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THE EFFECT OF IMPLANT POSITION ON THE STRESS BEHAVIOR OF MANDIBULAR IMPLANT RETAINED OVERDENTURES

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It has been reported that stone, wood, and even animal teeth have been used as the supportive structure in the maxilla (upper jaw) and mandible (lower jaw) [1]. The improvements have been made to this approach in dentistry, and implants have been developed and introduced into the practice of dentistry to restore lost functions. The materials used in dental implants vary greatly, along with the multiplicity of models. Experimental and mathematical stress analyses are required to select the appropriate geometry and material of dental implants. Generally, the finite element method is used in mathematical analysis. Barbier et al. [2] evaluated axial and non-axial forces around intraosseous implant systems using the finite element method, and showed the need for reducing horizontal loading.

The present study evaluated the effects of the number and configuration of the implants inserted to the lower jaw without any remaining teeth to support lower overdenture on the stress distribution on the lower jaw and implant system assembly using the finite element method. Figure 2 shows a section from the implant insertion site in the incisor teeth in the two implant-supported model.

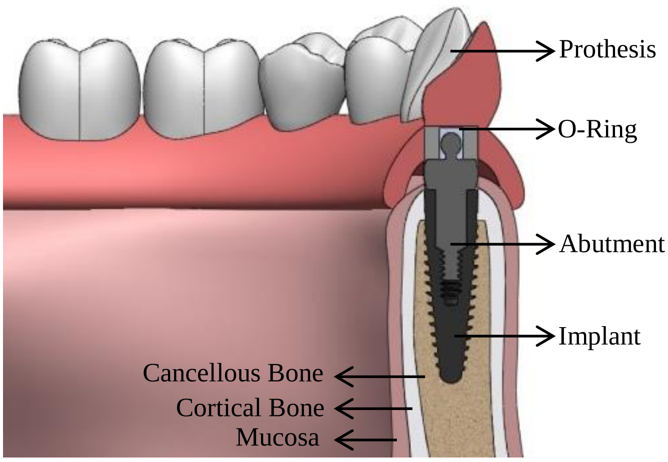

Figure 1 Model of implant system

The stress on the cortical bone for 2PM model is presented in Figure 2. The figure show that the stress is higher in the cortical bone where the implant was inserted and maximum stress was observed in this location.

The materials and fabric used in the study show different mechanical and physical characteristics. These materials were considered isotropic and homogeneous, and the elasticity modulus and Poisson's ratios were acquired from the literature. Elasticity modules and Poisson's ratios of the materials are presented in Table 1.

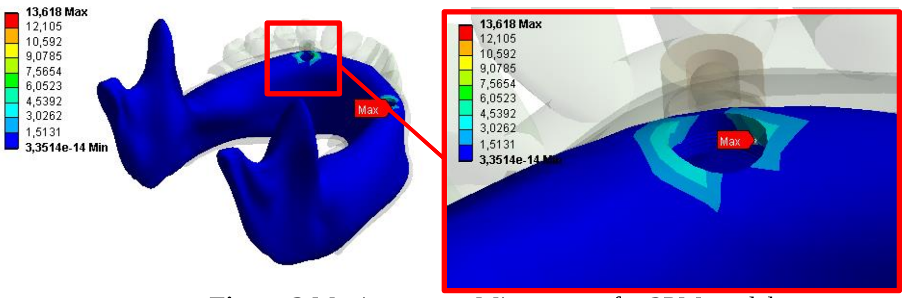

Figure 2 Maximum von Mises stress for 2PM model

Table 1 Material Properties

Material	Elastic Modulus (MPa)	Poissons Ratio
Ti6Al4V [3, 4]	110,000	0.35
Prosthesis [3]	2,940	0.3
Cortical Bone [4]	13,700	0.3
Trabecular Bone [4]	1,370	0.3
O-ring [3]	15	0.4
Mucosa [3, 4]	1	0.3

The stresses around the implants were found to be higher than the stresses measured on the jawbone. This could be explained by the elasticity module of the Ti6Al4V implant material being 8-fold higher than the cortical bone layer and 80-fold higher than the trabecular bone layer (Merdji et al., 2010; Esmail et al., 2010).

In all models, the stress on the dental implant was higher on the cervical region of the implant. This finding is related to the implant being supported by the cortical bone layer and the cervical region of the implant being seated in the cortical bone layer.

CONCLUSION

The results of the present study are discussed below.

1. The highest stresses were observed on the cortical bone layer.
2. The most critical loading site in 2 and 4 implant-supported models was first molar tooth. This finding was explained by the fact that the loading stress is primarily counteracted by the load-bearing implant and transferred to the other implants after attenuation. The stress values observed in the implants support this notion.

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