Titanium vs. Stainless Steel Alloy Bridge Plates for Distal Femur Fractures: Does Callus Form Earlier with Titanium?

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INTRODUCTION:

The most commonly used anatomic plates for fracture fixation in the distal femur are made from stainless steel or titaniumalloys[JP1]. While surgeons can control the working length of the construct, the implant materials have different mechanical properties including modulus of elasticity and fatigue resistance to cyclic loading. While stainless steel constructs are stiffer and exhibit higher absolute load to failure, titanium implants are more flexible and durable to fatigue failure by cyclic loading. Perren's strain theory suggests that less rigidity may facilitate secondary bone healing. There has been little direct comparison of *in vivo* union rates between steel and titanium alloy implants used as bridge plates for metaphyseal distal femur fractures (OTA/AO 33-A and -C). We hypothesized that given similar plate and working lengths, callus would be visualized earlier in the postoperative course when titanium bridge plates were used compared with stainless steel.

METHODS:

A retrospective consecutive cohort study of AO/OTA 33-A and 33-C fracture patterns in patients over 18 years of age treated with a lateral bridge plate by a single fellowship-trained orthopaedic trauma surgeon from 2011-2020. The surgeon switched to titanium for all bridge plates at the midpoint of the series. Exclusion criteria were use of dual implants or lack of radiographic follow-up to union. A separate fellowship-trained orthopaedic trauma surgeon reviewed all anterior-posterior (AP) and lateral radiographs of 26 patients (13 stainless steel, 13 titanium) who sustained an OTA/AO 33-A or 33-C distal femur fracture. 6, 12, and 24-weeks (+/- 2 weeks) postprocedure radiographs were used to evaluate the modified radiographic union scale (mRUST). mRUST Scores were compared using two sample t-test statistical analysis.

RESULTS:

Statistically significant increased mRUST scores, indicating more callus formation, were seen at on 12-week radiographs (11.75 vs. 8.70, $p = 0.02$) when titanium bridge plates were used. There was no statistically significant difference in mRUST scores at 6 or 24-weeks; however, the 6-week scores with titanium plates were higher (10.6 vs. 8.78, $p = 0.09$) and approached statistical significance. The stainless steel group had 3 nonunions while the titanium group had 1.

DISCUSSION AND CONCLUSION:

Earlier callus formation and secondary bone healing was seen at 12-weeks after bridge plating AO/OTA 33-A and 33-C fractures with titanium versus stainless steel alloy lateral locking plates. The material properties of titanium alloy may promote earlier callus formation in the working length of the plate compared with stainless steel.