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Original article

Is arthroplasty preferable to internal fixation for the treatment of extracapsular fracture of the upper femur in the elderly?

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ABSTRACT

Introduction: Although internal fixation is the reference treatment for extracapsular fracture of the upper femur, indications for arthroplasty are broadening, especially in unstable comminutive fracture in fragile bone. The present study hypothesis was that arthroplasty reduces early mortality and morbidity and provides better recovery of autonomy in over-80 year-old patients than does internal fixation.
Material and methods: A prospective multicenter study was conducted on 8 sites. Internal fixation was systematically used in 5 centers; arthroplasty was used systematically in 1 center, and reserved for unstable fracture in 2 centers. A total of 697 patients aged over 80 years (mean age, 85 ± 5 years), presenting with extracapsular fracture, were included; 521 were treated by internal fixation and 176 by arthroplasty. Results were studied on multivariate analysis of ASA score, blood loss, transfusion, and also of treatment modality as an independent factor for early (first 6 months) mortality and morbidity (mechanical, general and nutritional complications) and functional outcome (autonomy and dependence).
Results: Overall mortality was 19.2%. Autonomy deteriorated in 56% of patients alive at 6 months and dependence worsened in 44%. Two percent of those managed by internal fixation underwent revision for disassembly ($n = 8$) or infection ($n = 1$). Eight percent of those managed by arthroplasty underwent revision for dislocation ($n = 4$), implant loosening ($n = 3$) or infection ($n = 7$). On univariate analysis, mortality was higher in the arthroplasty group (25%) than with internal fixation (17%; $P = 0.002$), as were blood loss (425 ± 286 mL versus 333 ± 223 mL; $P < 0.0001$), transfusion rate (61% versus 32%; $P < 0.0001$) and infection (4% versus 0.2%; $P < 0.001$). On multivariate analysis, however, treatment modality no longer showed impact on mortality or on morbidity and autonomy at 6 months. Nutritional status was better conserved at 6 months following arthroplasty, but dependence worsened. Poor preoperative autonomy, ASA score, and nutritional status and time to treatment were independent factors for mortality. Transfusion, associated with onset of mechanical complications, significantly increased dependence.
Conclusion: Type of treatment had little impact on mortality, morbidity or functional outcome. Differences seemed more related to preoperative functional and nutritional status.
Level of evidence: III, prospective case-control study.

1. Introduction

Extracapsular upper femoral fracture in the elderly is a public health issue due to constantly increasing incidence with increasing life expectancy [1]. Global incidence is forecast at 6.26 million in 2050 (compared to 1.66 million in 1990) [2], with major impact on health-care costs [3,4]. Classically, surgical management is

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conservative, consisting in intra- or extra-medullary internal fixation. Mechanical complications [5,6] have been associated with the various materials, especially in unstable fracture on osteoporotic bone [7]. Stappaerts et al. reported a 26% rate of mechanical complications in 47 patients managed by intramedullary internal fixation, requiring revision surgery in 2 cases [8]. Hélin et al. [9], in 155 intertrochanteric fractures in over-70 year-olds, found intramedullary internal fixation by proximal femoral nail antirotation (PFNA) to be less effective in unstable fracture, with a 2.6% rate of disassembly requiring revision surgery. Some teams therefore suggested first-line arthroplasty; but severe complications were associated in elderly patients: Dobbs et al. [10] notably reported severe intraoperative cardiorespiratory complications.

Broadening indications for arthroplasty in extracapsular fracture therefore call for comparative studies against internal fixation. The 2006 meta-analysis by Parker and Handoll [11] reported an absence of proof of superiority of arthroplasty over internal fixation, highlighting a relative lack of data in the literature. Bonnevialle et al. [12], in a prospective cohort, reported better functional and mechanical results in unstable fracture in over-75 year-olds treated by arthroplasty, despite greater blood loss; however, their sample was small, with considerable loss to follow-up, and analysis was only univariate. Geiger et al. [13] found no significant difference in 1-year mortality in over-60 year-olds between the two techniques; but theirs was a retrospective study without control group. Given these contradictory results without high level of evidence, we performed a large-scale retrospective study comparing arthroplasty against internal fixation in extracapsular fracture in the elderly.

The study hypothesis was that arthroplasty shows:

- lower early mortality;
- lower morbidity;
- better functional recovery than internal fixation.

Two questions were addressed:

- what is the impact of type of treatment (arthroplasty or internal fixation) on mortality, morbidity and functional results?
- what other parameters may affect these three endpoints?

2. Material and methods

A prospective multicenter study was conducted on 8 sites during 2014, consecutively including all patients aged over 80 years, admitted for displaced intertrochanteric fracture. A total of 888 patients were recruited; 187 had incomplete 6-months records and were considered lost to follow-up (21%); 701 files were analyzable for 6-months data: 560 female, 141 male patients: mean age 85 ± 5 years (range: 80–108 years).

The surgeons involved in the study implemented their usual techniques. In 5 of the 8 centers, internal fixation was systematic; in 1 arthroplasty was systematic, and in 2 it was reserved for unstable fracture. Four cases managed functionally were excluded; 521 patients underwent internal fixation, which was intramedullary in 75% of cases, and 176 underwent arthroplasty, with 77% total prostheses (75% dual-mobility) and 23% hemiarthroplasties. Fractures were graded on the AO system [14] and dichotomized as stable (A1: 1 and 2, $n = 315$) or unstable (A2: 1 and 2, $n = 326$, and A3, $n = 60$).

The main endpoint was all-cause 6-month mortality. Secondary endpoints comprised morbidity and functional progression; morbidity included worsened nutritional status, general complications (infection, decompensation of preexisting conditions, thromboembolic complications), and mechanical complications requiring revision surgery.

Nutritional status was assessed on MNA score [15]. Function in patients surviving at 6 months was assessed in terms of autonomy on Parker score [16] and of dependence on Katz score [17]; differences between pre-fracture and 6-month scores were interpreted qualitatively, with deteriorated autonomy and increased dependence counting as unfavorable progression. This qualitative endpoint, while sacrificing precision, seemed less subject to reproducibility issues in the quantitative Katz and Parker scores to which the multicenter design laid itself open.

Radiologic screening for fixation disassembly and implant migration was performed.

Statistical analysis. Certain parameters were patient-related (age, gender, body-mass index, ASA grade, hematocrit, nutritional status, preoperative Parker and Katz scores), others treatment-related (type of implant fixation, total or hemiarthroplasties, intra- or extra-medullary internal fixation, blood loss, transfusion, time to surgery), and others fracture-related (type of fracture, stable or unstable).

Descriptive analysis used comparisons on Student or Wilcoxon test. Qualitative variables were expressed as proportions, with comparison on Chi^2 or Fisher exact test and correlation (variation from preoperative value) on Pearson test.

Results were studied on multivariate analysis to identify any independent effect of each parameter on the endpoints: early mortality, morbidity and functional outcome. Each parameter was first tested on univariate analysis to select those relevant to endpoints, with significance of $\geq 25\%$. Stepwise multivariate analysis was performed on the parameters thus identified, ranking them in decreasing order of significance. Results were expressed as odds ratios with 95% confidence intervals.

For quantitative parameters with independent influence on a given endpoint, threshold values were tested on multivariate analysis, qualitatively (above or below threshold).

Predictive value was calculated for each multivariate analysis, expressing power according to the number of cases examined. Power was considered acceptable for a positive predictive value > 70% and good for > 80%.

3. Results

A total of 134 patients died within the first 6 months (19%). On univariate analysis (Table 1), mortality was higher with arthroplasty (25%) than internal fixation (17%; $P = 0.002$), but the effect was no longer found on multivariate analysis (Table 2). High ASA score, long time to surgery, Parker score ≤ 3 and MNA score < 8 were significantly associated with increased mortality, with predictive power of 70% (Table 2).

Table 1
Parameters selected on univariate analysis for inclusion in multivariate analysis of mortality factors.

	P-value
Qualitative variables	
Type of treatment (arthroplasty vs. internal fixation)	**0.02**
Gender	***0.15***
Quantitative variables	
Age	**0.009**
Preop Parker score	**< 0.001**
Preop hematocrit	***0.12***
BMI	**0.009**
Time to surgery	**0.08**
Preop MNA score	**< 0.0001**
ASA score	**< 0.0004**
Preop Katz score	**< 0.001**

Values in italics are statistical trends. BMI: body-mass index; MNA: Mini Nutritional Assessment; ASA: American Society of Anaesthesiologists. Bold: significant variables and *p* values.