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Equivalent mortality and complication rates following periprosthetic distal femur fractures managed with either lateral locked plating or a distal femoral replacement

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ABSTRACT

Introduction: Management of distal femur fractures above total knee arthroplasty (TKA) remains challenging. Two common surgical options are locked lateral plating (LLP) and distal femoral arthroplasty (DFR). Unfortunately, approximately 30–50% of patients may die within one year of injury, require further surgery, or not regain prior mobility performance. We compared 87 LLP to 53 DFR patients – to our knowledge the largest comparative study – focusing on 90- and 365-day mortality, mobility maintenance, and further surgery.

Methods: We performed a retrospective review of patients at least 55 years old who sustained femur fractures near a primary TKA (essentially OTA-33 or Su types 1, 2, or 3) from 2000 to 2015 assigning cohort based on treatment: LLP or DFR. We excluded patients having prior care for the injury, whose surgery was not for fracture (e.g. loosening), or having other surgical intervention (e.g. intramedullary nail).

Results: Results Cohorts were similar based on body mass index and age adjusted Charlson Comorbidity Index (aaCCI). LLP was more common than DFR for fractures above and at the level of the implant, but similar for fractures within the implant for patients with aaCCI $\geq$ 5. LLP and DFR had similar mortality at 90 days (9% vs 4%) and 365 days (22% vs 10%), need for additional surgery (9% vs 3%), and survivors maintaining ambulation (77% vs 81%). Patients whose surgery occurred 3 or more days after presentation had similar mortality risk to those whose surgery was before 3 days. The mean age of one year survivors was 77 whereas for patients who died it was 85. Neither surgical choice nor aaCCI was associated with increased risk in time to surgery.

Conclusions: Fracture location, remaining bone stock, and patient's prior mobility and current comorbidities must guide treatment. Our study suggests that 90- and 365-day mortality, final mobility, and re-operation rate are not statistically different with LLP vs DFR management.

Introduction

Recent studies have highlighted the poor prognosis of geriatric patients with distal femur fractures [1–4]. Surgeons managing this injury with a locked lateral plate (LLP) might expect one quarter of their patients to die within a year and another quarter to experience infection, nonunion, or other further surgery [5]. Distal femur fractures near a prior primary total knee arthroplasty (TKA) are estimated to occur with an incidence of 0.3-2.5% [6–11]. LLP is one standard surgical option for this injury, yet many authors report nonunion in the 10–20% range as summarized in a recent thorough review [12]. Patients who fail further standard fracture care may eventually progress to distal femoral replacement (DFR), and these patients continue to have a higher rate of complications than patients initially managed with DFR, have incurred a greater cost, and have endured multiple major surgeries [13]. The next question in this thought process is thus: might patients with *peri*-TKA femur fractures benefit from index DFR management instead of LLP?

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Methods

We performed an Institutional Review Board-approved retrospective cohort study of patients treated for distal femur periprosthetic fractures at a single network of tertiary referral hospitals between 2000 and 2015. Patients were identified by reviewing operative logs of all femur fracture surgeries and manually reviewing imaging to confirm implant used. All fractures fit the general classification of OTA-33. We included patients who were at least 55 years old, had a femur fracture near an existing TKA (as proximal as the diaphyseal-metaphyseal transition) and had no fracture care prior to our initial LLP or DFR. We excluded patients with non-primary TKA, any treatment prior to our initial fracture surgery, or management with any technique other than LLP or DFR. Patient factors evaluated included age at injury, Charlson Comorbidty Index (CCI) as well as age-adjusted CCI (aaCCI), body mass index (BMI), and smoking status. Major outcome measures were re-operations, 90- and 365 day mortality, and return to pre-injury mobility level (graded as independent or cane ambulation, front-walker ambulation, and wheelchair or less). Statistical analysis was performed with Prism 7.0 (GraphPad, Lajolla CA), with Student's *t*-test used for continuous data and Fisher's Exact test for categorical data. We evaluated potential selection bias of fixation choice based on fracture location with the chi-square goodness of fit test. In all calculations a p-value <0.05 was considered significant and data is presented as mean ± standard deviation where applicable.

The CCI is a common validated metric for estimating future mortality and is a weighted sum tally of existing patient diseases. A value of one point each is given for myocardial infarction, congestive heart failure, peripheral vascular disease, dementia, chronic pulmonary disease, connective tissue disease, peptic ulcer disease, mild liver disease, and uncomplicated diabetes; two points each for hemiplegia, moderate to severe renal disease, complicated diabetes, malignancy within five years of diagnosis, leukemia, or lymphoma; three points each for moderate to severe liver disease, and six points each for AIDS (not HIV) and metastatic solid tumor. The one year mortality for the different scores is estimated at: 0 points = 12%; 1–2 points = 26%; 3–4 points = 52%; ≥5 points = 85% [14]. Age adjustment adds one additional point for each decade after 50 years [15]. The aaCCI has remained a commonly used tool to estimate and assess the health of a population in trauma studies [16–19]. Given that a patient with aaCCI of 4 is expected to have around 50% one year survival, we separated cohorts into aaCCI ≤ 4 and aaCCI ≥ 5 for subgroup analysis as appropriate.

Results

A total of 87 LLP and 53 DFR patients fit inclusion and exclusion criteria. Table 1 presents demographic data. The LLP and DFR groups had no significant differences in any measured demographic category except LLP patients had a higher rate of diabetes causing end organ damage. Table 2 presents implant choice based on fracture location, with subgroup analysis based on aaCCI. LLP was used more frequently for all fracture location and aaCCI pairings, except for aaCCI ≥ 5 patients with fractures within the femoral implant. Patients treated with DFR whose fracture was outside (proximal to) the femoral TKA implant had surgeon notes stating the reason for DFR was for fracture comminution and concern for post operative nonunion. Fractures occurring within the femoral TKA implant were treated with DFR if pre-operative imaging suggested inadequate implant bone stock to secure the LLP; some intra-implant aaCCI ≤ 4 patients had notes specifying faster expected return to unassisted ambulation as the preference for DFR.

Table 3 presents overall patient outcomes. LLP patients had surgery at an average of 1.25 days after presentation whereas DFR patients had surgery on average 2.06 days after presentation ($p < 0.01$), but this did not lead to significant differences in any outcome measures.

Tables 4 and 5 show subgroup analysis of outcome data, dividing cohorts into those below (aaCCI ≤ 4) and above 50% expected 1-year mortality (aaCCI ≥ 5). For the aaCCI ≤ 4 subgroup, LLP and DFR patients fared similarly. For the aaCCI ≥ 5 subgroup, LLP patients were managed post operatively in the ICU at twice the rate of DFR patients (27/60 vs 8/35, $p = 0.05$); however, no other outcome measures were different between LLP and DFR in this subgroup.

Based on two recent studies of patients with distal femur fractures managed with LLP with [1] and without prior TKA [5] which identified an increased mortality rate for patients whose operation occurred more than two days after presentation, a second subgroup analysis was performed comparing one year mortality of patients who were treated within two calendar days of presentation to those treated three or more days after presentation. Neither the implant choice nor time to surgery achieved significance in its relationship with one year mortality (Table 6).

Table 7 presents the patient pre and post operative mobility based on surgical procedure. There were no statistically different changes of mobility at one year based on the operation performed.

Patient age has been identified as an independent risk of mortality [20,21]. Table 8 presents the mean age, BMI, and aaCCI of

Table 1
Patient demographics.

	LLP (n = 87)	DFR (n = 53)	p-value
Age (y)	80.0 ± 9.9	80.1 ± 7.8	0.95
BMI	32.6 ± 9.3	30.6 ± 7.8	0.19
aaCCI	5.61 ± 1.96	5.19 ± 1.69	0.18
Diabetes (end organ effects)	31 (11)	14 (0)	.27 (<0.01)
Tobacco	5	3	1
Open fracture	8	2	0.31
Follow days	469 ± 686	673 ± 877	0.18

Table 2
Surgical Management by Fracture Location relative to Femoral Component.

Fracture	aaCCI ≤ 4			aaCCI ≥ 5			All Patients		
	LLP	DFR*	p	LLP	DFR*	p	LLP	DFR*	p
Inside	9	14	0.03	23	25	0.69	32	39	0.32
<5 cm	18	3	<0.01	30	8	<0.01	48	11	<0.01
>5 cm	0	0	–	7	1	<0.01	7	1	<0.01

*No pre-operative images could be found for two DFR patients; one aaCCI ≤ 4, one aaCCI ≥ 5.

Table 3
Patient Outcomes.

Outcome	LLP (n = 87)	DFR (n = 53)	p
Days to operation	1.25 ± 1.41	2.06 ± 1.61	< 0.01
ICU	30	12	0.18
ICU days	0.9 ± 1.6	1 ± 1.5	0.36
Transfusion	49	28	0.71
Hospital days	6 ± 4.3	6 ± 3.2	0.76
Nursing home	81	48	0.77
90 day readmission	4	6	0.73
1-year re-operation*	9	3	0.36
90 day mortality	9	4	1
1-year mortality	22	10	0.41
1-year mortality days	136 ± 99	138 ± 108	0.97
Regained prior mobility	44	28	1

*LLP n = 65 due to 22 deaths by one year; DFR n = 43 due to 10 deaths by one year.