

# The epidemiology and functional outcomes of operative fixation of extracapsular proximal femoral fractures (AO 31-A) in young adults

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**Abstract** Proximal femoral fractures in adults under 50 years are not as common as in the elderly, but may have just as significant an impact. There is little in the literature describing the functional outcomes of fixation in this age group. Our aim was to assess the clinical and functional outcomes of operative management of extracapsular proximal femoral fractures (AO 31-A) in the young adult (<50 years). Consecutive skeletally mature patients <50 years undergoing operative fixation of these fractures were obtained from a prospective database over a 12-year period. Complications and mortality data were obtained from this database and case note review. Outcome scores were obtained via postal questionnaires. Eighty-eight patients were included in the study of which 74 (84%) had fixation with the dynamic hip screw. The mean age was 39 years (range 17–50) with a male preponderance (73.8%). Mean hospital stay was 14 days (range 2–94). Seventeen (19.3%) patients had died at a mean of 40 months from their operation date. The 1-year mortality was 4.5%. There were five complications (5.7%). SF-36 and EuroQol 5D scores showed that 5–10% had severe problems with a 20% decrease in quality of life compared to population norms. The biggest differences were in the physical function modalities. One-third had fair to poor hip function as assessed by the Oxford Hip Score. Though these injuries are relatively rare in this age group, they do have significant mortality and functional impairment reflecting a higher energy of injury rather than the frailty seen in the elderly.

**Keywords** Young adult hip fracture · Proximal femur · Extracapsular fracture

## Introduction

Proximal femoral fractures in the young adults are not as common as in the elderly. The incidence has been quoted to be around 2.8% of all proximal femoral fractures (5/100,000 patients) [1]. Several papers have defined those less than 50 years to be young [2, 3]. This group, with better general health than the elderly, may yield a clearer end result of operative fixation [4, 5]. The majority (83%) are extracapsular fractures in this age group [2]. High-energy trauma is the main single cause [3]. Young adults with hip fractures have also been noted to frequently have concomitant injuries [6]. Verettas et al. [2] noted high overall operative complication rates (22.5%) for proximal femoral fractures in this group. Several studies have reported the outcomes of intra- and extracapsular fractures in the older age group [5, 7] and of intracapsular fractures in the younger age group [8, 9], but none have specifically looked at outcomes of surgical fixation of this fracture type in this younger population.

The aim of this study was to assess the clinical and functional outcomes of operative management of extracapsular proximal femoral fractures (AO 31-A) in the young adult (<50 years).

## Patients and methods

Approval was granted by the institutional research and audit department. All skeletally mature patients 50 years of age or younger who underwent operative fixation of an

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extracapsular proximal femur fracture at our major trauma centre from August 1999 to August 2011 were included. Patient and treatment details as well as mortality data were obtained through a prospective hip fracture database and case note review. All patients had minimum 1 year of clinic follow-up.

Short Form-36 (SF-36) [10], EuroQol 5D (EQ 5D) [11], University of California, Los Angeles (UCLA) Activity [12] and Oxford Hip Scores (OHS 12-60 version) [13] were collected by three independent members not directly involved in the surgical fixation via postal questionnaires. Minimum time post-injury was 2 years.

### Statistical analysis

Results for outcome scores were presented as means with 95% confidence intervals. Pearson correlation coefficient matrix was performed to identify any correlation between the scoring systems. All statistical analyses were performed using GraphPad Prism version 6.0a (GraphPad Software Inc., USA).

## Results

### Demographics

Eighty-eight patients had operative fixation of extracapsular proximal femur fractures (AO 31-A) in the study period. Patient demographics are outlined in Table 1. The majority was involved in high-velocity injuries (road traffic accident 19.3%, fall from a height 29.5%, assault 2.2%). Twenty-five percentage of patients had concomitant injuries (three chest injuries, two head injuries, two spine fractures (no neurology), two pelvic fractures, seven ipsilateral lower limb fractures requiring fixation, six minor lower limb injuries, seven upper limb fractures).

Table 2 demonstrates the fracture characteristics and fixation devices. The majority (71.6%) had per trochanteric simple fractures and was treated with a dynamic hip screw (84.1%).

**Table 1** Patient demographic details and comorbidities

Demographic details	Study group ( <i>N</i> = 88)
Mean age (range) (years)	39 (17–50)
Male	65 (73.8%)
Female	23 (26.2%)
Number of comorbidities	
0	38 (43.1%)
1	32 (36.3%)
2	14 (15.9%)
>2	4 (4.5%)

**Table 2** Fracture patterns and modes of fixation

Type of fracture	<i>N</i>
Pertrochanteric simple (31-A1)	63 (71.6%)
Pertrochanteric multi-fragmentary (31-A2)	25 (28.4%)
Operation	
DHS	74 (84.1%)
Cephalomedullary device	7 (8%)
Other	7 (8%)

The mean hospital stay was 14 days (range 2–94).

### Mortality and complications

Overall 1-year mortality was 4.5%. This rate was the same irrespective of whether the proximal femoral fracture was an isolated injury. Seventeen (19.3%) patients had died at a mean of 40 months from their operation date. All deaths resulted from other injuries or comorbidities.

There were five complications (one case of post-operative DVT, two chest infections and two patients with pressure sores) giving a complication rate of 5.7%.

There were no reported re-operations or non-unions at minimum follow-up of 1 year.

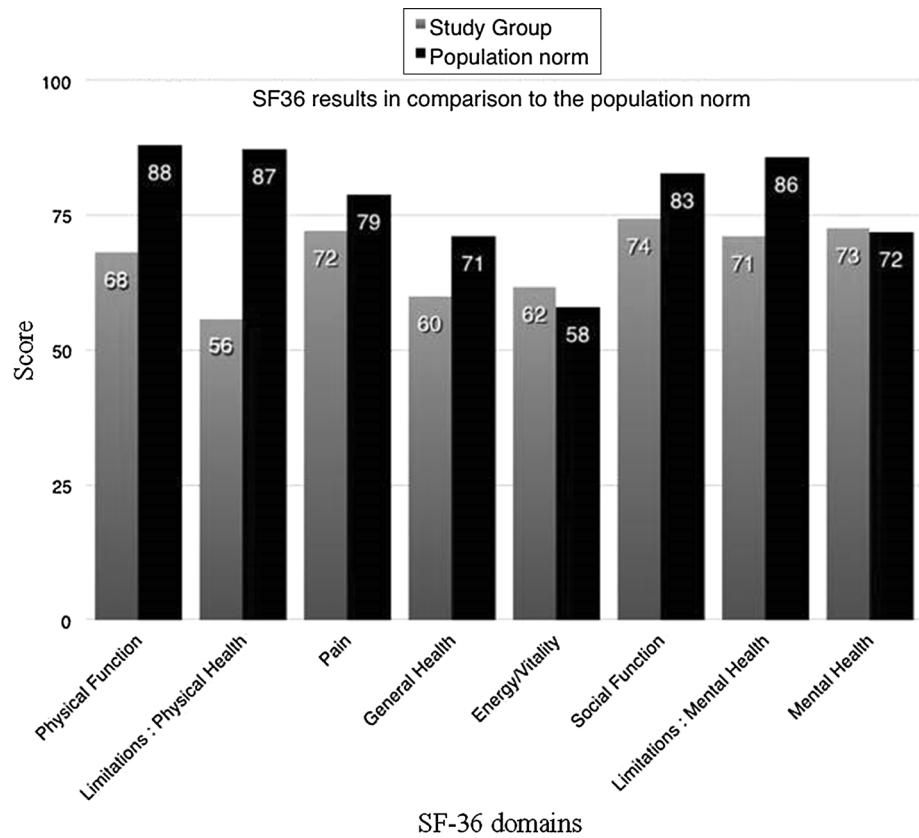
### Outcome scores

Of the 71 patients who were alive, outcome scores were collected from 43 (61%). SF-36 results along with the population normative values [14] are graphically represented in Fig. 1. The differences from the population normative values were greater in the scores for physical function and limitations to physical health than they were for the other domains including pain.

The mean EQ 5D index was 0.7 (95% CI 0.6–0.8), representing an almost 20% decrease in quality of life after fixation of these injuries in this group compared to the population norm (range 0.87–0.92 [15]). EQ VAS (Visual Analogue Score) for general health was 73.3 (95% CI 67.0–79.5) compared to a population norm of 85–87 [16] for this age group. Table 3 shows the scoring distribution for each modality of the EQ 5D score. The scores from 1 to 5 denote increasing severity of problems with 1 denoting no problems. Severe problems were noted in 7.5% of patients in Mobility, 5% in Self-care, 7.5% in Usual activities, 10% in Pain and 7.5% in Anxiety/depression dimensions.

The mean ULCA activity score was 5.4 (95% CI 4.6–6.1). A total of 62.5% of patients scored 5 or above (participation in at least moderate activities), and 12.5% patients scored 2 or below (inactive or restricted to minimal

**Fig. 1** Bar chart of SF-36 scores in study population and in normal population



**Table 3** Distribution of EQ 5D individual modality scores

Score	Mobility (%)	Self-care (%)	Usual activities (%)	Pain/discomfort (%)	Anxiety/depression (%)
1	47.5	62.5	47.5	20	65
2	20	22.5	27.5	50	17.5
3	25	10	17.5	20	10
4	5	5	5	10	5
5	2.5	0	2.5	0	2.5

activities of daily living). The mean Oxford Hip Score was 22.2 (95% CI 19.2–25.2) (<19 excellent, 19–26 good, 27–33 fair, > 33 poor [13]). A total of 32.5% of patients had fair to poor functional hip scores.

When patients with isolated proximal femur fractures were analysed independently, the outcome scores were comparable to the above (SF-36: Physical function 69, Limitations to Physical Health 59, Pain 74, General Health 61, Energy/Vitality 63, Social Function 75, Limitations to Mental Health 72, Mental Health 73; Mean EQ 5D Index 0.7; Mean UCLA activity score 5.5; Mean OHS 22).

EQ 5D index had good correlation with SF-36 general health ( $r = 0.7$ ), reasonable correlation with the UCLA activity score ( $r = 0.6$ ) and good inverse correlation with OHS ( $r = -0.8$ ).

## Discussion

Proximal fractures in the young adult (<50 years age) are rare [17]. This is supported by our study group in which only 88 cases were identified over 12 years at a level 1 regional trauma centre. This equated to approximately seven cases per year or one case every 2 months. The majority had fixation with a DHS (84.1%) in line with the recommendations by the Cochrane collaboration [18]. As would be expected with this age group, patients had few comorbidities with 79% having one or no comorbidities. However, about half of the group had high-velocity injuries which are comparable to earlier published studies [2, 3]. Hence, management of these fractures in this age group presents a unique clinical challenge which is different from similar fractures in the more elderly age group. These

factors must be taken into consideration when counselling these patients with respect to the outcomes of operative management of these injuries.

Elderly patients have significant mortality (10% within a month and 33% with one year) after sustaining proximal femur fractures [19, 20]. Young patients with displaced intracapsular fractures have been quoted to have a mortality of 12% within the first year [21]. Though the 1-year mortality in this study was found to be lower than this (4.5%), this is still a significant figure for an otherwise fit subset of the population. Additionally, we found that a high proportion of patients (19.3%) died within 3 years of the injury. All of these deaths were due to other injuries or comorbidities. This again highlights that even in this population there is a need for continued monitoring and optimization of care in both the immediate and delayed post-operative periods.

Patient-reported outcome scores are vital in assessing patients' experience after an intervention [22] and have been suggested to be equally important to objective measures of outcomes. In this study, we utilized the SF-36, EQ-5D and UCLA activity scores to assess general functional outcomes and the Oxford Hip Score (OHS) to specifically assess hip-specific function. SF-36 has been used widely to assess the general well-being of a population after a medical intervention. Overall our study group scored lower in most modalities of SF-36 when compared to the normative population values [14] (Fig. 1), with the difference being most marked in the physical modality domains. Interestingly, though the scores for pain approached the normative values, the scores for physical function and physical health were still comparatively lower. EQ 5D values revealed a majority of the patients reported good functional status in all the five modalities (Table 3). However, 5–10% of the patients had persistent severe problems in all the modalities at the 2-year stage. Though there are no specific normative values in the literature which can be used for the exact population examined in this study, the mean EQ 5D index in a study in 2006 for age groups between 18 and 49 years had a range of 0.87–0.92 [15]. Kind (1998) [16], in similar age groups for a UK normative population, reported mean EQ VAS scores from 85 to 87. Both these ranges are higher than the respective mean EQ 5D index and VAS scores (and confidence intervals) for our study population confirming that a proportion of these patients do have a significant functional deficit following fixation of these fractures. This was further emphasized by the UCLA activity score results which showed that 12.5% of patients scored 2 or below, i.e. inactive and restricted to minimum activities of daily living.

In terms of hip-specific function, we found good correlation between the mean OHS and the SF-36 and EQ 5D scores. It may thus indicate that the borderline functional scores could be due to a combination of complex injuries along with severe

nature of hip fractures. Though most patients in the study had an OHS that was in the 'good' to 'excellent' range, approximately one-third of the group had 'fair' to 'poor' scores. The mean overall score was 22.2 which is comparable with that of patients post-total hip replacement [13].

Overall, both the general physical modalities and hip-specific scores suggest that a small but significant proportion of the study population has persistent hip dysfunction despite healing of the fractures. The majority of patients in our study had DHS fixation of these fractures. Though a 2010 Cochrane review did not find any sufficient evidence of a clear difference in functional outcomes between DHS and cephalomedullary nail fixation of these fractures in all age groups [18], more recent studies have found superior or quicker recovery of mobility for those treated with an intramedullary device [23, 24]. It has been noted that there is significantly more femoral neck shortening with DHS fixation [23] including in the young patient [25]. In the elderly, this collapse is desirable to promote contact and healing [26], but in the younger patient, excessive collapse and resultant abductor dysfunction may lead to more functional impairment in this higher demand group. Our study was limited as radiological follow-up was not available for analysis for most patients as most patients' injuries predated the electronic imaging system and hard copies of radiographs were not accessible. As such we were dependent on data from the database and case notes, and hence, radiographic measurements could not be performed to assess this parameter. Further studies comparing DHS and cephalomedullary nail fixation of these fractures are required to determine whether there is a radiological and functional difference between these fixation methods for this fracture type in this age group.

Other limitations of our study include a small sample size and the retrospective nature of the study. This represents how rare these injuries are. The clinical outcome data was, however, obtained from a prospectively collected database. For functional outcome in the younger group, we did not ask our patients for retrospective functional pre-operative scores as this would be subject to response or recall bias [27]. Hence, we acknowledge that though baseline pre-injury functional outcome scores would increase the strength of our study, given the nature of these injuries, this would have been impossible to collect. The OHS and UCLA scores have been validated for use in hip arthroplasty but not for hip fractures. Both are questionnaire based, and hence, both could be posted. Oxford Hip Scores, however, have been used in assessing functional results of hip fracture patients [28, 29]. The UCLA scoring system was used as it has high reliability, completion rates and no floor effects [30]. There is a lack of normative values for SF-36 and EQ 5D specific to our patient group. The population norms we used to compare our SF-36

scores were established in a population aged between 18 and 65 years [14] as this was the most approximate value available in the literature. Similarly, normative values used for the EQ 5D index and VAS were for a population group which, though similar, was not exactly comparable to the group analysed in this study. Finally, for those who were alive, we were only able to collect outcome data for 61% of the patients. However, with the 19% mortality rate, that meant we had outcome data for 80% of all the patients. The lower response rate also reflects the more mobile young demographic of the patient cohort, who are more likely to move and not respond to follow-up.

## Conclusions

The mortality rate of young patients undergoing operative fixation of extracapsular proximal femoral fractures was approximately 20% at 3 years, reflecting the higher energy of injury rather than frailty that is seen in elderly patients. These injuries are rare and complex due to associated injuries. Although most will function well, there is overall a near 20% decrease in the quality of life and a third of patients will have fair to poor hip function. There is a need for multi-centre randomized control trials to compare DHS with other methods of fixation specifically in these younger patients.

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**Author contributions** DN Ramoutar, corresponding author, analysed the data and wrote the manuscript. P Kodumuri collected the data and wrote the manuscript. JN Rodrigues performed statistical analyses and wrote the manuscript. S Olewicz collected the data. CG Moran and BJ Ollivere, senior authors, wrote and edited the manuscript. DP Forward, senior author, analysed the data and wrote and edited the manuscript.

## Compliance with ethical standards

**Conflict of interest** The authors declare that they have no conflict of interest.

**Ethical approval** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

**Informed consent** Informed consent was obtained from all individual participants included in the study.

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