THE TITLE SHOULD BE IN ALL CAPITAL LETTERS AND AS CONCISE AS POSSIBLE

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INTRODUCTION: After a fracture, bones are often fixed with plate and screw constructs. Periprosthetic fracture at the end of the construct is a well-recognized complication and is thought be related to the contact behavior between the bone ends, the plate, and the screws. Locking screw constructs have been shown to have a greater periprosthetic fracture risk than conventional constructs.

RATIONALE: The purpose of the current study is to establish the biomechanical rationale for the increased risk of periprosthetic fracture associated with locking screw constructs over conventional screw constructs. This is important because the promise of locking plates to increase fixation in osteoporotic bone must be balanced with the potential complication of a periprosthetic fracture. An understanding of the biomechanical rationale for fracture may result in a potential solution to improve fixation in osteoporotic bone while minimizing complications. Our hypothesis was that the application of a conventional screw at the end of a locking screw construct (hybrid plating) leads to a decrease in contact stress at the interface between the plate and the bone.

MATERIAL & METHODS: A finite element study was performed to investigate a conventional screw construct, locking screw construct, and hybrid plating construct under normal, oblique, and shear loads. The models consisted of a bone block and a plate with two screws. A static load of 100N was applied at the plate end. Finite element analyses were performed on the three models using Abaqus 6.11 with the following combinations: (1) two conventional screws (2) two locking screws and (3) one conventional and one locking screw with the conventional screw located at the end of the plate. Each construct was evaluated with cancellous bone densities 0.08 g/cm³ and 0.16 g/cm³ to simulate osteoporotic bone. Contact surfaces at the plate-bone interface and screw-bone interface were evaluated.

RESULTS: Locking screw constructs experienced 62% higher plate-bone contact pressure than conventional screw constructs (Figure 1). Substitution of a conventional screw instead of a locking screw at the end of a locked construct reduces the contact pressure by 72%. It was also observed that the greater the bone density, the greater the effect that the construct type has. In other words, there was less of a difference between locking and conventional constructs in low density osteoporotic bone compared to higher density osteoporotic bone.

CONCLUSIONS: The clinical significance of this study is that it supports the placement of a conventional screw in the last hole of a locking screw construct to help prevent periprosthetic fracture.

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