

Clinical and Radiographic Outcomes for Femoral Neck Fracture Fixation with Femoral Neck System versus Multiple Cannulated Screws

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INTRODUCTION:

Despite biomechanical evidence of non-inferiority there are few studies in the orthopaedic surgery literature that examine clinical outcomes for femoral neck system (FNS) fixation of femoral neck fractures. This retrospective study suggests non-inferiority for femoral neck fixation with an anti-rotation screw, cylindrical bolt, and lateral plate with locking screw FNS versus multiple cannulated screws (MCS). Primary outcomes for this study include nonunion, avascular necrosis, screw cut out, and reoperation rate.

METHODS:

Retrospective comparison examining outcomes for femoral neck fracture fixation with FNS versus MCS using electronic medical record search for patients 18 years or older whom underwent surgery between March 01, 2018 to September 01, 2021 by the on call orthopedic surgeon at a Level 1 Trauma Center. Two reviewers examined radiographic and clinical data reaching consensus. Patients were called via telephone to complete Short Form 12-item (SF-12) surveys with consent. Survey completion rate was 22% (21/88). Twenty one FNS and 67 MCS patients met inclusion criteria. Average age was 77 years for MCS and 63 years for FNS ($p=0.0065$). Three (14.29%) FNS patients had history of alcohol abuse versus 0 in MCS cohort ($p=0.0121$). There were no significant differences in functional status ($p=0.2543$) or any other comorbidities between the groups. Table 1 describes patient demographics and comorbidities. Table 2 describes mechanism of injury, location, and Pauwels classification. Average follow up was 173.50 (MCS) and 169.20 (FNS) days ($p=0.7688$). Sub-analysis of patients 60 years or older included 12 FNS and 61 MCS patients. One FNS patient was lost to follow up after 41 days and was not included for analysis. Average age was 80 years for MCS and 78 for FNS ($p=0.6993$). Sub-analysis cohorts were similar in demographics and medical comorbidities.

RESULTS:

Initial injury for the MCS group was 23.88% (16/67) non-displaced, 73.13% (49/67) valgus impacted, 1.49% (1/67) valgus and externally rotated (ER), and 1.49% (1/67) displaced. For FNS group 28.57% (6/21) non-displaced, 42.86% (9/21) valgus impacted, 4.76% (1/21) valgus and ER, and 23.81% (5/21) displaced. There was significant difference in surgical time with 47.81 (MCS) and 89.71 minutes (FNS) ($p<0.0001$). Urinary tract infection (UTI) ($p=0.0528$), sepsis ($p=0.0549$), and surgical site infection (SSI) ($p=0.0549$) approached significance. Rate of UTI was 4.48% (3/67) for MCS and 19.05% (4/21) for FNS. Rate of SSI 9.52% (2/21) FNS and 0 for MCS. For sepsis 9.52% (2/21) FNS and 0 for MCS. Rate of any complication was 29.85% (20/67) MCS and 52.38% (11/21) for FNS ($p=0.0711$). Six (8.96%) MCS patients returned to OR compared to 4 (19.05%) FNS ($p=0.2414$). Table 3 summarizes surgical outcomes. SF-12 physical scores were not different with 36.83 (MCS) and 40.57 (FNS) ($p=0.7539$). There was also no difference in SF-12 mental scores with 47.2 (MCS) and 47.89 (FNS) ($p=0.8932$). Table 4 describes intraoperative and postoperative radiographic changes. There was no difference in intraoperative reduction between groups ($p=0.1707$) or postoperative change in varus or shortening ($p=0.8041$). Two (2.99%) MCS patients went to nonunion versus 4 (19.05%) FNS ($p=0.027$). Average age for FNS nonunion patients was 44.5 years. Injuries were 75% (3/4) displaced and 25% (1/4) nondisplaced for FNS. Average age for MCS nonunion patients was 69 years and injuries were 50% (1/2) displaced and 50% (1/2) nondisplaced.

Sub-analysis of patients 60 years or older showed significant difference in surgical time with 45.36 minutes (MCS) versus 59.75 minutes (FNS) ($p=0.0006$). Length of stay was significantly different with 6.72 days (MCS) compared to 3.92 days (FNS) ($p=0.0336$). There was no difference in SSI ($p>0.9999$), nonunion ($p>0.9999$), or any complication ($p=0.7404$). Average follow up was 145 days (FNS) and 170 days (MCS) ($p=0.6041$). SF-12 scores were not significantly different between groups with physical component scores of 36.32 (MCS) and 46.72 (FNS) ($p=0.3516$) and mental component scores of 45.46 (MCS) and 60.56 (FNS) ($p=0.1319$). There was no difference in postoperative avascular necrosis (AVN) ($p=0.8716$), screw cutout ($p=0.6346$), fixation failure ($p=0.6552$), or change in varus ($p=0.9250$) or shortening ($p=0.8381$) on follow up. There was no significant difference in revision rate with 11.47% (7/61) for MCS and 8.33% (1/12) for FNS ($p=0.8855$).

DISCUSSION AND CONCLUSION:

This retrospective comparison study demonstrated non-inferiority of femoral neck fracture fixation FNS versus MCS. Care should be taken with respect to injury displacement and patient comorbidities when determining fixation method given longer surgical times with FNS and risk for nonunion.

	MCS	FNS	p-value
Male n (%)	18 (26.9)	6 (28.6)	>0.9999
Female n (%)	49 (73.1)	15 (71.4)	>0.9999
White n (%)	62 (92.6)	17 (81)	0.1037
Black n (%)	1 (1.5)	0 (0)	
Hispanic n (%)	1 (1.5)	1 (4.8)	
Asian n (%)	2 (3)	0 (0)	
Other n (%)	1 (1.5)	3 (14.3)	
Independent function n (%)	47 (70.2)	18 (85.7)	0.2543
Dependent function n (%)	20 (29.9)	3 (14.3)	
Diabetes n (%)	16 (23.9)	1 (4.8)	0.0619
Alcohol abuse n (%)	0 (0)	3 (14.3)	0.0121
Steroids use n (%)	3 (4.5)	2 (9.5)	0.5891
Smoking history n (%)	31 (46.3)	9 (42.9)	0.8076
COPD n (%)	11 (16.42)	0 (0.00)	0.0396
CHF n (%)	4 (6)	0 (0.00)	0.5686
HTN n (%)	44 (65.7)	11 (52.4)	0.3084
CKD n (%)	2 (3)	0 (0.00)	>0.9999
Diabysis n (%)	0 (0.00)	0 (0.00)	>0.9999

Table 1: patient demographics and comorbidities. SD: standard deviation.

		MCS		FNS	
		n	Percent	n	Percent
Mechanism of injury	GLF	54	80.60%	15	71.43%
	Fall from bed	3	4.48%	0	0.00%
	Attrumatic	4	5.97%	1	4.76%
	Fall from steps	3	4.48%	1	4.76%
	MVA	2	2.99%	3	14.29%
	Fall from height	1	1.49%	1	4.76%
Location	Basement	0	0%	3	14.3%
	Transcortical	18	26.9%	5	23.8%
	Subcortical	49	73.1%	13	61.9%
Fracture classification	Class 1	49	73.1%	12	57.1%
	Class 2	13	19.4%	2	9.5%
	Class 3	5	7.5%	7	33.3%

Table 2: mechanism of injury by group. GLF: ground level fall, MVA: motor vehicle accident.

	MCS	FNS	p-value
Mortality n (%)	1 (1.5)	0 (0.00)	>0.9999
Length of stay in days Mean (SD)	6.9 (5.3)	8 (11.8)	0.3889
Wound dehiscence n (%)	0 (0.00)	0 (0.00)	>0.9999
SSI n (%)	0 (0.00)	2 (9.5)	0.0549
Implant failure n (%)	0 (0.00)	1 (6.67)	0.1875
Pneumonia n (%)	2 (3)	0 (0.00)	>0.9999
Unplanned intubation n (%)	0 (0.00)	0 (0.00)	>0.9999
Screw cutout n (%)	1 (1.54)	0 (0.00)	>0.9999
AVN n (%)	4 (6.15)	1 (6.67)	>0.9999
DVT n (%)	2 (3)	0 (0.00)	>0.9999
PE n (%)	1 (1.5)	0 (0.00)	>0.9999
CIT n (%)	3 (4.5)	4 (19.1)	0.0528
Blood transfusion n (%)	13 (19.4)	7 (33.3)	0.2337
Sepsis n (%)	0 (0.00)	2 (9.5)	0.0549
Septic shock n (%)	0 (0.00)	0 (0.00)	>0.9999

Table 3: operative time and surgical outcomes

	MCS	FNS	p-value	
Intraoperative Reductive	Anastomosis n (%)	14 (20.9)	6 (28.6)	0.1707
	Valves Inspected n (%)	30 (74.6)	12 (57.1)	
	Clot < 2 mm n (%)	3 (4.3)	2 (9.5)	
Postoperative Change	Fail-post > 2mm n (%)	0 (0)	1 (4.8)	0.8041
	Unchanged n (%)	39 (58.2)	15 (71.4)	
	Yes n (%)	2 (3)	0 (0)	
	Shortening n (%)	8 (11.9)	2 (9.5)	
Valves Assessed	> 2* n (%)	48 (71.6)	17 (81)	0.6835
	> 2* n (%)	3 (4.5)	2 (9.5)	
	> 2** n (%)	6 (9)	1 (4.8)	
Shortening Assessed	> 2* n (%)	42 (62.7)	15 (71.4)	0.7392
	0* to 10* n (%)	9 (13.4)	2 (9.5)	
	> 10* n (%)	6 (9)	3 (14.3)	

Table 4: intraoperative and postoperative radiographic changes