Construct Characteristics Predisposing to Nonunion After Locked Lateral Plating of Distal Femur Fractures

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Background/Purpose: Nonunion rates after lateral locked plating (LLP) of a distal femur fracture range from 0% to 21%. Previous studies have examined patient and injury parameters such as obesity, age, diabetes, fracture type, etc, as possible predictors of nonunion. We now seek to identify discrete construct characteristics related to construct stiffness that may be independent predictors of nonunion risk after LLP fixation of distal femur fractures.

Methods: This is a retrospective review of 271 distal femoral fractures treated with LLP at three Level I academic centers. Nonunion was defined as the occurrence of any secondary procedure to manage poor healing. Construct variables recorded were: (1) plate material, (2) plate length, (3) number of screws proximal to the fracture, (4) ratio of filled screw holes to total plate holes, (5) presence of a screw crossing the main fracture plane, and (6) an overall stiffness score (range, 0 [low stiffness] to 5 [high stiffness]) incorporating the above variables in an equally weighted manner. Stiffness score was calculated by awarding 1 point for each of the following: if the construct was stainless steel, if it had >4 screws proximally, if the plate was <10 holes in length, if the ratio of filled to unfilled holes was >0.65, and if a screw crossed the main fracture plane. Multivariable analysis was performed using logistic regression to control for confounding in order to identify independent risk factors for nonunion.

Results: The overall nonunion rate was 13.3% (n = 36). There was a significant association between plate material and nonunion with rates of 9.6% for titanium and 40.6% for stainless steel ($P < 0.001$). Fixation crossing the fracture was associated with a higher rate of nonunion but did not reach statistical significance ($P = 0.13$). No significant univariate differences with respect to number of proximal screws ($P = 0.34$), plate length ($P = 0.14$), or ratio of filled to total holes ($P = 0.56$) were observed between healed fractures and those with nonunion. Stiffness score did reach significance ($P = 0.025$) but likely reflects the overbearing effect of plate material. Results of the multivariate analysis confirm that the primary significant independent predictor of nonunion is use of stainless steel material showing an odds ratio >6 times higher for nonunion compared to titanium use (odds ratio = 6.4, 95% confidence interval: 2.8-14.7, $P < 0.001$).

Conclusion: When treating distal femur fractures with LLP, plate material has a highly significant and overbearing influence on the risk of nonunion independent of any other construct variable, including an overall stiffness score that weights suspect construct char-

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acteristics equally. Material is a highly dominant predictor and a significant risk factor for nonunion. Comparison of construct characteristics as contributors to stiffness and nonunion risk are not useful unless all constructs compared are of similar material. A stiffness score that incorporates plate material as an equally weighted variable as other construct characteristics may overestimate the relevance of the other variables.