Paper - Basic Science

Paper Session: Biomechanics

Evaluation of Intramedullary Olecranon Screw Fixation for Simple Olecranon Fractures: A Biomechanical Study

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Purpose: Olecranon fractures are common orthopaedic injuries accounting for 82% of elbow fractures. There are many different fixation methods, including intramedullary (IM) olecranon screws and locking compression plates. The specific aim of this study was to biomechanically evaluate and compare the IM olecranon screw to locking compression plate fixation for OTA/AO 2UB1 olecranon fractures under cyclic full range of motion of the elbow.

Methods: Powered for significance, 24 matched paired elbows were tested. Each paired specimen was randomly assigned to either IM olecranon screw fixation or locking compression plate fixation and underwent 2 cyclic phases of testing. Part I tested the fixation construct pull-out strength by applying direct force to the proximal fragment by increasing force on the triceps and looking for fracture gap formation. Part II simulated rehabilitation range of motion performed with the forearm having increasing loads applied, again looking for fracture gap formation. The arm was cycled through a 135° arc of motion at 40°/sec using a servohydraulic testing system. For Part I, the proximal fragment was loaded by incrementally increasing load applied to the triceps from 22 N to 156 N with 500 cycles at each applied load. For Part II, a constant load of 4 N, 13 N, 22 N, and 44 N was applied to the forearm with 100 cycles at each applied load. Fracture gap displacement was measured to an accuracy of 0.001 mm using 2 differential variable reluctance transducers for each part.

Results: There was no significant difference in fracture gap formation between the IM olecranon screw and locking compression plate fixation during pull-out strength testing with triceps tendon loading; 22 N ($P = 0.710$), 67 N ($P = 0.570$), 111 N ($P = 0.186$), and 156 N ($P = 0.091$). Additionally, there was no significant difference in fracture gap formation between the IM olecranon screw and the locking compression plate during rehabilitation testing with cyclic forearm loading; 4 N ($P = 0.642$), 13 N ($P = 0.074$), 22 N ($P = 0.861$), and 44 N ($P = 0.673$). The institutional cost analysis showed the locking compression plate was 20 times more expensive than the IM olecranon screw.

Conclusion: The overall findings of this study illustrate that for OTA/AO 2UB1 olecranon fractures, a single 6.5-mm IM olecranon long screw fixation demonstrated similar fracture stability when compared to the locking compression plates for both pull-out strength and range of motion studies. Additionally, the IM olecranon screw construct has a lower profile and IM long screws are less expensive than plate fixation.