AIM: The symphysis and angle region are the most frequent sites for mandibular fractures. Direct application of 2.0mm conventional and locking titanium miniplates are the most commonly used intraoral open reduction and internal fixation technique today. Anatomic and biomechanical limitations continue to make this application technically challenging with a considerable complication rate. Such incongruences are analysed with respect to the complex biomechanical behaviour of the mandible.

METHODOLOGY: Individual human mandible geometry, the specific bone density distribution, and the position and orientation of the masticatory muscles were evaluated by performing computed tomography scan of the cadaveric human mandible. Dimensional changes in the holes of the 2.0mm (Orthomax, Leforte and Synthes) titanium conventional and locking miniplates/screws were evaluated using RAPID-I Precision Vision Measuring System (VMS) pre and post adaptation to angle and symphysis region. The average bite forces of 15 patients who were operated for symphysis and angle fractures were measured using AXPERT electronic bite force gauge at 5 bite points viz right molars, right premolars, left molars, left premolars and anteriors. Three Dimensional Finite Element Analysis (3D FEA) was performed for symphysis and angle fracture sites with Temporomandibular Joint remaining static. Deflection, stability, mechanical stress over bone, maximal stress over miniplate, fracture gap and direction of displacement evaluated for loading conditions.

RESULTS: Symphysis fracture fixation showed maximum deflection of 6.05196mm with Orthomax conventional and least of 2.50747mm with Leforte locking miniplates. Maximum stress over bone was 98.6587 Mpa with Orthomax conventional and least was with Synthes locking of about 78.476 MPa. Stress over plate was more of about 75.4011 MPa in Orthomax conventional and least of about 61.2447 MPa in Synthes
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locking. Fracture gap was more of about 0.86241mm in Orthomax conventional and least of about 0.01804mm with Leforte locking. Angle fracture fixation showed maximum deflection of 5.93459mm with Orthomax conventional and least of about 3.00287mm with Synthes locking plates. Maximum stress over bone was more of about 379.81 Mpa for Orthomax conventional and least of about 309.63 MPa for Synthes locking plates. Stress over plate was more of about 2114.62 MPa in Orthomax conventional and least of about 833.457 MPa in Synthes locking. Fracture gap was more of about 2.2708mm in Orthomax conventional and least of about 1.86241mm with Leforte locking.

CONCLUSION: Consecutive rapid failure of the miniplates could not be prevented when the angle and symphysis region are loaded with vertical bite forces. The more stable plate is Synthes locking plate followed by Leforte locking plate for the symphysis region and angle region. The static yield limit of titanium exceeds, when geometry and dimension of the miniplates get altered, while adapted to angle and symphysis region. Hence, the dimensional changes in the holes of miniplates occurring during adaptation of the plate to the fracture site are also a factor to be considered for stability of the plate.

KEY WORDS: Biomechanics, mandibular symphysis and angle fractures, fracture fixation, conventional miniplates, locking miniplates, Three Dimensional Finite Element Analysis, bite force.