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## Distal Femoral Fractures in the Elderly: Does Early Treatment with Locking Plates Reduce Mortality Rates?

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### Abstract

**Aim:** Distal femoral fractures are associated with high mortality rates in the elderly. Our aim was to evaluate the effectiveness of our management of distal femoral fractures and the mortality rates amongst various treatment modalities.

**Methods:** Seventy-eight patients were included in a retrospective study at our department of all distal femoral fractures between 2006 and 2012. Data was collected on: demographics, injury related data and outcomes.

**Results:** Demographics: Of the final study population, females constituted 81% of patients with 85% of patients older than 65 years old. Injury related data: 67% of patients underwent operative intervention of which 68% were operated on within 48 hours. Outcomes: Our overall 1 year mortality rate was 46% and the length of hospital stay was found to increase with increasing age. Both were found to be least with the use of locking plates and greatest in those treated conservatively.

**Conclusion:** These fractures are challenging to treat and are likely to increase given the ageing population. We propose their outcomes are improved when treated surgically particularly with the use of locking plates. We also suggest they should be managed similar to proximal femoral fractures, with early routine orthogeriatric review.

**Keywords:** Distal femur fracture; Elderly; Mortality; Locking plates; Outcome

### Introduction

Distal femoral fractures occur in two population groups, the young and the elderly. The former usually resulting from high energy trauma and the latter from falls in osteoporotic individuals. They account for 1% of all fractures [1,2] and 4-6% of all femoral fractures [3]. They are the second most common type of femoral fracture in the elderly following proximal femoral fractures despite being 10 times less frequent [2,4]. These fractures usually require operative intervention to allow early mobilization and rehabilitation, where conservative management has largely fallen out of favor secondary to advances in implants and surgical technique [5]. Various techniques used to treat these fractures surgically include Dynamic condylar screw, blade plates, locking plates, intramedullary nails and knee replacement however. They are an injury type with significant morbidity and mortality particularly in this population when compounded by multiple co-morbidities. There have been reported mortality rates of up to 0.05% at 1 month, 16% at 6 months and 30% at 1 year of distal femoral fractures in the elderly, increasing with the presence of medical co-morbidities [6,7]. Better outcomes have been demonstrated through surgical management [3], however operative intervention is not without risks, which include infection, neurovascular damage, mal-union, non-union, and mortality. Stiffness and reduced range of motion is a risk with prolonged immobilization and early motion is therefore integral part of rehabilitation [8].

As with any fracture, treatment requires restoring and maintaining femoral alignment to preserve function. Treating these fractures are particularly challenging when having to consider healing potential and bone quality to achieve a satisfactory functional outcome [9]. This is further compounded when these are periprosthetic fractures making

surgery even more challenging [10]. In a previous study looking at mortality after distal femoral fractures in elderly patients suggested a delay of greater than 4 days increased the 6-month and 1-year mortality risk, compared to surgery 48 hours after admission. The mortality of a native distal femoral fracture was found to be similar to that of a control hip fracture population and an important field to explore if management and outcomes can be improved [6].

Our aim was to evaluate the current effectiveness of our management of distal femoral fractures by measuring one year mortality rates amongst different treatment modalities. We also assessed time to surgery and therefore if early surgery provided better outcomes, pre- and post-operative mobility and complications to ascertain if improved management suggestions could be made.

### Methods

We conducted a retrospective cohort analysis of all patients presenting with distal femoral fractures to our department between January 2006 and December 2012. A total of 91 patients were identified. Patients aged less than 18 years old, those who sustained osteochondral fractures, ligamentous injury through avulsion fractures and patients who required referral to tertiary centers for further treatment were excluded. A final study population of 78 patients was therefore included in our analysis. The average follow-up was 9 months.

Data was collected from a variety of sources including emergency department notes, admission assessments, radiographic imaging, operation notes, physiotherapy assessments and clinic letters. The data was subsequently divided into 3 broad categories including: demographics, injury related data and outcomes. Demographics included gender and

age, which was subdivided into three groups, those younger than 65 years old, between 65 and 85 and those older than 85.

Injury related data included fracture type. Native fractures were classified according to the AO system and peri-prosthetic fractures according to the Lewis and Rorabeck classification. Treatment comprised conservative cast treatment and surgical fixation with intramedullary nailing, locking plates and cannulated screws. Time to operation in days was also recorded.

The primary outcome of the study was 1 year mortality rates which were assessed according to treatment type. Secondary outcome measures comprised length of hospital stay, complications and mobility. Length of hospital stay was calculated in days. Complications included infection, non-union, mal-union, knee stiffness and re-operation. Radiographs were analyzed digitally by a single surgeon (MH) to assess union. Radiographic union was considered when there was disappearance of the fracture line, bridging of the fracture site with callus or cortical continuity. Mal-union was defined as greater than ten degrees of angulations in each plane. Mobility outcomes were assessed by comparing pre- and post-operative mobility. Simple data analysis was conducted using descriptive statistics with the use of percentages, mean and range.

## Results

### Population demographics

Eighty-one per cent of patients in our study were female and 48% over the age of 85, representing a population particularly vulnerable to fractures (Table 1). The average population age was 80, with a range between 22 and 101 years of age. The mean age amongst females was 83 (range 56-101) and 67 in men (range 22-88).

### Injury related data

Fifty-seven patients (73%) sustained native DFFs and 17 patients sustained peri-prosthetic fractures (22%). It was not possible to ascertain the type of fracture according to the AO/Lewis and Rorabeck classification in the remaining four patients (5%). Type A1 was the most common fracture configuration in the native group and type 2 in the periprosthetic fracture group. Forty-four per cent and 55% of fractures were right and left sided respectively. One patient in this group sustained bilateral DFFs. On average, 11 patients with native DFF and 3 patients with peri-prosthetic fractures were managed annually at our department. Two thirds of patients underwent operative intervention for their injury, refer to Figure 1, with 73% treated within two days 2 days, see Figure 2.

### Primary outcome

40% of patients died in the operative group in comparison to 58% in the conservative group over the duration of the study. One year mortality rates were calculated based on those treated non-operatively, with IM nails and locking plates. Little conclusion of mortality rates in the single patient treated with cannulated screws could be drawn and therefore were excluded in Figure 3 below.

### Secondary outcomes

**Length of hospital stay:** Date of discharge was unavailable in three patients. 43% of patients were discharged within 2 weeks and 25% of patients were discharged beyond 6 weeks. The remaining 32% were discharged between these time frames, refer to Figure 4. A greater length of hospital stay was found with increasing age.

**Mobility:** 21% of patients had either no pre- or post-operative mobility status recorded or had died. 24% of patient's mobility had worsened post injury and management. The remaining 55% of patients regained their pre-operative mobility status.

Characteristic	Subgroup	N = 78
Gender	Male	15 (19%)
	Female	63 (81%)
Age in years	22 – 65	12 (15%)
	65-85	29 (37%)
	Over 85	37 (48%)

Table 1: Population demographics

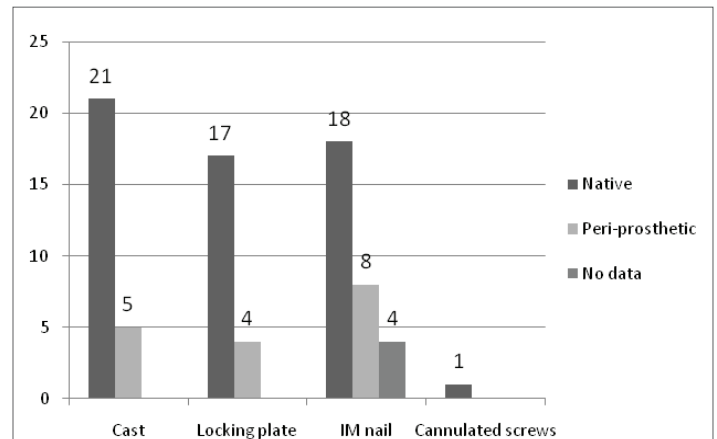


Figure 1: Graph showing fracture type and treatment

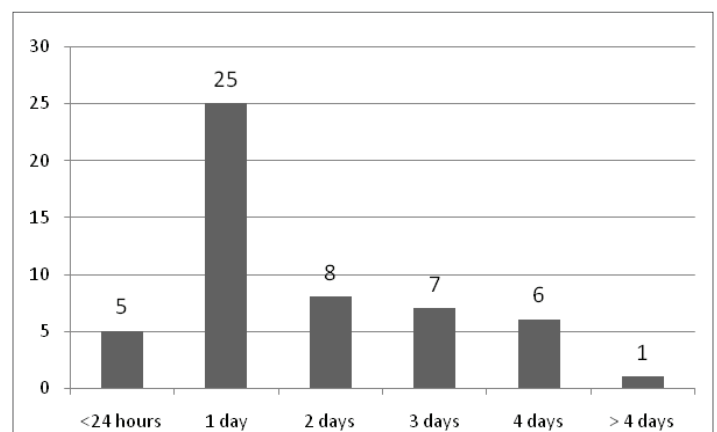


Figure 2: Graph showing time to surgery

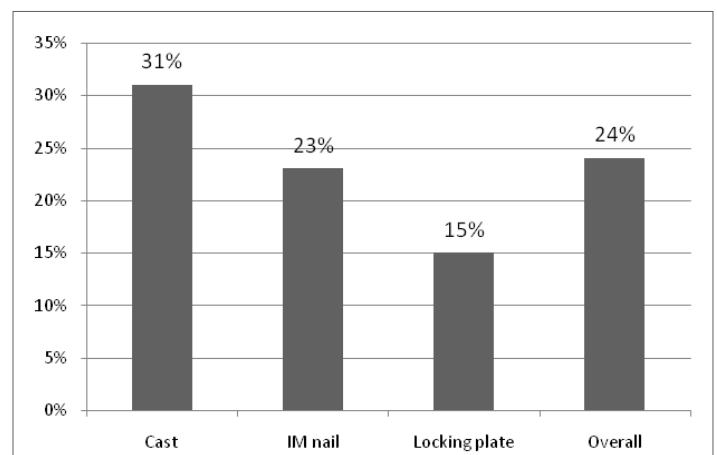


Figure 3: Graph showing one year mortality rates according to treatment modality

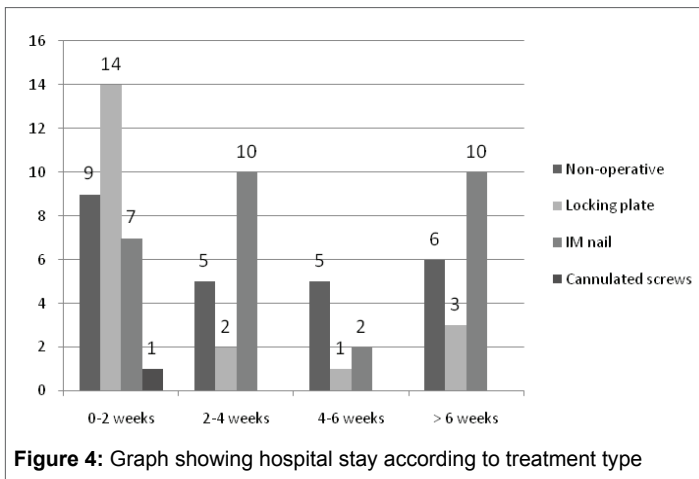


Figure 4: Graph showing hospital stay according to treatment type

**Complications:** The most commonly reported complication was stiffness in 9 patients. It is difficult to ascertain if this was related to the injury or treatment, or pre-existing stiffness from osteoarthritis. This was followed by 3 cases of non-union, two of which had reasons for non-union including presence of secondaries and motor neuron disease. There were three further cases of mal-union, one each of metalwork failure, re-operation and on-table mortality. We had no cases of infection or neurovascular injury.

## Discussion

With hip fractures being a major leading public concern, development of a hip fracture care pathway has allowed care to be optimized for such a vulnerable population group by providing better functional outcomes, reduced peri-operative complications and improved healthcare expenditure. Elderly patients in comparison to the young with similar injuries have a longer hospital stay in addition to an increased mortality rate as they are frailer and require more resources particularly on discharge. This is particularly true of major long bone fractures integral to mobility. Although less common than proximal femoral fractures distal femoral fractures have similar rates of mortality in the elderly population. With an ageing population these injuries will be managed more frequently and is important they are managed adequately to reduce complication rate and improve clinical outcomes.

Our results clearly display improved outcomes with surgical management in comparison to conservative treatment, with a 7% reduction in one year mortality between the two. It has been suggested a surgical delay in the treatment of distal femoral fractures of more than 4 days increases the 1year mortality risk and suggested to be lowest when performed within 48 hours of admission [7]. In our study population 13% of patients were operated beyond 4 days, which may contribute to our low overall mortality rate compared to the 30% suggested in the literature [7]. This stresses the importance of early surgery in such injuries, akin to the management of proximal femoral fractures, inevitably reducing risks such as chest infection and venous thromboembolism associated with prolonged immobility when confined to bed.

The most effected group of patients are elderly females as evidenced in our data, who are likely to suffer from osteoporosis. Distal femoral fractures treated with locking plates are thought to provide a safe and effective fixation that improves fracture healing and stability, allowing early mobilization in those with poor bone quality [11] and have increasingly been used in fractures involving diaphyseal and metaphyseal bone in osteoporotic individuals and as a way of bridging severely comminuted fractures [12]. However, it has also been argued that poor bone stock quality in osteoporosis can risk failure such as cutout from poor implant

anchorage [13]. However, our results suggest patients treated with locking plates have better outcomes, with the lowest rates of mortality amongst the treatment options and a shorter length of hospital stay. It is suggested that plate osteosynthesis can interfere with the natural healing process of fractures due to its inherently stiff construct influencing the mechanical environment of callus formation [14] suppressing interfragmentary movement [15,16]. This is supported by non-union rates of 16-23% in recent studies with the use of locking plates in DFF [11,17,18]. Our results however showed no cases of non-union in those patients treated with locking plates.

Surgical technique may also have a bearing on outcome. Plates are popular as a minimally invasive approach can be adopted through submuscular insertion allowing for smaller incision, preservation of blood supply, minimal soft tissue damage and avoidance of disrupting the fracture haematoma [19,20]. In comparison reaming in intramedullary nailing can lead to thermal necrosis and alteration of bone architecture with increased risk of fat embolism [21]. Providing an optimal fracture healing environment will allow for earlier weight bearing again leading to a reduction in hospital stay and complications. It was not possible to ascertain if the plates in this population were inserted via a wide surgical exposure or minimally invasive approach which may have had some effect on non-union and infection rates.

Meneghini RM et al. [22] noted a greater failure rate among locking plates compared to IM nailing in periprosthetic fractures. A cadaveric study also suggested that femoral nails have better stiffness and fatigue life in comparison to non-locking nails and plates [23]. This is thought to be particularly advantageous in elderly patients with osteoporotic bone that are more likely to fail under loading [23]. In our population group, there was one case of stress fracture occurring at the proximal end of a locking plate 3 months post-operatively which required re-operation with further plating. Plate failure can occur as a result of delayed union or non-union with loading [6] however union was achieved in this specific patient suggesting no greater failure rate. Our data supports that by Khurshed et al. [24] who describe good union rates amongst 25 patients treated with locking plates using a minimally invasive method, where the average time of union was noted in 17 weeks.

## Limitations

Several limitations are considered in our study. Given its retrospective design approximately 15% of the initial cohort was excluded leaving a relatively small population size, where additional studies are needed to confirm these findings. The follow-up period was relatively short, although this takes into account a number of mortalities which are likely to explain its length. We did not have any detailed data on patient comorbidities or presence of osteoporosis, which may potentially influence outcomes such as length of hospital stay and treatment modality as we know elderly patients are clinically challenging as they respond differently. Furthermore, we did not analyse the biomechanical properties of our fixations, such as working length for IM nails, implant material, screw ratio, plate length, that can also effect outcomes. Range of motion and functional knee scores are a difficult measure to get in these groups of patients however these were not the primary aim of our study.

## Recommendations

There is ever increasing need to ensure the elderly population remain active members of society given the ageing population. Co-management by orthopaedic and geriatricians have shown to improve outcomes by reducing mortality and hospital stay [25]. With such fragility fractures, we recommend that such patients should be fast tracked to orthopaedic wards for optimization for surgery with early routine orthogeriatric review to minimize the delay to surgery. We also suggest prompt mobilization following surgery with multidisciplinary rehabilitation.

## Conclusion

Distal femoral fractures are likely to increase given the ageing population. Our study confirms that these are challenging fractures to fix and the mortality rates are quite high. Often the fixation is needed in moribund patients in order to improve the nursing care and hygienic needs. We were able to demonstrate that a robust extramedullary fixation is better tolerated by the patients. Also early management of these fractures resulted in longer survival of these patients. Although our study was small we propose surgical management of these fractures provides better mortality outcomes amongst the elderly population, particularly when treated with locking plates. This however, does require further in-depth analysis to confirm these conclusions. We also suggest patients should receive routine early orthogeriatric review to minimize delay to surgery to improve outcomes and mortality such that of the proximal hip fracture patients.

## References

1. Court-Brown CM, Caesar B (2006) Epidemiology of adult fractures: a review. *Injury* 37: 691-697.
2. Martinet O, Cordey J, Harder Y, Maier A, Buhler M, et al. (2000) The epidemiology of fractures of the distal femur. *Injury* 31: C62-63.
3. Kregor PJ, Stannard J, Zlowodzki M, Cole PA, Alonso J (2001) Distal femoral fracture fixation utilizing the less invasive stabilization system (L.I.S.S.): the technique and early results. *Injury* 32: SC32-SC47.
4. Arneson TJ, Melton LJ 3<sup>rd</sup>, Lewallen DG, O'Fallon WM (1988) Epidemiology of diaphyseal and distal femoral fractures in Rochester, Minnesota, 1965-1984. *Clin Orthop Relat Res*:188-194.
5. Frigg R, Appenzeller A, Cristensen R, Frenk A, Gilbert S, et al. (2001) The development of the distal femur less invasive stabilization system (LISS). *Injury* 32: SC24-SC31.
6. Streubel PN, Ricci WM, Wong A, Gardner MJ (2011) Mortality after distal femur fractures in elderly patients. *Clin Orthop Relat Res* 469: 1188-1196.
7. Kammerlander C, Riedmuller P, Gosch M, Zegg M, Kammerlander-Knauer U, et al. (2012) Functional outcome and mortality in geriatric distal femoral fractures. *Injury* 43: 1096-1101.
8. Nasr AM, McLeod I, Sabboubeh A, Maffulli N (2000) Conservative or surgical management of distal femoral fractures. A retrospective study with a minimum five year follow-up. *Acta Orthop Belg* 66: 477-483.
9. Doshi HK, Wenxian P, Burgula MV, Murphy DP (2013) Clinical outcomes of distal femoral fractures in the geriatric population using locking plates with a minimally invasive technique. *Geriatr Orthop Surg Rehabil* 4: 16-20.
10. Saidi K, Ben-Lulu O, Tsuji M, Safir O, Gross AE, et al. (2014) Supracondylar periprosthetic fractures of the knee in elderly patients: a comparison of treatment using allograft-implant composites, standard revision component, distal femoral replacement prosthesis. *J Arthroplasty* 29: 110-114.
11. Bottlang M, Fitzpatrick DC, Sheerin D, Kubiak E, Gellman R, et al. (2014) Dynamic fixation of distal femur fractures using far cortical locking screws: a prospective observational study. *J Orthop Trauma* 28: 181-188.
12. Egol KA, Kubiak EN, Fulkerson E, Kummer FJ, Koval KJ (2004) Biomechanics of locked plates and screws. *J Orthop Trauma* 18: 488-493.
13. Wahnert D, Hoffmeier K, Frober R, Hofmann GO, Muckley T (2011) Distal femur fractures of the elderly-different treatment options in a biomechanical comparison. *Injury* 42: 655-659.
14. Hak DJ, Toker S, Yi C, Toreson J (2010) The influence of fracture fixation biomechanics on fracture healing. *Orthopedics* 33: 752-755.
15. Henderson CE, Kuhl LL, Fitzpatrick DC, Marsh JL (2011) Locking plates for distal femur fractures: is there a problem with fracture healing? *J Orthop Trauma* 25: S8-S14.
16. Lujan TJ, Henderson CE, Madey SM, Fitzpatrick DC, Marsh JL, et al. (2010) Locked plating of distal femur fractures leads to inconsistent and asymmetric callus formation. *J Orthop Trauma* 24: 156-162.
17. Vallier HA, Immler W (2012) Comparison of the 95-degree angled blade plate and the locking condylar plate for the treatment of distal femoral fractures. *J Orthop Trauma* 26: 327-332.
18. Hoffmann MF, Jones CB, Sietsema DL, Koenig SJ, Tornetta P 3<sup>rd</sup> (2012) Outcome of periprosthetic distal femoral fractures following knee arthroplasty. *Injury* 43: 1084-1089.
19. Hoffmann MF, Jones CB, Sietsema DL, Koenig SJ, Tornetta P 3<sup>rd</sup> (2013) Clinical outcomes of locked plating of distal femoral fractures in a retrospective cohort. *J Orthop Surg Res* 27: 8-43.
20. Bolhofner BR, Carmen B, Clifford P (1996) The results of open reduction and internal fixation of distal femur fractures using a biologic (indirect) reduction technique. *J Orthop Trauma* 10: 372-377.
21. Bolhofner BR, Carmen B, Clifford P (2007) The biological and physiological effects of intramedullary reaming. *J Bone Joint Surg Br* 89: 1421-1426.
22. Meneghini RM, Keyes BJ, Reddy KK, Maar DC (2014) Modern retrograde intramedullary nails versus periarticular locked plates for supracondylar femoral fractures after total knee arthroplasty. *J Arthroplasty* 29: 1478-1481.
23. Pezmezci M, McDonald E, Buckley J, Kandemi U (2014) Retrograde intramedullary nails with distal screws locked to the nail have higher fatigue strength than locking plates in the treatment of supracondylar femoral fractures: a cadaveric-based laboratory investigation. *Bone Joint J* 96: 114-121.
24. Khursheed O, Wani MM, Rashid S, Lone AH, Manaana Q, et al. (2014) Results of treatment of distal extra articular femur fractures with locking plates using minimally invasive approach-experience with 25 consecutive geriatric patients. *Musculoskelet Surg* 99: 139-147.
25. Vidan M, Serra JA, Moreno C, Riquelme G, Ortiz J (2005) Efficacy of a comprehensive geriatric intervention in older patients hospitalized for hip fracture: a randomized, controlled trial. *J Am Geriatr Soc* 53: 1476-1482.