

The Number of Cannulated Screws in the Distal Block of a Later Condylar Plate Does Not Change the Strain at a Distal Femur Fracture Site: A Finite Element Study with Validation

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PURPOSE: To determine whether there is a difference in interfragmentary strain between having cannulated or solid screws in the distal block of lateral condylar plates (LCPs) when fixing distal femur fractures.

METHODS: Finite element models (FEMs) were created and validated with synthetic femur biomechanical testing, loaded with body weight (80 kg or 784 N) axially at the femoral head. In both models, a 20 mm gap in the distal femoral metaphysis was created, simulating a comminuted fracture. FEM used virtual models of synthetic femur, LCP, and screws. Two simulations were created: cannulated screws and solid screws in the bone block distal to the fracture gap. Two practicing orthopedic trauma surgeons approved the placement of the LCP and screws. The femoral condyles were fixed and vertical axial force was applied. For the synthetic femur validation n=5 samples each for cannulated and solid groups were implanted by an orthopedic surgeon. 3D printed guides were used to position implants consistently to FEM. Models were loaded axially using a servohydraulic load-cell. For all scenarios, the strain measurements were taken at 4 equidistant points along the fracture site. Strains were averaged for statistical analysis. A one-sample t-test was used to determine whether the FEM strain matched the validation. A two-sample t-test was used to compare the validation cannulated screw trials with the solid screw trials.

RESULTS: A two-sample t-test, there was no significant difference between interfragmentary fracture site strain between cannulated and solid screw validation scenarios. A one-sample t-test, there was no significant difference in each of the trials with their respective finite element analyses for cannulated screw (p=0.076) and solid screw (p=0.25) scenarios. Interfragmentary strains for each scenario were presented descriptively (Table 1).

DISCUSSION: No statistically significant difference was found between cannulated and solid screws in the distal block of LCPs. Strains were within range of previously published strains for comminuted fracture gap models.¹⁻⁴

SIGNIFICANCE/ CLINICAL RELEVANCE: Surgeon use of cannulated or solid screws in the distal block of a lateral condylar plate for supracondylar femur fracture fixation does not appear to effect fracture site interfragmentary strain, a key factor in fracture healing.

IMAGES AND TABLES:

Table 1: Spectrum of interfragmentary strains with averages for each trial and finite element analysis for cannulated screw scenarios and solid screw scenarios.

Cannulated Screws	Interfragmentary Strain Measurements (Lateral to Medial)				Average
	1	2	3	4	
Synthetic Femur 1	0.25%	4.25%	7.03%	8.44%	5.00%
Synthetic Femur 2	-10.37%	1.24%	5.34%	10.64%	1.72%
Synthetic Femur 3	1.08%	1.90%	2.26%	9.30%	3.64%
Synthetic Femur 4	0.99%	2.02%	3.09%	4.25%	2.59%
Synthetic Femur 5	1.29%	2.88%	3.96%	8.63%	4.19%
Finite Element Analysis	4.61%	4.82%	4.95%	4.87%	4.81%

Solid Screws	Interfragmentary Strain Measurements (Lateral to Medial)				Average
	1	2	3	4	
Synthetic Femur 1	1.46%	1.55%	2.45%	5.52%	2.74%
Synthetic Femur 2	-6.66%	-0.64%	2.06%	3.50%	-0.42%
Synthetic Femur 3	0.73%	2.51%	5.00%	6.44%	3.67%
Synthetic Femur 4	0.17%	0.38%	0.38%	5.2%	1.54%
Synthetic Femur 5	6.65%	6.66%	11.26%	12.13%	9.13%
Finite Element Analysis	1.05	1.13	1.20	1.25	1.16%

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