

# FINITE ELEMENTS ANALYSIS FOR EXTRAORAL MAXILLOFACIAL EXTERNAL HEXAGON IMPLANTS IN THE AURICULAR REGION.

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## Introduction

Facial prosthetics requires a means of retention. Over the last three decades, osseointegrated implants have been used to improve the hold and retention of facial prosthesis [1]. This finite elements analysis (FEA) was performed aiming the behavior of Brånemark extraoral implants with extended platform and bar-clip system placed for auricular prosthesis support.

## Methods

Dedicated Brånemark extraoral implants files in .step (INP Biomedical, São Paulo, Brazil) described in Table 1 and Figure 1, were placed on a virtual temporal bone model generated according to BioCAD protocol [2].

Group	Abutment Features	
	Neck Height (mm)	Conicity (°)
1	2	45
2	4	45
3	2	20
4	4	20

Table 1: Description of groups of extraoral external hexagon implants with extended platform analysed.

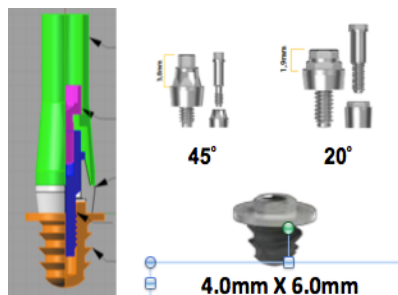


Figure 1: Extraoral external hexagon with extended platform implant characteristics.

The FEA was performed with the Abaqus software, Abaqus/Explicit package (Dassault Systèmes, Vélizy-Villacoublay Cedex, France). All assembled implant components and bar-clip system were considered one single rigid body. There were assumed for temporal bone the properties of cortical bone, i.e., Young Modulus (E) = 1.30 GPa and Poisson Coefficient ( $\nu$ ) = 0.40. In order to simulate the removal of a bar-clip retained auricular prosthesis, 20N was applied during 0.5s for tension, which can be considered the worst stress configuration for the cortical bone.

## Results

FEA outcomes are on Figure 2 and Table 2.

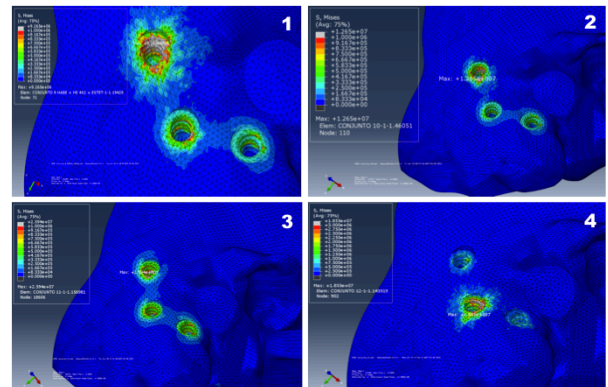


Figure 2: The mastoid region is the least stressed in the four simulations.

Group	Maximum Von Mises Stress (MPa)	Maximum Principal Stress (MPa)	Minimum Principal Stress (MPa)
1	9.27	10.03	-9.77
2	12.65	7.30	-12.25
3	25.94	8.63	-32.28
4	18.55	15.85	-13.39

Table 2: Maximum stress values after clip removal.

## Discussion

The upper position implant was the most stressed and the implant placed in the mastoid bone was the least stressed. The exception was for Group 4. This confirms the current surgical protocol for auricular two-implant supported prosthesis (one on the mastoid bone and the other in the clock position of 3h for left ear or 9h for right ear).

## References

1. Fornelli RA, Fedok FG, Wilson EP, Rodman SM. Otolaryngol Head Neck Surg 123(3):207-10, 2000.
2. Perestrelo P, Torres M, Noritomi P, Silva J In: Digital Human Modeling. Applications in Health, Safety, Ergonomics and Risk Management: Ergonomics and Health, V.G. Duggy ed., Springer Int Pub Switzerland 9185:358-366, 2015.

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