Injury, Int. J. Care Injured 47 (2016) 1732–1736

Contents lists available at ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury

# Geriatric distal femur fracture: Are we underestimating the rate of local and systemic complications?

Gele B. Moloney, Tiffany Pan, Carola F. Van Eck, Devan Patel, Ivan Tarkin*

*Department of Orthopaedic Surgery, University of Pittsburgh Medical Center, Kaufmann Building, Suite 911, 3471 Fifth Avenue, Pittsburgh, PA, United States*

ARTICLE INFO

*Keywords:*
Geriatric distal femur fracture
Distal femur nonunion
Mortality
Complications
Periprosthetic distal femur fracture
Geriatric fracture

ABSTRACT

*Background:* Low energy distal femur fractures often occur in a fragile elderly population that is prone to local and systemic complications following operative treatment of extremity fractures. The nonunion rate and early complication rate following laterally based locked plating in this specific fracture are not well described.

*Methods:* We conducted a retrospective cohort study conducted at three affiliated tertiary care hospitals to evaluate nonunion, early post operative complications, discharge disposition, length of stay, and mortality in patients over 60 years old undergoing laterally based locked plating of a low energy distal femur fracture.

*Results:* Forty-four out of 176 patients were deceased at one year (25%). Predictors of one year mortality included older age, higher Charlson Comorbidity Index (CCI), and delay to surgery greater than 2 days ($p < 0.001$). Of 99 patients alive and with follow up at one year, 24 (24%) developed a nonunion and 21 of 24 required nonunion surgery. Development of a surgical site infection was statistically significantly correlated with development of nonunion. Age and CCI did not predict development of nonunion. Average length of stay was 10 days and 82% of patients were discharged to a skilled nursing facility. Thirty eight percent of patients experienced at least one postoperative systemic complication.

*Conclusions:* Laterally based locked plating of the low energy geriatric distal femur fracture is most often followed by a tumultuous post-operative course with a high rate of local and systemic complications including death, nonunion, and extended hospital stays.

*Level of evidence:* Level III prognostic.



## Introduction

Low energy distal femur fractures represent a significant public health problem in the elderly population, yet there is insufficient data to fully inform providers and patients of the expected post-operative course. Although laterally based locked plating is widely accepted as a preferred treatment for these fractures, the incidence of local and/or systemic complications in the elderly population may be significantly underestimated.

The unique challenges of treating the geriatric fracture patient with a femur fracture have been illuminated by extensive work on morbidity and mortality after fracture of the proximal femur in this particular population [1,2]. Only recently have reports on the comparable mortality rates after geriatric supracondylar femur fracture, up to 25% at one year [3–5], begun to emerge. However, there is minimal data on the rate of post-operative systemic medical complications or rates of nonunion.

Union rates of 80–93% [6–8] have been reported following laterally based locked plating when considering geriatric patients alongside a younger patient population. However, by combining patient populations, and thus overlooking the age related comorbidities and decreased biologic reserve inherent to these patients, the nonunion rate in this specific population may be considerably higher.

Despite the prevalence of the distal femur fracture in the geriatric population we lack adequate evidence on both local and systemic complications to appropriately set expectations for health care providers and patients. The purpose of this study was to quantify the rates of local and systemic complications, including nonunion, following laterally based locked plating of the low energy supracondylar femur fracture in a geriatric population.

* Correspondence to: Department of Orthopaedic Surgery, Chief, Division of Orthopaedic Trauma, University of Pittsburgh Medical Center, Kaufmann Building, Suite 911, 3471 Fifth Avenue, Pittsburgh, PA 15213, United States.

*E-mail addresses:* gelemoloney@gmail.com (G.B. Moloney), pantj@upmc.edu (T. Pan), vaneckcf@upmc.edu (C.F. Van Eck), Patel.Devan@medstudent.pitt.edu (D. Patel), tarkinis@upmc.edu (I. Tarkin).

http://dx.doi.org/10.1016/j.injury.2016.05.024
0020-1383/

## Materials and methods

After Institutional Review Board approval, a retrospective cohort study of patients admitted to three affiliated hospitals within a large health care network over a ten-year period (July 2004–March 2014) was conducted. We searched for CPT codes 27507 (open treatment of femur fracture with plates and screws), 27511 (open treatment of condylar femur fracture), 27513 (open treatment condylar fracture with shaft extension), 27514 (open treatment femur, distal end), and 27472 (fixation nonunion or malunion of femur with graft).

Inclusion criteria included age greater than 60 years old, treatment of an AO/OTA 33 fracture with a laterally based periarticular locking plate, and a low energy mechanism of injury. Patients with less than one year of clinical and radiographic follow up were excluded from evaluation of fracture union. Patients who presented initially to our institution with a nonunion were excluded. Patient charts and radiographs were reviewed. AO/OTA classification [9] and presence or absence of a TKA were determined based on radiographic review. Presence of open fracture was determined based on the operative note. Demographic data collected included age, gender, body mass index (BMI), and smoking status.

One hundred and seventy six patients met the inclusion criteria. The average age of patients was 78 ± 9.5 years with a range of 60–99. One hundred and forty six patients were female (83%). The average BMI was 31 ± 9 with a range of 15–68. Forty two percent of patients (75/176) were obese with a BMI of 30 or greater. Twenty patients (11%) were current tobacco users. Sixty seven patients (38%) were diabetic.

There were 99 living patients who had a minimum of one year follow up. Follow up in this group ranged from one to 10 years and averaged 34 months. Evaluation the rate of nonunion and factors associated with nonunion was based on this cohort. One hundred and forty three out of 176 patients (81%) were either deceased at one year or had adequate follow up to evaluate for union.

The AO/OTA classification was as follows: 33A1–84 (48%), 33A2–32 (18%), 33A3–17 (9%), 33B1–3 (2%), 33C1–12 (7%), 33C2–21 (12%), 33C3–7 (4%). Seventy-two fractures (41%) were periprosthetic above a total knee arthroplasty. There were 25 open injuries, accounting for 14% of fractures.

Additionally, patient comorbidities present at the time of injury were collected from the electronic medical record to allow calculation of the Charlson Comorbidity Index (CCI) [10] and age-adjusted CCI [11]. The CCI is calculated by assigning one point each to 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 are assigned to hemiplegia, moderate to severe renal disease, complicated diabetes, malignancy within five years of diagnosis, leukemia, or lymphoma. Three points are assigned for moderate to severe liver disease, and six points each are assigned to AIDS (not HIV) and metastatic solid tumor [10]. To calculate age adjusted CCI one additional point is added to the CCI for each decade after the age of 50 years [11].

Date of death was extracted from the publicly available Social Security Death Index (SSDI). Length of hospital stay, delay from admission to surgery, and post hospital disposition (home or skilled nursing facility) were noted.

Complications during the post operative period including deep vein thrombosis (DVT), pulmonary embolism (PE), pneumonia, respiratory insufficiency, urinary tract infection (UTI), acute kidney injury (AKI), myocardial infarction (MI), congestive heart failure (CHF), and gastrointestinal bleed (GIB) were extracted from the electronic medical record. Presence of surgical site infection was noted.

Nonunion was defined as a fracture requiring a reoperation to promote union or treat a symptomatic nonunion. This included conventional nonunion surgery as well as conversion to distal femoral replacement.

### *Statistics*

Descriptive statistics including mean, range, standard deviation and frequency were calculated for all recorded variables. To identify predictors of 1-year mortality, an independent samples *t*-test was used to determine if there was a difference between those subjects who experienced death within 1 year of injury and those who did not for continuous variables including age, BMI, delay to surgical intervention, Charlson Comorbidity Index and age adjusted Charlson Comorbidity Index. The Phi coefficient was used to determine the relationship between 1-year mortality and the following potential risk factors: tobacco use, open nature of the fracture, periprosthetic fracture; and a past medical history of myocardial infarction (MI), congestive heart failure (CHF), peripheral artery disease (PAD), stroke (CVA), dementia, chronic lung disease, connective tissue disease, peptic ulcer disease, mild or moderate/severe liver disease, uncomplicated or complicated diabetes mellitus (DM), hemiplegia, renal disease, cancer with or without metastases, leukemia, lymphoma and AIDS.

Patients with a minimum of one-year follow up were included for analysis of nonunion.

To identify predictors of nonunion, an independent samples *t*-test was used to determine the difference between subjects who went on to union versus those who were diagnosed with nonunion for age, BMI, delay to surgical intervention, CCI and age adjusted CCI. Chi square testing was used to determine the significance of open fracture, surgical site infection, metaphyseal comminution, diabetes, presence of TKA, and tobacco, on development of nonunion.

## Results

### *Mortality*

There were 176 patients included in mortality analysis. The 30 day, 90 day, six month, and one year mortality were 6% (11 patients), 11% (20 patients), 19% (34 patients), and 25% (44 patients) respectively.

When further subdivided by age, the one year mortality was 11% (5/46) for patients aged 60–69, 17% (8/47) for patients aged 70–79, and 33% (31/83) for patients aged over 80. The one year mortality for patients over 80 was significantly higher ($p = 0.01$) than that for patients aged 60–69 or 70–79.

Statistically significant predictors of one-year mortality included older age ($82 \pm 9$ vs $76 \pm 9$, $p < 0.001$), increased CCI ($4.5 \pm 2.5$ vs. $3.3 \pm 2.1$, $p < 0.02$), and increased age adjusted CCI ($7.2 \pm 2.3$ vs. $5.4 \pm 2.2$, $p < 0.001$). Further investigation using Phi analysis revealed CHF, cerebrovascular accident, and mild to moderate liver disease were significant predictors of one-year mortality ($p < 0.05$). Increased BMI was not a risk factor for increased one year mortality. OTA fracture classification and presence or absence of TKA did not correlate with mortality.

### *Delay to surgery and mortality*

There were 40 patients operated on more than two days after presentation to our institution. There was no difference in the CCI of patients operated on before two days and after two days (3.5 vs. 3.3, $p = 0.5$). Fifteen of those 40 (37.5%) were deceased at one year