Use of a Novel Augmented Reality Software to Assist in Cephalad Lag Screw Placement Into the Femoral Head for Cephalomedullary Nails

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Purpose: Our objective was to study the effect of a novel augmented reality software designed to aid in lag screw placement into the femoral head for cephalomedullary nails.

Methods: Between November 2017 and December 2020, 114 consecutive patients with a hip fracture that underwent repair with a cephalomedullary nail by one of two orthopaedic trauma surgeons at a single institution were reviewed. Fracture classifications included AO/OTA 31-A1, 31-A2, 31-A3, and 31-B3. The first 57 patients underwent fracture repair without the software (control), and the subsequent 57 patients underwent repair with use of the augmented reality software (AR). Tip-apex distance (TAD), distance to bone (DTB), and femoral head quadrant (AP: superior, center, inferior; lateral: anterior, center, posterior) were measured using standardized techniques. Independent sample t tests and $\chi 2$ tests of homogeneity were completed using IBM SPSS to compare measurements between these two cohorts.

Results: The mean TAD was lower for the AR versus control cohort (11.9 ± 4.3 vs 15.4 ± 3.8; $P<0.001$). The mean DTB was lower for the AR versus control cohort (5.1 ± 2.0 vs 6.7 ± 1.8, $P<0.001$). TAD <10 mm for AR versus control was 20 (35.1%) versus 3 (5.3%), $P<0.001$. TAD <15 mm for AR versus control was 25 (43.9%) versus 44 (77.2%). On the AP view, center position was achieved in 42.1% versus 7.0% of cases for the AR versus control cohorts, respectively. On the lateral view, center position was achieved in 37.4% versus 12.3% of cases for the AR versus control cohorts, respectively.

<div style="float:left">TECHNICAL TRICKS AND TIPS</div>

Conclusion: This study suggests that use of the novel augmented reality software for assistance in lag screw positioning within the femoral head improves overall TAD, DTB, and ability to achieve the center-center position.

Tip-Apex Distance in AR vs. Control Groups			
TAD	**Control** (N=57)	**AR** (N=57)	***p*-value**
<10.0 mm	3 (5.3%)	20 (35.1%)	0.000
10.0–14.9 mm	22 (38.6%)	24 (42.1%)	0.703
15.0–19.9 mm	27 (37.4%)	10 (17.5%)	0.001
20.0–24.9 mm	4 (7.0%)	3 (5.3%)	0.696
≥25.0 mm	1 (1.8%)	0 (0.0%)	0.315
Femoral Head Quadrant in AR vs. Control Groups			
Alignment	**Control** (N=57)	**AR** (N=57)	***p*-value**
Vertical Alignment			
Superior	2 (3.5%)	10 (17.5%)	0.015
Inferior	51 (89.5%)	23 (%)	0.000
Center	4 (7.0%)	24 (42.1%)	0.000
Rotational Alignment			
Anterior	18 (31.6%)	12 (21.1%)	0.202
Posterior	32 (56.1%)	18 (31.6%)	0.008
Center	7 (12.3%)	27 (37.4%)	0.000