In Vitro Mechanical Evaluation of Mandibular Bone Transport Devices

Uriel Zapata1, Ikuya Watanabe, Lynne A. Opperman, Paul C. Dechow, Timothy Mulone and Mohammed E. Elsallamy

[+] Author and Article Information

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Abstract

Bone transport distraction osteogenesis (BETO) is a surgical procedure that has been used over the last 30 years for the correction of segmental defects produced mainly by trauma and oncological resections. Application of BETO has several clinical advantages over traditional surgical techniques. Over the past few years, several BETO devices have been introduced to reconstitute mandibular bone defects. Based on the location and outline of the defect, each device requires a uniquely shaped reconstruction plate. To date, no biomechanical evaluations of mandibular BETO devices have been reported in the literature. The present study evaluated the mechanical behavior of three different shaped prototypes of a novel mandibular bone transport reconstruction plate and its transport unit for the reconstruction of segmental bone defects of the mandible by using numerical models complemented with mechanical laboratory tests to characterize strength, fatigue, and stability. The strength test evaluated device failures under extreme loads and was complemented with optimization procedures to improve the biomechanical behavior of the device. The responses of the prototypes were characterized to improve their design and identify weak and strong regions in order to avoid posterior device failure in clinical applications. Combinations of the numerical and mechanical laboratory results were used to compare and validate the models. In addition, the results remark the importance of reducing the number of animals used in experimental tests by increasing computational and in vitro trials.

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