study was included in the analysis as following criteria:

(1) Studies on complex tibial plateau fractures and conducted on human subjects (RCTs or quasi-RCTs).
(2) Studies directly compared the effectiveness of ExFx and ORIF.
(3) Reporting the data of outcomes (radiological, clinical and others) and complications (OA, infections, DVT and others).
(4) The follows were excluded: reviews, isolated case reports, pathological fractures, biomechanics analyses and others.

2.3. Quality assessment

The risks of bias were assessed independently by two of the authors, with Randomized control trial were assessed by using the Cochrane Collaboration Risk of Bias Tool [13]. The contents were seven parts—random sequence generation (selection bias), allocation concealment (selection bias), blinding of participants and personnel (performance bias), blinding of outcome assessment data (detection bias), incomplete outcome data (attrition bias), selective reporting (reporting bias) and other bias. Each items were recorded as “high risk”, “low risk”, “unclear risk”. For non-RCT, the Methodological Index for Non-Randomized studies (MINORs) scale was applied for quality assessment [14], which scored from 0 to 24. Any disagreement was discussed and resolved with a third independent author.

2.4. Study selection and data extraction

Datum were independently extracted from articles, tables and figures by two investigators, including the first authors, study design, the publication date, sample size, follow-up duration, interventions, outcomes as well as adverse event. Any disagreement was discussed and resolved with a third independent author.

2.5. Data analysis and statistical methods

Statistical analyses were conducted with Review Manager Version 5.3 (Cochrane Collaboration, Software Update, Oxford, UK). Statistical heterogeneity was assessed using the I^2 value and chi-square test. When I^2 >50%, $P < 0.1$ was considered to be significant heterogeneity, random-effect model was applied for meta-analysis. Otherwise, fixed-effect model was performed. If possible, sensibility analysis was conducted to search the origins of heterogeneity. Dichotomous outcomes were expressed as odds ratios(OR) with 95% confidence intervals (CIs). While continuous outcomes, mean differences (MDs) and 95% confidence intervals (CIs) were calculated.

3. Results

3.1. Search result

A total of 672 studies were identified with an initial decision, this yielded 243 titles for initial screening after removal of 429 duplicates. Following initial screening and application of the inclusion/exclusion criteria, there were one RCT and eight retrospectives, a total of 11 articles were carried out on all [15–25]. The characteristics were described as Table 1. Two of them came from a same study, conducted by the Canadian orthopaedic trauma society (COTS) [23,24], which was also the only RCT. Two came from a same institution, located in Boston [18,22]. The search process was performed as Fig. 1.

3.2. Risk of assessment

The details about the included studies were summarized in Table 1. Cochrane Handbook for Systematic Review of Interventions was consulted to assess the quality of RCTs. The COST [23,24], the only RCT, was assessed to be at low risk of bias in almost all terms (Table 2), except for blinding of assessor and reporting bias. Due to there was no blinding of the evaluators and the protocol was not published before recruitment commenced. The risk of bias was assessed for the eight retrospective studies by MINORs [14] and showed as Table 3. Except for two of them were lost to follow-up >5% [21,25], the others were assessed as high quality.