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A Novel, Intramedullary Nail/Plate Construct Compared to Standard Dual-Plate Fixation of Intra-Articular C2.3 Distal Humerus Fractures

Introduction: The gold-standard treatment for intra-articular distal humerus fractures is dual-plate/column fixation. Optimal orientation is not established and without a superior method, we propose a novel intramedullary-plate load sharing design. We compared biomechanical properties of the novel implant to orthogonal dual-plating.
Methods: 10 fresh-frozen matched pairs of human cadaveric arms with no prior elbow pathology or surgery were used. Pairs were randomized into 2 groups: Dual-Plate or novel Nail/Plate. AO/ASIF type 13-C2.3 multi-fragmentary fractures with simulated metaphyseal comminution were created. Biomechanical testing included stiffness and load to failure in axial and coronal planes. Failure mechanisms were identified and reviewed by 3 consultant surgeons for decision on their management (revision vs. immobilization).
Results: During stiffness testing, 0 Nail/Plate instrumented specimens failed, compared to 2 Dual-Plate constructs. Nail/Plate coronal stiffness was comparable to Dual-Plate constructs (41.5 vs. 39.0 MPa, p=0.44). Dual-Plate constructs had greater axial stiffness than Nail/Plate (118.3vs. 95.6 MPa, p=0.02). Failure loads were comparable between Nail/Plate and Dual-Plate constructs (1,327.8 vs. 1,032.4 N, p=0.17). The most common overall mechanism of failure was fracture/osteotomy site posterolateral plate bending. Revision recommendation rate was comparable (Nail/Plate, 22.2% vs. Dual-Plate, 44.4%, p>0.05).
Discussion: The novel Nail/Plate construct demonstrated non-inferior coronal stiffness, despite producing lower axial stiffness than Dual-Plate constructs, potentially due to the load-sharing cross-locked design. Considering comparable biomechanical performance, our novel construct warrants further evaluation as an alternative to the gold-standard, dual-plate fixation method for intra-articular distal humerus fractures.

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