Optimal Plate Position in Minimally Invasive Plate Osteosynthesis for Midshaft Clavicle Fractures: Simulation Using 3D-Printed Models of Actual Clinical Cases

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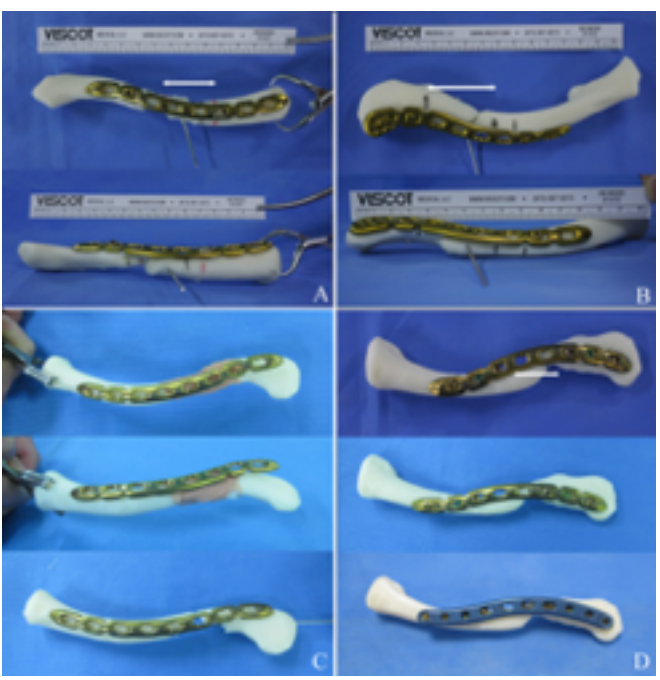
Purpose: This study evaluated the optimal anatomical locking plate position using 3-dimensional (3D)-printed models of the clavicle.

Methods: 3D models of the fractured clavicle were reproduced from 17 patients who underwent minimally invasive plate osteosynthesis (MIPO) procedures. The fracture location-the percentage of the distal fragment length compared to the entire clavicle-ranged from 30% to 44%. We evaluated 4 commercially available plate systems for position and fitting with the bone. After reducing the fracture on each 3D model, we determined the best plate-fitting system.

Results: All the 8-hole anatomical plates fitted well when the plate was positioned in the middle of the clavicle for fracture locations between 40% and 60% (Fig. 1). All 3 cases with a fracture location ≥40% were treated with the 8-hole anatomical plate, and the simulation study showed that these cases had an acceptable fit with the 8-hole anatomical plate and the lateral clavicle plate. Among 11 cases with a fracture location between 30% and 40%, only 4 cases had an acceptable fit with the 8-hole anatomical plate and the lateral plate, but the other 8 cases had an acceptable fit onto the clavicle with a reversed position of the anatomical plate or the lateral clavicle plate. In actual clinical practice, the 8-hole anatomical plate was used in 2 cases, a reversed position of the plate in 7 cases, and a lateral plate in 2 cases. The 8-hole anatomical plate was found to be unsuitable when the fracture location was <30%, in which case the lateral fragment was not enough for 3 screws to be fixed. In this case, only the lateral clavicle plate had an acceptable fit. The length of the lateral fragment when the fracture location was 30% equaled about 4.5 cm, which was the minimum length required to fix 3 bicortical screws.



Conclusion: Fitting the anatomical plate in MIPO for clavicle fractures depends on the fracture location. This can help surgeons determine the optimal plate for clavicle MIPO.

See the meeting app for complete listing of authors' disclosure information.