Tip-Apex Distance (TAD) <10 mm and Apex-to-Center <4 mm as a Risk Factor for Cut-Throughs in Intertrochanteric Hip Fracture Fixation

Arielle R. Levine, MS*; Trevan K. Klug, BS; Matthew Riedel, MD; Michael P. Leslie, DO*

Purpose: TAD >25 mm is a risk factor for cut-out in intramedullary nailing. Less attention has been given to the risk factors for central cut-through and the possible outcomes of TAD <10 mm. Furthermore, the risk of cut-through depending on minimum depth on either anteroposterior (AP) or lateral views has not been explored.

Methods: Retrospective review of 2128 intertrochanteric hip fractures admitted to a single center from 2014 to 2023 was conducted. Variables included patient and operative characteristics, fracture fixation device, fracture type based on OTA/AO 2018 classification, TAD, and neck-shaft angle; radiographic and clinical outcomes were assessed.

Results: TAD <10 mm carried a significantly higher risk for lag screw and blade cut-through. Cut-through risk increased significantly when either AP or lateral apex-to-center distance was <4 mm, including when controlling for fracture reduction quality for a cohort including dynamic hip screws (DHS), lag screws, and blades. Cut-out complications in this cohort only occurred with a TAD >10 mm and was significantly more likely to occur with TAD >25 mm, similar to prior studies.

Conclusion: TAD optimization between 10 to 25 mm reduces risk of both cut-out and cut-through and maintenance of 4 mm of distance between apex-to-center distance may help decrease the risk of cut-through complications.

Total Constructs w/ Sliding Hip Screws, Lag Screws or Blades w/o Cut-Out or Cut-Through: N = 2098 **Able to Measure TAD: N = 1963** **Able to Measure Neck-Shaft Angle: N = 2,052**		**Total Cut-Outs: N = 31** **(Constructs unable to measure TAD: N = 2)**	**Total Cut-Throughs: N = 19**	**Risk Ratio (95% CI) / p-value**
Average TAD (SD)	18.9 (6.5)	27.2 (7.4)	15.5 (7.1)	No Complications vs. Cut-Outs: $7.0x10^{-12}$*** No Complications vs. Cut-Throughs: 0.024*** Cut-Outs vs. Cut-Throughs: $1.8x10^{-6}$***
Average AP Apex-Center (SD)	9.0 mm (3.3)	13.1 mm (4.3)	7.3 mm (3.3)	No Complications vs. Cut-Outs: $9.0x10^{-11}$*** No Complications vs. Cut-Throughs: 0.0302*** Cut-Outs vs. Cut-Throughs: $1x10^{-5}$***
Average Lateral Apex-Center (SD)	9.9 mm (4.0)	14.2 mm (4.6)	8.2 mm (4.5)	No Complications vs. Cut-Outs: $1.5x10^{-8}$*** No Complications vs. Cut-Throughs: 0.065 Cut-Outs vs. Cut-Throughs: $6.1x10^{-5}$***
Average Neck-Shaft Angle (SD)	128.8° (4.7)	129.2° (5.6)	128.0° (5.1)	No Complications vs. Cut-Outs: 0.61 No Complications vs. Cut-Throughs: 0.48 Cut-Outs vs. Cut-Throughs: 0.45
Constructs w/ TAD <10	94 40 Blade 54 Screw	0 0 Blades 0 Screws	4 3 Blades 1 Screws	No Complications vs. Cut-Outs: 0 (0 – NaN), p = 0.1 No Complications vs. Cut Through: 5 (1.66 – 15), p = 0.014*** Blades: 4.95 (1.33 – 18.5), p = 0.038*** Screws: 3.32 (0.406 – 27.1), p = 0.29 Blades vs. Screws: 3.84 (0.414 – 35.6), p=0.32
Constructs w/ TAD 10-25	1578 490 Blades 1088 Screws	12 4 Blades 8 Screws	13 7 Blades 6 Screws	N/A
Constructs w/ TAD >25	241 44 Blades 197 Screws	17 5 Blades 12 Screws	2 1 Screws 1 Blades	No Complications vs. Cut-Outs: 8.73 (4.22 – 18.1), p<0.0001*** Blades: 19.7 (5.09 – 76.5), p<0.0001*** Screws: 6.45 (2.7 – 15.4), p<0.0001*** No Complications vs. Cut Through: 1.01 (0.229 – 4.44), p = 1 Blades: 1.58 (0.198 0 12.5), p = 0.5 Screws: 0.921 (0.111 – 7.61), p = 1
Constructs w/ AP or Lateral Apex-Center <4 mm	93 38 Blades 45 Screws	0 0 Blades 0 Screws	4 3 Blades 1 Screws	No Complications vs. Cut-Outs: 0 (0 – NaN) p = 1 No Complications vs. Cut Through: 3.99 (1.38 – 11.5), p = 0.025*** Blades: 4.73 (1.3 – 17.2), p = 0.04*** Screws: 3.42 (0.428 – 27.3), p =0.28 Blades vs. Screws: 3.77 (0.406 – 34.9), p=0.32