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Intramedullary versus extramedullary internal fixation for unstable intertrochanteric fracture, a meta-analysis

Xi Yu [a], Hong Wang [b], Xin Duan [b], Ming Liu [b], Zhou Xiang [b, *]

[a] Rehabilitation Medicine Center, West China School of Medicine, Sichuan University, Chengdu, Sichuan, PR China
[b] Department of Orthopaedics, West China Hospital, Sichuan University, Chengdu, Sichuan, PR China

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ABSTRACT

Objective: The aim of this meta-analysis was to explore the difference between and compare intramedullary fixation (IF) and extramedullary fixation (EF) for unstable intertrochanteric fractures.
Methods: We searched Pubmed database and Cochrane library following by including and excluding articles based from inception to December, 2016. All randomized controlled trials (RCTs) comparing IF and EF for unstable intertrochanteric fractures were assessed and selected by two researchers independently. Data were analyzed using Review Manager 5.1 version.
Results: 17 RCTs were enrolled in our meta-analysis comparing IF and EF and showed evidence that IF had lower rate of implant failure RR = 0.2695%CI 0.13−0.51, P < 0.0001 and re-operation (RR = 0.60, 95% CI 0.37−0.98, P = 0.04), while there was no statistical differences of cut-out, postoperative infections and other complications. Moreover, PPM scores verified that IF had better postoperative hip mobility recovery (MD = 0.87, 95%CI 0.08−1.66, P = 0.03).
Conclusion: IF has lower incidence of failure of implant and reoperation and shows better postoperative functional recovery when treating adult unstable intertrochanteric fracture while the most postoperative complications were not statistically different from EF.
Level of evidence: Level I, therapeutic study.

Introduction

Intertrochanteric fractures are one of the elementary orthopedic clinical problems, that are commonly resulted from low energy injuries and lead to severe functional defects and heavy socioeconomic pressure.[1] The incidence of intertrochanteric fracture has been kept increasing recently and the mortality rate maintains 30% within 5 years after fracture.[2] The internal fixations are usually considered as prior options for treatments that can enable the patient to have postoperative early mobilization, good functional recovery and less complications.[3,4] With the time of invention and promotion internal fixation devices, the diversity of devices brings orthopedic surgeons more choices, such as intramedullary fixation (IF) (e.g. gamma nail, PFNA) or extramedullary fixation (EF) (e.g. SHS, CHS).[5–7]

Since intertrochanteric is an essential area connecting the femoral head and the shaft, the stability of this area is the key goal that orthopedic surgeons should achieve. Recently, the classification of intertrochanteric fracture is based on the stability of this area. Stable intertrochanteric fractures are commonly simple fractures which are less affected by vertical stress during one-leg standing while unstable intertrochanteric fracture always have affected posteromedial or lateral femoral cortex that decreased the resistibility to stress.[8,9]

However, even with increasing number of clinical trials comparing IF with EFfor treating unstable intertrochanteric fracture, the reported results still have not reached the consistency.[10–12] Although there were several systematic reviews and meta-analysis comparing the differences between two kinds internal fixation devices, the findings are still in need of more evidence.[13–15] In the same time, novel devices and surgeon's experience with device also updates with time. Thus, in this study, we conducted a mate-analysis to achieve a detailed comparison and evaluation of IF and EF for unstable intertrochanteric fractures.

* Corresponding author. Department of Orthopaedics, West China Hospital, Sichuan University, #37 Guoxue Alley, Chengdu, 610041, Sichuan, PR China.
E-mail address: xiangzhou15@hotmail.com (Z. Xiang).
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Materials and methods

Interventions

IF represents an internal fixation with an intramedullary nail inserting into the femoral bone marrow cavity, for instance intramedullary hip screw (IMHS), gamma nail (GN), proximal femoral nail (PFN), Targon proximal femoral nail (Targon PFN), proximal femoral nail anti-rotation (PFNA), Holland nail and INTERTAN nail (INT), while EF including Sliding hip screw (SHS), as known as Richard screw or AMBI screw, Dynamic hip screw (DHS), Compression hip screw (CHS), Medoff sliding plate (MSP), Percutaneous compression plating (PCCP), Locking compression plate (LCP) and Less invasive stabilization systems (LISS), stands for internal fixations applied outside the marrow cavity for reduction and stabilization. In this meta-analysis, we categorized IF and EF groups to maintain the information integrity according to Cochrane collaboration.[16]

Search strategy

The database of PubMed database and Cochrane Central Register of Controlled Trials (CENTRAL) were searched from inception up to Jan, 31, 2017. We developed search strategy with target items as followed, #1 “Trochanteric Fractures”, “Fractures, Trochanteric”, “Intertrochanteric Fracture”, “Fractures, Intertrochanteric”, “Hip Fractures”; #2 “Fracture Fixation, Intramedullary”, “Fixations, Intramedullary Fracture”, “Fracture Fixations, Intramedullary”, “Intramedullary Fracture Fixation”, “Intramedullary Fracture Fixations”, “Osteosynthesis, Fracture, Intramedullary”, “Intramedullary Nailing”, “Intramedullary Nailings”, “Nailings, Intramedullary”, “Nailing, Intramedullary”, #3 “Fixation, Internal Fracture”, “Fixations, Internal Fracture”, “Fracture Fixations, Internal”, “Internal Fracture Fixation”, “Internal Fracture Fixations”, “Osteosynthesis, Fracture”, “Fracture Osteosyntheses”, “Fracture Osteosynthesis”, “Osteosyntheses, Fracture”,#3 “Fracture Fixation, Internal”, “Fixation, Internal Fracture”, “Fixations, Internal Fracture”, “Fracture Fixations, Internal”, “Internal Fracture Fixation”, “Internal Fracture Fixations”, “ Osteosynthesis, Fracture”, “Fracture Osteosyntheses”, “Fracture Osteosynthesis”, “Osteosyntheses, Fracture”; #4 “randomized controlled trial”, “randomized [Title/Abstract] OR placebo [Title/Abstract]”.

Inclusion and exclusion criteria

Prospective randomized controlled clinical trials (RCTs) comparing IF and EF for treating unstable intertrochanteric fractures in adults were considered being enrolled as shown in Flowchart (Fig. 1). Unstable intertrochanteric fractures were categorized according to AO/OTA classification (AO/OTA 31 A2.2-A3) and Evans-Jensen classification (II–V type). RCTs published in English with related titles and abstracts were screened by two independent reviewers.

Outcomes of interest

The potential outcomes of interest included intraoperative and postoperative indexes. Intraoperative indexes were Cleveland zone and tip-apex distance (TAD) while postoperative indexes included adverse events, such as cut-out, fracture of femoral shaft, re0peration, failure of the implant, other complications and hip functional evaluation scores, Harris hip score (HHS) and Parker Palmer hip mobility (PPM).[17,18]

Risk of bias assessment and data extraction

Two independent reviewers screened the abstracts and full-text of eligible studies to evaluate the risk of bias of included researches using a tool recommended by Cochrane collaboration.[19] For evaluating the surgeon's experience on using devices, a “high” would be marked if there was not enough information whether the research avoided learning curve problem.

Statistical analysis

Review Manager 5.3 software was employed to process statistical analysis. Continuous data was calculated with weighted mean difference (MD) while dichotomous data calculated with relative risk (RR). Both results adopted a corresponding 95% confidence interval (CI). A P value of <50% was considered significant. The heterogeneity was evaluated between comparisons though I-square (I^2) test and Chi-square (X^2) test. A fixed effect model was applied when I^2<50% otherwise a random effect model was enabled.

Results

Characteristics of the studies

17 RCTs were recruited based on the search strategy and inclusion and exclusion criteria. In total, 2653 cases with average age ranging from 53.95 to 84.6 were enrolled, of which the sample number ranged from 12 to 203 cases. Table 1.

Position of implant and tip-apex distance (TAD)

The Cleveland zone and TAD of IF and EF group was evaluated on postoperative radiographs according to the introduction and description of Parker and Baumgeartner.[20,21] The ideal cephalic implant position as known as Cleveland zone was confirmed to be “center-center” position. There were 5 RCTs provided proper data of Cleveland zone of both internal fixation devices as shown in Fig. 2.[22–25] It showed that there was no difference of number of Cleveland zone between IF and EF group (RR = 0.96, 95%CI 0.87−1.05, P = 0.36) and no evidence of heterogeneity (Chi^2 = 1.20, df = 3, P = 0.75, I^2 = 0%). As shown in Fig. 3, 3 RCTs measured and the TAD for both groups. It showed that TAD value is significant higher in IF group than that in EF group (MD = 0.85 95%CI 0.08−1.62, P = 0.03) and no evidence for heterogeneity (Chi^2 = 1.45, df = 2. P = 0.48, I^2 = 0%).

Cut-out

10 RCTs concerned about the most important complication, cut-out.[22–31] Totally, 1409 patients were involved in this meta-analysis, the result showed that the incidence of cut out had no significant difference between two kinds devices without evidence of heterogeneity (RR = 0.67, 95%CI 0.40−1.12, P = 0.12, Chi^2 = 9.87, df = 9, P = 0.36, I^2 = 9%) (shown in Fig. 4.).

Failure of implant

8 RCTs pointed out the failure of implant which would lead to severe consequences to the stability and function of the affected limb as shown in Fig. 5.[23,24,26,29–33] The IF group had significantly less failure of implant than EF group (RR = 0.26, 95%CI 0.13−0.51, P < 0.0001). No evidence of significant heterogeneity was found (Chi^2 = 6.74, df = 7, P = 0.46, I^2 = 0%).

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