Complications after intracapsular hip fractures in young adults: a meta-analysis of 18 published studies involving 564 fractures

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CRD summary
The review assessed factors that influence complications after intracapsular hip fractures in young adults. The authors concluded that early or open fracture reduction may not reduce the risk of nonunion or avascular necrosis, and suggested that a higher incidence of nonunion follows open reduction. The conclusions were based on case-series studies; randomised controlled trials are needed to make more definitive conclusions.

Authors' objectives
To determine the influence of a number of clinical factors on outcome after intracapsular hip fractures in young adults.

Searching
MEDLINE, EMBASE, CINAHL, AMED, the British Nursing Index and DHSS Data: health administration and medical toxicology were searched from 1966 to 2003 for articles published in any language; the search terms were reported. The reference lists of eligible studies were also checked.

Study selection
Study designs of evaluations included in the review
Studies with at least 12 months' follow-up were eligible for inclusion.

Specific interventions included in the review
Studies that reported on the timing of surgery and method of fracture reduction (open or closed) were eligible for inclusion. Timing of surgery was dichotomised as 'early surgery' (less than a 12-hour time interval between fracture and surgery) and 'late surgery' (more than 12 hours). Studies of fractures treated non-operatively, or those using vascularity enhancing supplementary procedures (muscle pedicle grafts, vasculised iliac bone graft or fibular grafts), were excluded.

Participants included in the review
Studies of patients aged 15 to 50 years with acute intracapsular hip fractures were eligible for inclusion. The studies also had to report fracture displacement. Fractures classified as Garden stages I or II were considered as undisplaced, while those of stages III or IV were classified as displaced. The mean age of the participants was 27.9 years (range: 15 to 50).

Outcomes assessed in the review
Studies that reported on the incidence of nonunion or avascular necrosis were eligible for inclusion.

How were decisions on the relevance of primary studies made?
Titles and abstracts were reviewed independently. It was unclear how full papers were selected for the review, or how many reviewers performed the selection.

Assessment of study quality
Each study was assigned a quality score (1 being the lowest and 6 the highest) based on the following: description of the patient characteristics, treatment methods, inclusion and exclusion criteria, the number of exclusions and reasons for exclusions, definition and timing of the outcome measure. The authors independently reviewed each eligible study. It was unclear how many reviewers were involved in this process, or how any differences were resolved.
Data extraction
Two reviewers independently extracted the data from the included studies, and any differences were resolved by discussion. Data were extracted to determine the overall incidence of nonunion and avascular necrosis; the effect of fracture displacement (undisplaced or displaced) on the development of nonunion and avascular necrosis; the effect of timing of surgery (early or late) on the occurrence of nonunion and avascular necrosis; and the effect of closed or open reduction on the incidence of nonunion or avascular necrosis.

Methods of synthesis
How were the studies combined?
The results of the individual studies were combined in a meta-analysis. Fisher's exact test, two sided P-value and relative risks (RRs) with 95% confidence intervals (CIs) were used to analyse the influence of fracture displacement, timing of surgery and method of reduction (detailed already).

How were differences between studies investigated?
The studies were grouped by factors that may influence the outcome of hip fractures. The analysis was repeated, excluding studies with notably higher rates of outcomes.

Results of the review
Eighteen studies with 674 patients were included in the review. Follow-up data were available for 564 (83.7%).

Three studies scored 6 for methodological quality, six scored 5 and nine scored 4.

Fracture displacement and complications.
Displaced intracapsular hip fractures were more common than undisplaced fractures (79.9% versus 25.6%). Overall, the incidence of nonunion was 8.9% and avascular necrosis 23%. The incidences of nonunion and avascular necrosis were both higher in displaced than undisplaced fractures: 6% versus 0.9% for nonunion (P=0.02) and 22.5% versus 5.9% for avascular necrosis (P<0.001).

Method of reduction and complications.
The incidence of nonunion was significantly higher in fractures that underwent open compared with closed reduction (11.2% versus 4.7%, P=0.04; RR 0.42, 95% CI: 0.19, 0.93).

The incidence of avascular necrosis was significantly higher in fractures that underwent closed reduction than open reduction (28% versus 10.1%, P=0.0005; RR 2.8, 1.45, 5.29). No significant difference between open and closed reduction was observed following the exclusion of a study with a high rate of avascular necrosis.

Timing of reduction and complications.
No significant differences between early and late fracture reduction were found in the incidence of nonunion (11.8% versus 5%, P=0.18; RR 2.36, 95% CI: 0.7, 7.79) and the incidence of avascular necrosis (13.6% versus 15%, P=0.82; RR 0.91, 95% CI: 0.42, 1.95).

Authors’ conclusions
Early or late reduction of intracapsular hip fractures may not reduce the risk of nonunion or avascular necrosis. The evidence suggested a higher incidence of nonunion following open reduction. Randomised controlled trials with a 2-year follow-up are required to make definitive conclusions.

CRD commentary
The review addressed a clear research question and the inclusion criteria appeared appropriate. Several sources were searched for relevant studies and attempts were made to reduce publication bias. It was unclear whether methods were
used to minimise bias when selecting studies for inclusion. However, methods were used to reduce reviewer error and bias in the data abstraction and validity assessment. The validity assessment was adapted to account for the study designs included in the review. The methods used to combine the studies appeared appropriate. The authors were fully aware of the limitations of the study designs included in the review, which are likely to be representative of the best available evidence available. Consequently, their suitably cautious conclusion is appropriate.

**Implications of the review for practice and research**

**Practice:** The authors did not state any implications for practice.

**Research:** The authors stated that randomised studies, or prospective observational studies, with a minimum follow-up of 2 years and adequate sample size are needed before definitive conclusions can be made.

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