# Assessment of the Biomechanical Performance of 5 Plating Techniques in Fixation of Mandibular Subcondylar Fracture Using Finite Element Analysis

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**Purpose:** The aim of this study was to compare the performances of 5 plating techniques for fixation of unilateral mandibular subcondylar fracture.

**Materials and Methods:** Five titanium plating techniques for fixation of condylar fracture were analyzed using the finite element method. The modeled techniques were *1)* 1 straight plate, *2)* 2 parallel straight plates, *3)* 2 angulated straight plates, *4)* 1 trapezoidal plate, and *5)* 1 square plate. Three-dimensional models were generated using patient-specific geometry for the mandible obtained from a computerized tomographic image of a healthy living man. Plates were designed and combined with the mandible and analyzed under a 500-N load.

**Results:** The single straight plate presented the most inferior performance; it presented maximum displacement and strain on cortical bone. The trapezoidal plate induced the least amount of strain on cortical bone and was best at resisting displacement.

**Conclusion:** The trapezoidal plate is recommended for fixation of subcondylar fracture.

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There is accumulating evidence that open reduction and internal fixation (ORIF) is the treatment of choice for mandibular condyle fractures.[1-3] Important factors for the success or failure of ORIF are the design and material of the plates used to produce rigid fixation of fractured condyles. Biodegradable plates seem to be functionally unstable, whereas titanium plates are recommended for ORIF.[4] An issue that remains controversial is identifying the best design and configuration of titanium plates to maximize fixation stability.[5]

There is evidence that 1 plate is insufficiently stable; therefore, 2 plates should achieve stable fixation.[6-9] Furthermore, a nonparallel arrangement of the 2 plates has frequently been presumed to perform more favorably,[7] although some investigators have reported the opposite is true.[10] Recently, frame-like plates (square and trapezoid) were introduced and found to provide better stability than 2 straight plates.[11,12] However, some investigators disagree.[4] Therefore, further investigation must examine the mechanical performance and efficacy of various plating techniques.

Finite element analysis is a numerical technique that simulates the mechanical behaviors of loaded constructions. The technique has been used frequently in biomechanical studies to solve mechanical problems related to bone tissue and has proved beneficial in

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predicting bone mechanical response.[13] In this technique, a 3-dimensional (3D) model of the construction is discretized into a finite number of elements, resulting in a 3D mesh. The mechanical problem is defined by applying loads and constraints to the mesh and then solved using the appropriate mechanical theory.

In the present study, the finite element modeling technique was used to compare the rigidity of fixation, safety

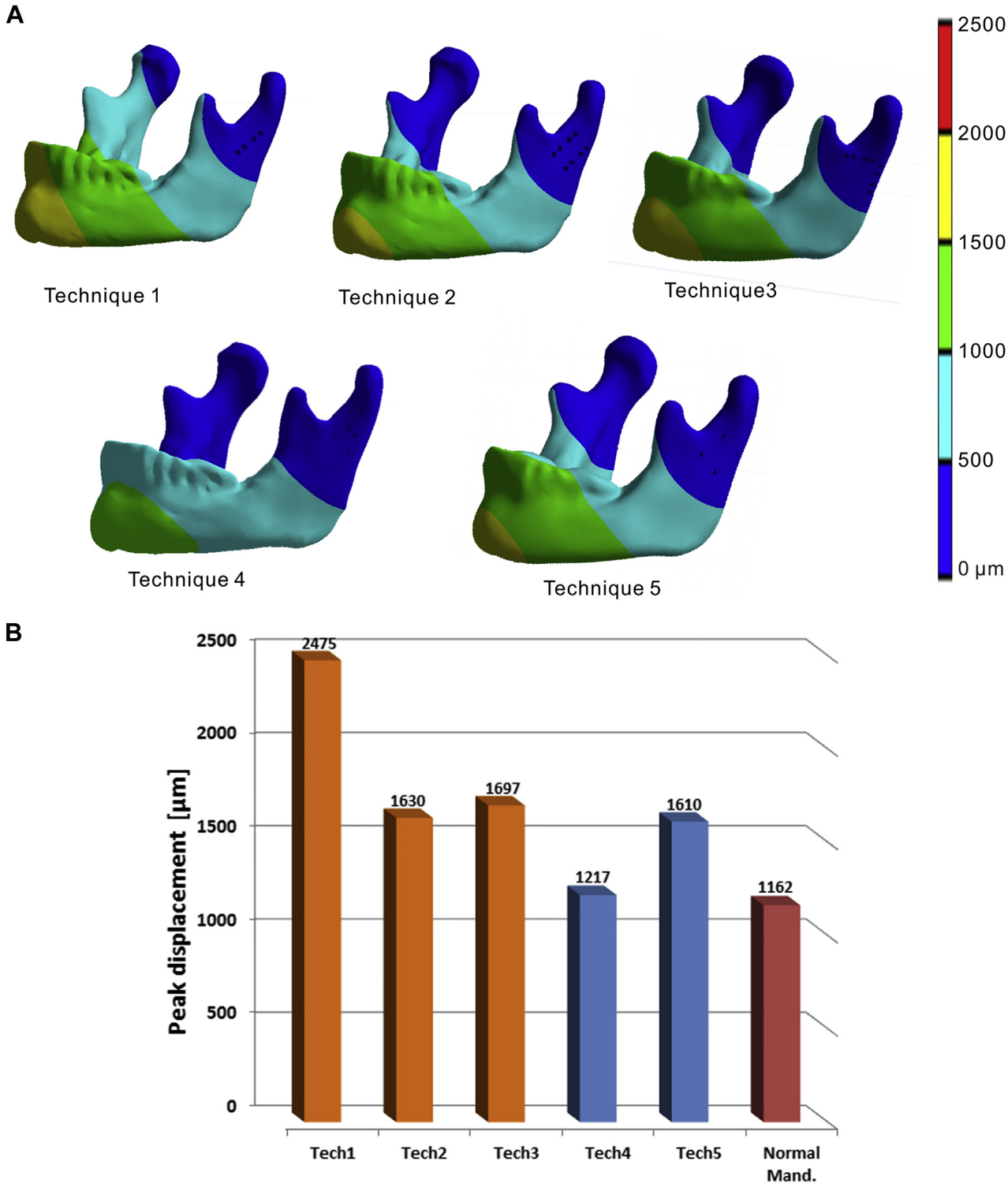


**FIGURE 1.** *A*, Displacement contours in the mandible for techniques 1 to 5. *B*, Peak values of displacement for techniques 1 to 5 compared with peak displacement in a normal mandible. **(Fig 1 continued on next page.)**