Dual-Plate Constructs Have Improved Biomechanical Properties for Humeral Diaphyseal Fractures Compared to Single-Plate Constructs

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Purpose: Single-plate constructs are the traditional fixation technique for mid-diaphyseal humerus fractures. Dual-plate constructs have been used as an alternative fixation method for advantages including less extensile dissection, provisional fixation for rotationally unstable fractures, and increased screw density. The study aim was to compare dual small and mini-fragment orthogonal plating with single small-fragment plating for biomechanical noninferiority using a cadaveric model.

Methods: Each specimen was randomized to one of 4 groups, stratified by CT-based bone mineral content (BMC). We compared 4 plating configurations: Group A, fixation with a single anterolateral 3.5-mm locking compression plate (LCP), and 3 different dual-plate constructs (Group B: 3.5-mm LCP and 2.7-mm LCP; Group C: 3.5-mm LCP and one-third tubular plate; and Group D: dual 2.7-mm LCP). A transverse osteotomy model with a 5-mm gap was created and specimens were plated with 8 cortices of fixation above and below the osteotomy. Axial, bending, and torsional stiffness were determined through non-destructive testing, followed by torsional load-to-failure testing (MTS 858 Bionix). One-way analysis of variance was used to evaluate differences between stiffness and failure testing of each construct.

Results: A total of 20 cadaveric specimens were tested. No significant differences were seen between the different groups for age (mean = 62.85 years [standard deviation (SD) = 14.54]; P = 0.189), sex (64% female; P = 0.890), or BMC (mean = 74.30 g [SD = 20.19]; P = 0.999). Dual-plate constructs demonstrated higher stiffness in axial compression, medial bending, and torsional testing compared to single-plate constructs (P = 0.003, P = 0.026, and P = 0.040, respectively). There was no significant difference between posterior bending stiffness and torsional load-to-failure between single and dual-plate constructs (P = 0.631 and P = 0.827, respectively).

Conclusion: This study is the first to examine the biomechanical differences of multiple single and dual-plate constructs for fixation of mid-diaphyseal humerus fractures using cadaveric models. These novel data support the hypothesis that dual-plate constructs have higher stiffness compared to single-plate constructs. Given increasing evidence to support early functional improvements with operative intervention for mid-diaphyseal humerus fractures, the results of this study provide further biomechanical evidence to guide operative decision- making and may be used to inform future clinical studies.