

Prospective, Randomized Evaluation of Optimal Implant Position of Gamma3 and PFNA for the Treatment of AO/OTA 31-A2 Fractures: Is Central Positioning Always the Best?

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Background/Purpose: Parker et al have reported on lag screw positioning during dynamic hip screw (DHS) implantation in the treatment of proximal femur fractures. They found significant differences in screw cut-out when positioned superior on the AP radiograph and posterior on the lateral. Our goal was to determine ideal positioning of prospectively randomized screw or helical blade placement during intramedullary nail fixation of AO/OTA 31-A2 fractures, in order to minimize the reoperation rate.

Methods: A prospective, randomized controlled study was initiated for the treatment of AO/OTA 31-A2 fractures with either a third-generation Gamma nail (Gamma3, Stryker) or proximal femoral nail antirotation (PFNA, Synthes). 200 patients from 2007 to 2010 with an average age of 81.1 years were randomized in a 1:1 ratio. Intraoperative AP and lateral radiographs were reviewed to calculate Parker's ratio and tip-apex-distance (TAD). Incidences of reoperation were categorized based on Parker's ratios and TAD, and logistic regression and receiver operator characteristic (ROC) curves were used for predictive modeling of reoperation. Significant values were set at $P < 0.05$.

Results: 177 patients (Gamma3: 91; PFNA: 86) met all study criteria. Both implants showed a predilection for a central position on the AP radiograph with 83/91 (91.2%) for Gamma3 and 81/86 (94.2%) for the PFNA group. In the Gamma3 group, there were significantly higher reoperation rates for Parker's ratio values less than 34 (inferior position) on the AP radiograph compared to values between 34 and 66 (central position; $P = 0.035$); this was not seen in the PFNA group. There was a significant association between implant type and reoperation, with Gamma3 having 11/91 (12.1%) reoperations and PFNA having 0/86 (0%) reoperations ($P = 0.001$). Predictive modeling of reoperation for Gamma3 was maximized when both TAD and Parker's ratios from AP radiography were incorporated into the model. With Parker's ratios subdivided into thirds (0-33, 34-66, 67-100), TAD categorized as <20 and ≥ 20 generated an ROC curve with area under the curve (AUC) of 0.700 ($P = 0.032$) while TAD categorized as ≤ 25 and >25 generated an ROC curve with AUC of 0.612 ($P = 0.226$). Although a higher risk for reoperation in the Gamma3 group was evident in cases with a lower-third Parker's ratio, these criteria were not predictive of cut-out. There were no significant differences between the Gamma3 and PFNA in terms of Parker's ratios and TAD.

Conclusion: For the Gamma3 device, central position on AP radiographs resulted in significantly fewer reoperations compared to an inferior position. ROC analysis indicates that the combination of Parker's ratio and TAD is a significant predictor of reoperation rate in Gamma3. It also indicates that TAD <20 mm is a better predictor of reoperation compared to 25 mm. The same criteria predicted reoperation, but not cut-out. If using a Gamma3

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system it is important to achieve central positioning of the lag screw on the AP radiograph and TAD <20 mm to minimize the risk of reoperation. In this study the PFNA nail did not fail and was more tolerant of outliers of position.

Rates for reoperation and cut-out subdivided by Parker’s ratio for Gamma3 and PFNA: Inferior positioning on AP radiography had a significantly higher reoperation rate. P values, odds ratios, and 95% confidence intervals (CIs) could not be calculated for PFNA because the absence of complications resulted in indistinguishable groups.

Rates for Reoperation and Cut-Out Subdivided by Implant Type and Parker’s Ratio								
Implant Type	X-Ray View	Outcome	Parker’s Ratio			P Value*	Odds Ratio*	95% CI*
			<33	34-66	67-100			
Gamma3	AP	Reoperation n/total (%)	3/8 (37.5)	8/83 (9.6)	0/0 (0)	0.035	5.63	1.13-28.04
		Cut-out n/total (%)	1/8 (12.5)	4/83 (4.8)	0/0 (0)	0.382	2.82	0.28-28.14
	Lateral	Reoperation n/total (%)	0/1 (0)	11/85 (12.9)	0/5 (0)	0.536	0.395	0.02-7.52
		Cut-out n/total (%)	0/1 (0)	5/85 (5.9)	0/5 (0)	0.683	0.424	0.01-25.92
PFNA	AP	Reoperation n/total (%)	0/6 (0)	0/80 (0)	0/0 (0)	N/A	N/A	N/A
		Cut-out n/total (%)	0/6 (0)	0/80 (0)	0/0 (0)	N/A	N/A	N/A
	Lateral	Reoperation n/total (%)	0/0 (0)	0/81 (0)	0/5 (0)	N/A	N/A	N/A
		Cut-out n/total (%)	0/0 (0)	0/81 (0)	0/5 (0)	N/A	N/A	N/A

Gamma3 = third-generation Gamma nail, PFNA = proximal femoral nail antirotation, N/A = not available. *Calculated using binary logistic regression.