ORIGINAL ARTICLE

Key factors influencing clinical and functional outcomes in extracapsular proximal femur fractures: the role of early weight-bearing - one-year follow-up cohort of 495 patients

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ABSTRACT

Aim To establish a correlation between immediate post-surgical weight bearing in extracapsular hip fractures and final functional outcome as well as to study the correlation between immediate post-surgical weight bearing and morbidity and mortality during the first year.

Methods Retrospective observational cohort study including 495 consecutive patients ≥75 years old operated of extracapsular proximal femur fracture. Medical records were reviewed and information of demographic data, radiological evolution, time to weight-bearing, mortality rate, medical and surgical complications and final ambulation status were recorded.

Results Patients' mean age was 87 years; 378 (76.4%) were females. One-year mortality rate was 21.2%. Immediate weight bearing was associated with: decreased hospital stays (7.5 days vs. 9.2 days; p=0.001) and decreased medical complications (78.3% vs. 82.3 %; p=0.02). Surgical complications prevalence was comparable (4.4% vs. 7.8 %; p=0.43) within the groups. Despite mortality rate was lower in patients with immediate weight bearing (21%) compared with delayed weight bearing (21.4%), the difference was not statistically significant (p=0.9).

Conclusion Immediate weight bearing was associated with shorter hospital stay and fewer medical complications, improving functional outcome. Also, no correlation was found between immediate weight bearing and increased surgical complications or mortality rate during first year after surgery.

Key words: hip injuries, osteoporotic fractures, recovery of function, weight-bearing

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INTRODUCTION

Hip fracture in an elderly patient constitutes a major public health issue with a high and rapidly rising incidence and associates high morbidity and mortality rates (1,2). Patients with hip fracture usually suffer functional worsening (2,3). Thus, hip fracture represents a substantial health-care burden (4).

Proximal femur fractures prevalence have risen significantly during last decades, with a predicted increase of 66% by the year 2021 and an almost double-fold prevalence by 2051, due to the increase in life expectancy (2,5). The incidence of hip fracture in Spain is over 500/100,000 persons per year in people of 65 years and older (6). It has been estimated that the global cost of hip fractures by the year 2050 will rise up to 131.5 million United States dollars (USD) per year (7).

Clinical guidelines of hip fracture encourage immediate weight-bearing after surgery (8,9). Early deambulation has a short-term impact, decreasing postoperative complications and shortening hospital stay (5,7). In the long-term, early deambulation improves patient autonomy and reduces mortality rate (1,10). On the other hand, immediate weight-bearing does not correlate with increased failure neither of osteosynthesis or implant (11-13). The economic burden of delayed weight-bearing has been estimated to an increased cost of 8400 USD per patient and procedure (5). In contrast, a 2011 Cochrane (14) review pointed out the lack of good quality evidence data to establish the best strategy for hip fracture management after surgery. Even though current evidence favours early weight-bearing after hip surgery, many studies that analyse medical practice and adherence to clinical guidelines demonstrate irregular compliance with these recommendations (15-17). This is the case at our department, where a low adherence rate to the indication of early weight-bearing after extracapsular proximal femur fracture has been noticed. The decision of early or delayed weight-bearing after surgery relies solely on the surgeon advice without established consensus criteria. This situation creates favourable conditions to develop a study that analyses the correlation between early deambulation and morbidity and mortality after hip surgery.

The aim of the study was to investigate the correlation of early weight-bearing after surgery with the following variables: functional outcome, surgical complications, morbidity and mortality during the first year after surgery.

PATIENTS AND METHODS

Patients and study design

This retrospective observational cohort study included 495 patients with proximal femur fracture type 31.A1, 31.A2 and 31.A3 according to Arbeitsgemeinschaft für Osteosynthesefragen/ Orthopaedic Trauma Association (AO/OTA) classification (18) operated at the Orthopaedic Surgery Department of the University Hospital Centre of Toledo (Spain) from 1 January 2016 to 31 May 2018. minimum follow-up was 1 year.

Inclusion criteria were: age 75 years or older (this is the minimum age for patient admission into the orthogeriatric unit, a commonly used cutting point (10,19), fractures type 31.A1 (Figure 1), 31.A2 (Figure 2) and 31.A3 according to AO/OTA classification (18) and minimum follow-up of one year. All surgeries where done using intramedullary fixation with proximal femur nail Gamma3 (Stryker Osteosynthesis, Kiel, Germany) without exception during the studied period.

Figure 1. Anteroposterior X-rays of a left hip pertrochanteric 31.A1 fracture (Complejo Hospitalario Universitario de Toledo, 2017)

Exclusion criteria were: fractures with diaphyseal extension, periprosthetic or peri-implant fractures, pathologic fractures, atypical fractures, poor reduction or osteosynthesis and follow-up at another institution. Tip-apex distance, cortical

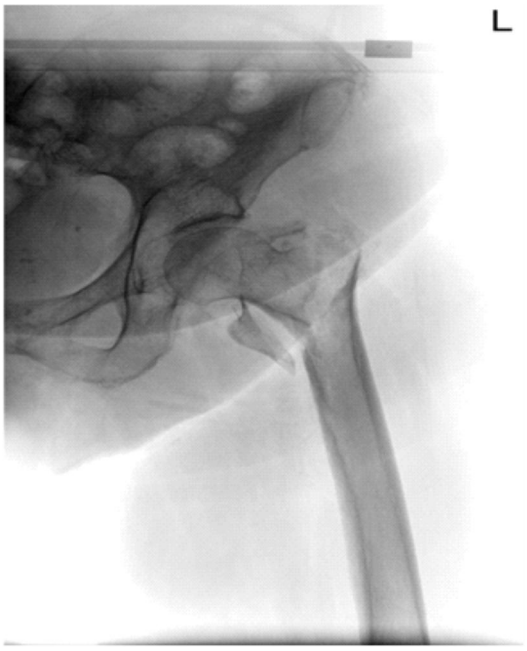

Figure 2. Anteroposterior X-rays of a left hip pertrochanteric 31. A2 fracture (Complejo Hospitalario Universitario de Toledo, 2017)

contact point of the lag screw at the lateral femoral cortex and screw position on the femoral head (Figure 3) were considered to evaluate quality of osteosynthesis (11, 20-22). Femoral neck-shaft angle and fragments displacement were considered to evaluate reduction quality (20).

Weight-bearing in the first 48 hours was considered to be an exposition factor (early weight-bearing). This variable was recorded as dichotomic, allocating patients to the early weight-bearing group or the delayed weight-bearing group. In every patient, it was the surgeon that decided to prescript or not early weight-bearing, considering the type of fracture, patient's features, intraoperative findings, surgical outcome and personal clinical experience.

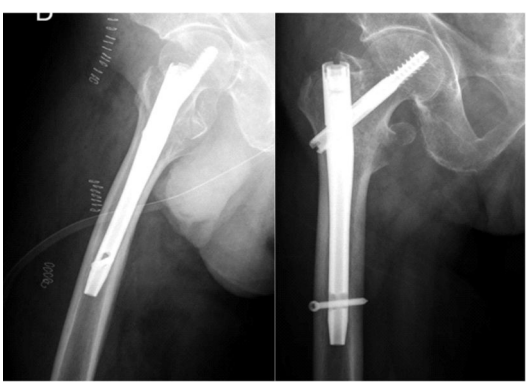

Figure 3. Anteroposterior axial X-rays of a right femur 31.A1 fracture after osteosynthesis. Adequate nail placement is characterized by an adequate tip-apex distance (less than 10mm) (noted in both images), contact of the lateral extreme of the lag screw with lateral femoral cortex (right image) and lag screw position on centre-centre quadrant on the femoral head (noted on both images) (Complejo Hospitalario Universitario de Toledo, 2017)

The study was approved by the Ethics Committee of the University Hospital Centre of Toledo.-

Methods

Fracture type was assigned after independent evaluation of anteroposterior and oblique hip x-ray view by two trainees orthopaedic surgeons. When there was discrepancy in the fracture classification, a third senior surgeon (blinded for previous decision) was consulted, allocating the patient to the consensus of two of the three evaluators. No case of three-evaluator disagreement was recorded.

After hospital discharge, patients were evaluated at consultation at one, three, six and twelve months after surgery. Its treating surgeon or one of the main investigators of this study carried out a final evaluation including functional status one year after surgery.

Functional independence was assessed by Barthel score (23) and cognitive function was assessed by the Global Deterioration Scale (GDS) (24). Both scales where recorded by geriatric specialist at the admission to the Orthogeriatric Unit and during the follow-up in outpatient consults. In Barthel scale, both numeric result and allocation into two groups (independent when less than 60 score) were recorded. The GDS scale divides patients into two groups, with those rating 4 or more being the group that need assistance.

Comorbidities prior the hip fracture where measured using the American Society of Anaesthesiology Scale (ASA) (25), registered by an anaesthesiologist in the preoperative assessment of the patient.

Objective outcomes were measured at one-year final evaluation. Principal outcome was deambulation status that intimately correlates with worsening of the functional status. Four categories were defined to evaluate deambulation status: autonomous deambulation, need of cane or crutches, walker or not-ambulant. Pre-surgical residence (particular house, institutionalized), length of hospital stays (in days), time from hospital admission to surgery (in days), medical complications, surgical complications, hospital readmission in the first month after surgery and one-year mortality rate were also recorded.

Statistical analysis

Quantitative variables were presented with median and standard deviation, qualitative with percentages. Weight-bearing and complications were adjusted as dichotomous variables. An analysis was performed with 2 tests for qualitative variables and ANOVA for quantitative ones. Independent or two-sided T-Student´s test or non-parametric Mann-Whitney test were used for continuous variables. Contingency table was used for dichotomus variables. The $p<0.05$ was considered statistically significant, with statistical power of 80%.

RESULTS

A total of 495 patients met the inclusion criteria and were included in the study; 378 (76.4%) were females and 117 (23.6%) males. Mean age was 87 years (75-106): 86.3 and 87.4 years in the delayed and early weight-bearing group, respectively.

According to data published by the Spanish Statistical Office (Instituto Nacional de Estadística, INE) (26), during the studied period (2014 to 2018) our hospital served an average population of 478,134 people. People older than 74 years represented 8.1% of the whole population. Among them, 58.7% were females and 41.3% were males. In light of these data, the incidence of extracapsular hip fracture in elderly population (75 years or older) in the studied population was 567.5/100.000 persons per year.

Two hundred sixty-four (53.3%) of 495 patients initiated deambulation in the first 48 hours after surgery and were allocated to the early weight-bearing group, and the remaining patients, 231 were allocated to the delayed weight-bearing group. Both groups were comparable in terms of demographic characteristics, Barthel score, GDS, pre-surgical deambulation status and pre-surgical residence, thereby delayed weight-bearing was not associated with a worse functional status (Table1).

The most common fracture according to the AO/OTA classification (18) (reference) was 31.A2 in 243 (49.5%) patients, followed by 31.A1 in 168 (34.2%) and 31.A3 in 80 (16.3%) patients. According to the fracture type, in the early weight-bearing group only 21 (8%) had 31.A3 fracture, whereas 128 (48.5%) corresponded to 31.A2 fractures and 115 (43.6%) to 31.A1 (Table 1).

Table 1. Demographic and functional features of early and delayed weight-bearing groups

Variable	No (%) of patients in the group		p
	Delayed weight-bearing (231)	Early weight-bearing (264)	
Gender			
Males	50 (21.6)	67 (25.4)	0.329
Females	181 (78.4)	197 (74.6)	
Barthel scale (23)			
100	24 (10.4)	44 (16.7)	
>60 -<100	119 (51.5)	130 (49.2)	
>40- <60	46 (19.9)	44 (16.7)	0.324
>20 - <40	30 (13)	35 (13.3)	
<20	12 (5.2)	11 (4.2)	
GSD (24)			
1	128 (55.4)	147 (55.7)	
2	21 (9.1)	27 (10.2)	
3	21 (9.1)	13 (4.9)	
4	21 (9.1)	26 (9.8)	0.348
5	27 (11.7)	25 (9.5)	
6	11 (4.8)	22(8.3)	
7	2 (0.9)	4 (1.5)	
ASA (25)			
I	5 (2.2)	10 (3.8)	
II	112 (48.5)	113 (42.8)	0.433
II	106 (45.9)	128 (48.5)	
IV	8 (3.5)	13 (4.9)	
Fracture type (AO/OTA)			
31.A1	53 (23.4)	115 (43.6)	
31.A2	115 (50.7)	128 (48.5)	0.000
31.A3	59 (26)	21 (8.0)	
Deambulation status			
Autonomous	59 (25.5)	71 (26.9)	
Cane/Crutches	90 (39.0)	89 (33.7)	0.209
Walker	69 (29.9)	96 (36.4)	
Not-ambulant	13 (5.6)	8 (3.0)	
Residence			
Particular house	171 (74.0)	184 (60.7)	0.286
Institutionalized	60 (26.0)	80 (30.3)	

AO/OTA, Arbeitsgemeinschaft für Osteosynthesefragen/Orthopaedic Trauma Association classification (18); Global Deterioration Scale (24); ASA, American Society of Anesthesiology Scale (25)

Early weight-bearing was associated with better final ambulatory status: 120 (51%) (CI: 0.57.0.7) patients with early weight-bearing showed worsening of their pre-fracture ambulatory status, whereas 136 (63%) (CI:0.57-0.7) patients with delayed weight-bearing worsened their ambulatory status. Also, the decrease of ambulatory status was only of one level in 78 (33.6%) patients with early-weight bearing. It was also noted that, independently of early or delayed weight-bearing, 256 (57.1%) patients showed worsening of at least one level of ambulatory status (Table 2). Early weight-bearing also associated fewer time to hospital discharge (early deambulation 7.5 days (standard deviation, (SD) +/-4.7) vs. delayed deambulation 9.2 days (SD+/- 6.6 ($p=0.001$) and lesser global complications: early deambulation in 206 (78.3%) vs. delayed deambulation in 190 (82.3%) patients ($p=0.02$) (Table 2).

Table 2. Time to surgical intervention and hospital stay, final ambulatory status, medical and surgical complications and one-year mortality, and their relation to weight-bearing.

Variable	Groups		p
	Delayed weight-bearing	Early weight-bearing	
Time to surgical intervention (days) (CI 95%)	3.2 (CI: 2.8- 3.6)	2.7 (CI:2.3-3.1)	0.108
Stay in hospital (days) (CI 95%)	9.22 (CI: 8.5 – 10.0)	7.50 (CI: 6.8 – 8.2)	0.001
Ambulatory status (No; %)			
Same	80 (37.0)	112 (48.3)	0.045
One-level decrease	100 (46.3)	78 (33.6)	
Two-level decrease	34 (15.7)	39 (16.8)	
Three-level decrease	2 (0.9)	3 (1.3)	
Medical complications (No; %)			
Without	41 (17.6)	57 (21.6)	0.02
Minor	124 (53.7)	134 (50.8)	
Major	66 (28.6)	73 (27.6)	
Surgical complications (No; %)			
No	202 (92.2)	218 (95.6)	0.25
Cut-Out	8 (3.7)	4 (1.4)	
Consolidation retard	6 (2.7)	5 (1.3)	
Pseudarthrosis	3 (1.4)	1 (0.4)	
Mortality (No; %)	49 (21.4)	53 (21.0)	0.90

Mortality rate at one year was 21.2%. Despite the fact that mortality rate was lower in the early weight-bearing group (21%) than in the delayed weight-bearing group (21.4%) that difference was not statistically significant (p=0.904) (Table 2). One-year mortality rates were higher in males, 39 (out of 114; 34.2%), than in females, 63 (out of 368; 17.1%) (p=0.00). Patients older than 89 years also presented an increased mortality rate (p=0.01). Complications during hospital stay correlated to the increased mortality rates at one-year (24.6% vs. 6.5%; p=0.00), and to longer hospital stay (8.8 days vs. 6.3 days) (Table 3).

Table 3. Correlation between one-year mortality and hospital stay of 390 patients with and 92 patients without complications

Variable	Without complications	With complications	p
No of patients	**92**	**390**	
Mortality (overall 102; 21.2%) (No; %)	6 (6.5)	96 (24.6)	0.000
Hospital stay (days)	6.3	8.8	0.000

No association was found between early weight-bearing and an increase of surgical complications: early deambulation in 10 (out of 228; 4.4%) vs. delayed deambulation in 17 (out of 219; 7.8% (p=0.43)

The rate of surgical complication was 6% (30 of 495 patients), with cut-out being the most common, 2.5% (11/495), followed by pseudoarthrosis 0.9% (4/495) (Table 2).

DISCUSSION

Our results are similar to those found in the current literature. Patients with early deambulation demonstrated less deambulation status deterioration (0.51 vs. 0.63), similarly to the studies by Petros et al. (2) and Barone et al (10). The rate of complications was lower in early weight-bearing group (78.3%) than in delayed weight-bearing (82.3%), and also hospital stay (7.5 days in early weight-bearing vs. 9.2 days in delayed weight-bearing). Even though one-year mortality rate was lower in early deambulation group (21%) than in delayed deambulation group (21.4%) this difference was not statistically significant.

Demographic characteristics of our population are similar to others studies, with a slight increase of the percentage of women compared to other series (7,27,28). The cutting point age that defines elderly population is an issue when comparing different studies of proximal femur fractures, because the range of age included differs in many of them. In the studied group, mean age is 87 years, with an ASA score of II or III in 94.5% of the patients, which characterizes our population as an aged one with low baseline functional status, similarly to other authors (10,28).

International clinical practice guidelines (8,9) encourage early weight-bearing because it had demonstrated a favorable short-term impact, decreasing postoperative complications and hospital stay. In the long-term, early deambulation associates with better functional outcome and reduced mortality rate, as many studies had demonstrated (1,10,29). Despite all evidence that sustains early weight-bearing as a better option, only 53% of the patients of the studied population initiated early deambulation after hip surgery. This may be related to the already reported tendency to delay deambulation to avoid hardware or surgical complications (29) and reflecting that clinical guidelines are not always applied in daily practice as they should be (15-17).

Current literature reports one-year mortality rate after hip fracture between 26 to 33% (28,30). In this cohort a 21.2% rate was found, similarly to that reported by Rosso et al. (31) with an 18.8% one-year mortality rate in a series of 1558 fractures. In our patients, both male gender and age over 89 years correlated to increased mortality at

one-year, similarly to the report from Frost et al. (32) with increased mortality rate in males (odds ratio 2.4) and patients over 90 years of age (odds ratio 8.7).

Intra-articular proximal migration of cephalic screw (cut-out) was the most usual implant-related complication with an incidence of 2.5% (11 out of 495 patients). This is a low rate compared to other studies, where prevalence of cut-out ranges from 0 to 16% (12,33) without a correlation between screw migration and early weight-bearing has been demonstrated. The lack of influence of early weight-bearing with cut-out is also supported in the study by Zuckerman et al. (34) demonstrating that forces through the hip were the same with deambulation and movements in bed. More recently Eberle et al. (35), based on a biomechanical model using Gamma3 nails (Stryker Osteosynthesis, Kiel, Germany), found that "even in the absence of fracture healing the implants would not fail during the first 100 days after surgery, assuming 5000 cycles of walking per day" (35). Koval et al. (13) also stated that early weight-bearing is safe and it is not associated with an increase of mechanical complications.

This study has limitations in being a retrospective, observational cohort study. In addition, analysis of surgical complications could not be performed due to insufficient sample size.

Early weight-bearing associates with improved final ambulatory status, shorter hospital stay, fewer short-term complications and does not increase mechanical complications. Overall, early deambulation proves to be an effective and safe therapeutic intervention. However, given the limitations of this study, further prospective studies that evaluate cost-effectivity of early weight-bearing and the relation with patient's quality of life are needed and, specially, studies that elucidate who are the patients that will benefit from delayed weight-bearing, if there are any.

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TRANSPARENCY DECLARATION

Conflict of interest: None to declare.

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