Biomechanical evaluation of chincup treatment with various force vectors

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Introduction: The aim of this study was to evaluate the biomechanical effects of chincup treatment by using a 3-dimensional finite element model. Methods: Three-dimensional models of the mandible and the temporomandibular joint were modeled and analyzed. The final mesh consisted of 1572 solid elements with 5432 nodes. The chincup with 500 g of force was applied in a direction from the chin toward the mandibular condyle, the coronoid process, and a point anterior to the coronoid process. Then, the mechanical responses in terms of displacement and von Mises stresses are evaluated. Results: The mandible was displaced backward and downward with the vector passing through the condyle. Forward and upward displacement was recorded with the force vector passing through or anterior to the coronoid process. The mandibular condyle and the coronoid process showed minimal displacement for all force vectors. The highest stress levels were observed in the condylar and posterior ramus regions and increased as the force vector was transferred away from the condyle. Conclusions: With the limitations of modeling, boundary conditions, and solution assumptions, chincups applied in various directions produce different force vectors, which induce different stress locations and displacements. The force vector is an important determinant of the orthopedic effects of the chincup and therefore should be carefully considered. (Am J Orthod Dentofacial Orthop 2008;134:773-81)