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A Prospective Study -To evaluate the biomechanical strength of reconstruction plate in resectioned cadaveric goat mandible using UTM (Universal Testing Machine)

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Abstract

The mandible has a central functional and an aesthetic role. It is unique bone in maxillofacial region and loss of mandibular continuity occurring as a result of trauma, tumour or inflammation may lead to airways reduction, poor swallowing, failure to retain saliva, impairment of speech and aesthetic disfigurement. Reconstruction may be carried out either with an osteoplasty combined with appropriate osteosynthesis or merely by alloplastic bridging of the defect using a reconstruction system without bone.

Keywords: Biomechanical strength, Reconstruction plate, Mandible

Introduction

The first generation of clinically available reconstruction plates was introduced in the mid-1970.Since the early 1980s, the standard treatment for a mandibular discontinuity defect has been the use of a rigid reconstruction plate with concurrent or subsequent osseous reconstruction.[1]

The current clinical procedure for mandible fracture fixation is plate application. Implant success is a function of biomaterials and biomechanical factors, including: materials and material processing, mechanisms of implant/tissue attachment, mechanical properties, implant design, loading type, tissue properties, stress and strain distributions, initial stability and mechanisms of enhancing osseo integration, biocompatibility, and surface chemistry, mechanics, and bone-binding ability of the implant. 3D reconstructions are used to validate procedures numerically preceding experimental analysis [2]

Various types of plates available for reconstruction or fixation of these large defects in the mandible likes locking plate and Reconstruction plate. Several mechanical and biological advantages have been attributed to the locking screw–plate, including axial and angular stability due to its locking mechanism between plate and screw, preservation of the periosteal blood supply, reduced requirement for anatomical plate contouring, and possibility the system's elasticity to stimulate bone healing. These advantages have stimulated the

modification or conversion of various traditional bone plates into locked systems, including reconstruction plates, by changing especially the screw-hole geometry[3]

Trauma is a leading cause of death among ages 1 through 40 and the promptness of care is critical for patient survival and functionality (Committee on Trauma Research, 1985). In a majority of trauma cases, especially cases when there are skin or neurovascular structures in danger, undesirable alignment, and/or comminuted fractures, open reduction and internal fixation (ORIF) is used to stabilize the fracture[4]

The main goals of mandibular reconstruction are to restore the continuity of the mandible arch and provide support to the outer soft tissue, which in turn can support functional and aesthetic rehabilitation and improved postoperative quality of life.[5]

In this prospective study, we aim to evaluate Biomechanical strength of Reconstruction plate in resected cadaveric goat mandible using Universal Testing Machine to get the more accurate value and determined the Yield strength and Yield displacement.

Case Study

In Vitro study including 3 Cadaveric goat hemi mandible.

Study Design

This study was conducted on 3 cadaveric goat hemi mandibles and all the hemi mandibles were sectioned at angle region using motor saw.

Methods Of Collection Data

Asian Universal Testing Machine (UTM) with Monitor

Materials

1. 3 cadaver goat hemi mandible
2. Reconstruction plate 2.7mm (12 hole)
3. Drill Bit 1.5mm
4. Screws 2.5mm
5. Screw driver
6. Universal testing machine with monitor and printer
7. Micromotor
8. Straight hand piece
9. Motor saw
10. Divider and Metallic scale

Technique

All goat hemimandibles were re -sectioned obliquely at the planned area in the angle region from superior border to inferior border anteroposteriorly using motor saw then fractured mandible were fixed using 2.7mm precontoured reconstruction plate.

After fixation of the fractured segments, they were stabilized in jig and tested in UTM (universal testing machine) for the Yield load and Yield displacement and for evaluation of biomechanical strength of the reconstruction plate. Yield load expressed in Newton is that load at which the permanent deformation of the system begins. Yield displacement expressed in mm is that displacement at which permanent deformation begins.

Figure 1: Fixation of 2.7mm reconstruction plate with 12hole in cadaveric goat mandible at angle region of right side

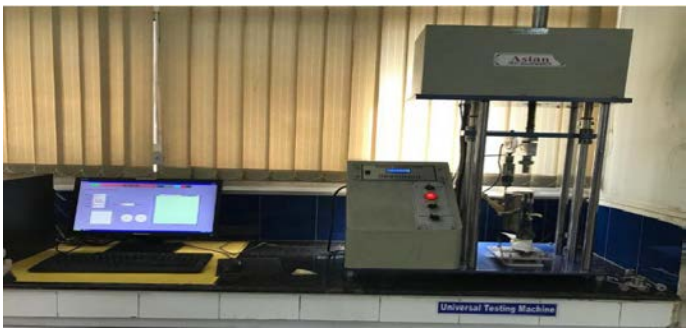

Figure 2

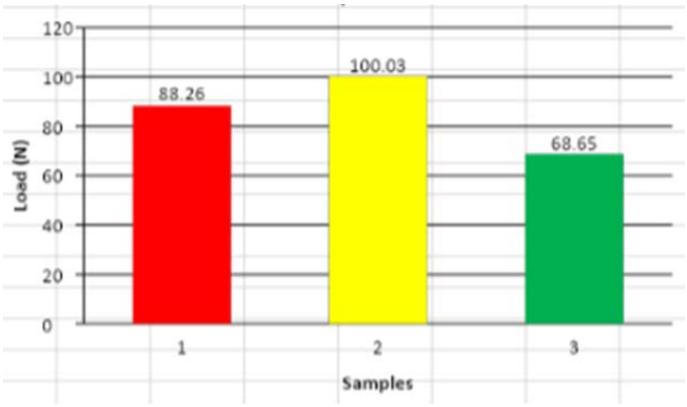

Figure 3

Discussion

The main goals of mandibular reconstruction are to achieve functional and esthetic recovery by restoring mandibular arch continuity, to maintain soft tissue coverage, and to improve the patient's postoperative quality of life. The success rate of mandibular reconstruction has increased as a result of advances in plate design and materials. However, plate-related complications still develop frequently and can sometimes cause serious problems for patients Kimura et al. found that masticatory pressure can contribute to vertical stress on the plate, leading to bone resorption around the screw and screw loosening. Arias-Gallo et al. reported that most hardware complications developed at sites exposed to higher moment and shear forces. Mandibular functional movements such as mastication cause mechanical stress, an important factor in complications. Forces that are caused by contracture of the masticatory muscles (temporalis muscle, lateral and medial pterygoid muscle, masseter muscle) during mastication act directly on the mandible6

In this study we found that minimum value of Biomechanical strength of Reconstruction plate in cadaveric goat mandible is 68.65N and maximum value of Biomechanical strength of Reconstruction plate in cadaveric goat mandible is 100.03N.

The demerits of our study are in vitro and limited samples, therefore more prospective longitudinal and clinical studies are required to draw definitive conclusion.

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