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Original Article

Predictors of early failure in young patients with displaced femoral neck fractures

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ABSTRACT

Introduction: This study compares early failure rates of sliding hip screw (SHS) and cannulated screw (CS) constructs in young patients.
Methods: Patients <60 years of age, with displaced femoral neck fractures treated with CS or SHS fixation were included. Primary outcome was failure within 6 months.
Results: One patient (3%) with SHS fixation and 6 patients (21%) with CS fixation failed within 6 months ($P = 0.04$). Regression analysis demonstrated type of fixation ($P = 0.005$) and reduction quality ($P = 0.04$) are independent predictors of early failure.
Conclusions: SHS constructs demonstrate a significantly lower short-term failure rate than CS constructs.

1. Introduction

Displaced femoral neck fractures in the young and active population are a relatively rare but potentially devastating injury. Treatment typically involves open or closed reduction and internal fixation with either cannulated screws (CS) or a fixed-angle sliding hip screw (SHS). Reconstruction with total hip arthroplasty is increasingly advocated as the definitive primary treatment in the elderly who sustain displaced femoral neck fractures but is far less desirable and often contra-indicated in a young active patient due to the significant demands of this population and concerns for implant longevity. The published results of fixation of displaced femoral neck fractures in the "younger population" (<60 years of age) are mixed.[1–10] Complication rates including loss of fixation, nonunion, and avascular necrosis (AVN) of the femoral head remain high; ranging from 10 to 45% regardless of fixation method.[9,11]

Currently, there is no clear difference in the literature with regards to the clinical results of patients treated with CS and SHS fixation for displaced femoral neck fractures.[9,11–13] Biomechanical analysis has indicated that fixed-angle sliding hip screw constructs are stronger than cannulated

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lag screws, especially in the higher energy, vertically oriented femoral neck fractures.[14,15] However, there is limited clinical evidence to suggest superiority of either implant in terms of AVN, nonunion or need for revision surgery. Furthermore, few series have reported on early (prior to 6 months) loss of fixation in young patients with displaced femoral neck fractures.[5]

The primary aim of this study is to compare the rate of loss of fixation in younger patients with displaced intracapsular femoral neck fractures treated with either SHS or CS constructs. The secondary aim is to identify risk factors associated with either early or late failure of fixation, AVN or nonunion in this patient population.

2. Materials and methods

We performed a retrospective review of a prospectively enrolled trauma database at three American College of Surgeons Level One Trauma Centers from January, 2000 through December, 2010. Institutional review board approval was obtained at all institutions prior to initiating the study. Patients included were skeletally mature, less than 60 years of age, and had sustained a displaced femoral neck fracture (OTA 31.B2/31.B3) and were treated with either CS or SHS fixation.[16] Additionally, only patients with at least 6 months of follow-up were studied. The primary outcome measure was the identification of early failures, defined as the need to return to the OR for revision surgery within 6 months from the time of injury. Additional outcomes included nonunion and avascular necrosis (AVN).

All radiographs were reviewed and classified as displaced intracapsular femoral neck fractures (AO/OTA classification 31.B2 or 31.B3) by a single surgeon (SG). Any patient with a fracture involving either trochanter or extending beyond the intertrochanteric line was excluded. The decision to perform a closed or open reduction, with or without a capsulotomy, was made at the time of surgery by the treating surgeon. All CS fixations were performed with either 6.5 mm or 7.3 mm cannulated partially threaded cancellous screws (Synthes. West Chester, PA) and all SHS constructs utilized the Dynamic Hip Screw System (Synthes. West Chester, PA). CS fixation included three partially threaded cancellous screws, placed in parallel, in an inverted triangle configuration. Screw and thread length was chosen based on fracture characteristics to ensure no threads traversed the fracture. SHS constructs were performed according to the manufacture's technique guide. Our standard surgical practice is to obtain a combined tip-apex distance (TAD) of less than 25 mm.[17]

The quality of reduction for all patients and the tip-apex distance (TAD) in the SHS patients were evaluated by a single surgeon (SG). All early failures in the CS group were classified by the Pauwels' classification system.[18] The quality of the final fracture reduction was rated on the basis of maximal residual displacement or angulation on any radiographic view on the first post-operative radiograph as described by Haidukewych et al. Reductions were rated as excellent (<2 mm displacement and/or <5 degrees of angulation), good (2–5 mm displacement and/or 5–10 degrees of angulation), fair (5–10 mm displacement and/or 10–20 degrees of angulation) or poor (>10 mm displacement and/or >20 degrees of angulation).[7] TAD was calculated as the sum of the distance from the tip of the lag screw to the apex of the femoral head on the AP and lateral radiographs as described by Baumgaertner et al.[17]

The primary outcome measure, early failure, was defined as loss of reduction requiring a return to the operating room within 6 months of the index procedure. Secondary outcomes included nonunion; defined clinically by pain and radiographically by the lack of bony healing at the fracture site, and symptomatic AVN of the femoral head requiring intervention. Baseline patient demographics were collected including age, gender, mechanism of injury and comorbidities (Table 1). The patient population in this series was relatively healthy given the young age and there were few comorbidities documented in the cohort. We identified and searched for specific comorbidities based on their presumed negative influence on bone healing; end-stage renal disease (ESRD), diabetes mellitus (DM), steroid use, alcohol abuse and smoking. Mechanisms of injury were broadly classified as fall, motor vehicle crash (MVC), sports related, and other [seizure (SZ), gunshot (GSW)].

Two-tailed Fisher Exact test was used to compare independent outcome variables. Pearson's Chi-square test was used to compare means of groups. Multivariate logistic regression analysis was performed to control for possible confounding covariates. Kaplan–Meier curve was constructed

Table 1 – Demographics data for fixation types for treating displaced femoral neck fractures.

Variable	Total (N = 69)	SHS (N = 40)	CS (N = 29)	P value
Age, years, mean ± SD	42.9 ± 12.5	42.4 ± 11.8	43.7 ± 13.5	0.68
Gender				
Male	38 (55%)	21 (53%)	17 (59%)	0.63
Female	31 (45%)	19 (47%)	12 (41%)	
Diabetes	2 (3%)	1 (3%)	1 (3%)	1.00
Alcohol Abuse	4 (6%)	2 (5%)	2 (7%)	1.00
Smoking	9 (13%)	3 (8%)	6 (21%)	0.15
ESRD	2 (3%)	2 (5%)	0 (0%)	0.51
Steroids	4 (6%)	3 (8%)	1 (3%)	0.63
Initial post-op reduction[a]				
Excellent	20 (32%)	12 (34%)	8 (29%)	0.60
Good	34 (54%)	17 (49%)	17 (61%)	
Fair	9 (14%)	6 (17%)	3 (11%)	
Mechanism of injury				
MVC	9 (13%)	5 (13%)	4 (13%)	0.65
Fall	42 (61%)	23 (58%)	19 (66%)	
Sports related	12 (17%)	9 (23%)	3 (10%)	
Other (GSW, SZ)	6 (9%)	3 (8%)	3 (10%)	
Follow-up, mos, median (IQR)	18 (11–30)	15 (11–32)	25 (11–35)	0.45
Capsulotomy	13 (19%)	6 (15%)	7 (24%)	0.37
Tip-apex distance, cm, median (IQR)[a]	–	21.4 (17–24.25)	–	–

ESRD, end-stage renal disease; DHS, dynamic hip screw; CS, cannulated screw; MVC, motor vehicle collision; GSW, gunshot wound; SZ, seizure; IQR, interquartile range; AVN, avascular necrosis.
[a] Missing information from X-rays (n = 6).