STUDY OF STRESS DISTRIBUTION IN PREMOLARS AND BIO IMPLANTSWITHDIFFERENTLOADCONDITIONS

[1]Mr. P. Shivaraj,[2]Mr. Kuna Naresh Raj,[3]Mr. AlgotKiran Kumar
[123]Assistant Professor
Department Of Mechanical Engineering
Kshatriya College of Engineering

ABSTRACT

The purpose of this study was to examine the stress distribution in premolars and BOI implant with various loading conditions and materials. In our work, first, three-dimensional geometry of the premolar is built in CATIA V5 parametric and the analysis was done in ANSYS-14.5. Gold alloy, Ni-Cr alloy, Zirconium are the materials utilized in this project. We estimate the load bearing capacity of premolars and BOI implant by applying the different loads i.e. (1, 1.5 and 2Mpa) and by observing von-missies stresses, strains and deformations generated from static analysis in ANSYS 19.2. Finally concluded the suitable material.

Keywords: CFD analysis, premolars and bio implants, Ansys workbench, gold alloy, Ni-Cr alloy, and Zirconium.

1. INTRODUCTION

An implant is a medical device manufactured to replace a missing biological structure, support a damaged biological structure, or enhance an existing biological structure. Medical implants are man-made devices, in contrast to a transplant, which is a transplanted biomedical tissue. The surface of implants that contact the body might be made of biomedical materials. Metals and their alloys are widely used as biomedical materials. On one hand, metallic biomaterials cannot be replaced by ceramics or polymers at present. Because mechanical strength and toughness are the most importaJournalnof E ngineeringt Sciences safety requirements for a biomaterial under load-bearing conditions, metallic biomaterials like stainless steels, Co-Cr alloys, commercially pure titanium (CP Ti) and its alloys are extensively employed for their excellent mechanical properties. On the other hand, metallic materials sometimes show toxicity and are fractured because of their corrosion and mechanical damages [1]. Therefore, development of new alloys is continuously trialed. Purposes of the development are:

- To remove toxic element.
- To decrease the elastic modulus to avoid stress shield effect in bone fixation.
- To miniaturize medical devices.
- To improve tissue and blood compatibility.

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Figure 1. Different types of biomedical implants

Human Teeth Anatomy: There are 32 permanent teeth. There are 16 teeth on both the top and bottom jaw. Each jaw consists of specific teeth, which are incisors (cutting teeth), canines (tearing teeth) and molars (grinding teeth). From the midline of one side of each jaw consists of 2 incisors, 1 canine, 2 premolars and 3 molars (fig.2).

Figure 2. Human Teeth Anatomy

2. CAD

Computer-aided design (CAD), also known as computer-aided design and drafting (CADD), is the use of computer technology for the process of design and design-documentation. Computer Aided Drafting describes the process of drafting with a computer. CADD software, or environments, provide the user with input-tools for the purpose of streamlining design processes; drafting, documentation, and manufacturing processes. CADD output is often in the form of electronic files for print or machining operations. The development of CADD- based software is in direct correlation with the processes it seeks to economize; industry-based software (construction, manufacturing, etc.) typically uses vector-based (linear) environments whereas graphic-based software utilizes raster-based (pixelated) environments. CATIA is an acronym for Computer Aided Three-dimensional Interactive Application. It is one of the leading 3D software used by organizations in multiple industries ranging from aerospace, automobile to consumer products. CATIA provides the capability to visualize designs in 3D. When it was introduced, this concept was innovative.

3D model Assemble product

Figure 3. Solid model of implant (left). Model of premolars (right).

3. ANALYSIS

STATIC ANALYSIS OF PRE-MOLARS

Material properties

Materialproperties	Ni-Cr	Au-Ag	Zirconium
Density(Kg/m³)	8400	8000	4560
Possion'sratio	0.325	0.33	0.26
Young'smodulus(Gpa)	245	91	97
Yieldstrength(Mpa)	2100	800	810
Ultimatetensilestrength(Mpa)	2300	855	939

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Imported model

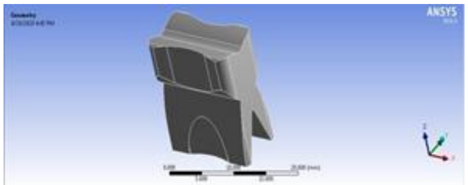

Figure 4. Imported model form modelling software

Meshed model

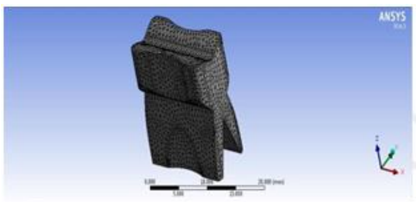

Figure 5. Meshing model

According above figure shows divided by elements through fine meshing.below figure shows number elements and number nodes as:

Statistics	
Nodes	12554
Elements	1728
Mesh Metric	None

Solution A6>insert>total deformation>right click on total deformation>select evaluate all result Insert>stress>equivalent (von misses)>right click on equivalent >select evaluate all results Insert>strain>equivalent (von misses)>right click on equivalent >select evaluate all results

Material: au-ag

Total deformation

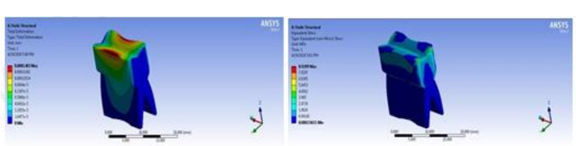

Figure 6. Deformation (left). Stress (right).

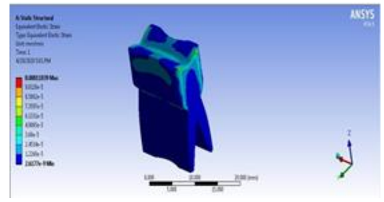

Figure 7. Equivalent strain

STATIC ANALYSIS OF BOI IMPLANT

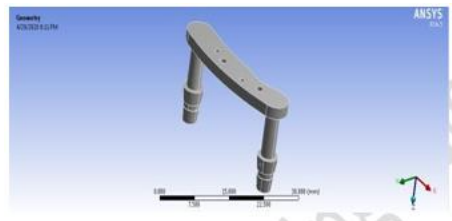

Figure 8. Imported model

Total deformation

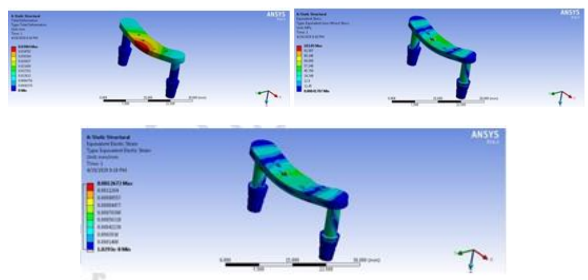

Figure 9.Deformation (top left). Stress (top right). Strain (bottom).

4. RESULTS AND DISCUSSION Static Results tables

Material	Load(Mpa)	Deformation(mm)	Stress(N/mm^2)	Strain
Ni-Cr	**1**	6.1209e-5	9.943	4.5742e-5
	1.5	9.1813e-5	14.916	6.861e-5
	2	0.0012242	19.888	9.1484e-5
Au-	**1**	0.0001483	8.9209	0.00011039

ag	**1.5**	0.0002306	13.877	0.000 17172
	2	**0.0002955**	17.842	0.000 22079
	1	**0.00013886**	9.3236	0.000 70927
	1.5	**0.0002162**	14.503	0.000 16998
	2	**0.0002777**	18.647	0.000 21854

Materials	**Deformation (mm)**	**Stress(N/mm^2)**	**Strain**
Ni-Cr	0.014508	103.33	0.00047215
Au-ag	0.03904	103.05	0.0012677
Zr	0.036853	107.04	0.0012411

5. CONCLUSION

The static structural analysis of the dental premolar has a great significance, In this project, the design approach for Basal Osseo integrated implant using CATIA V5 R20 software, Analysis work was supported by ANSYS 14.5. Among the Static structural analysis, considered on materials, Au-Ag Material exhibited the maximum stress 8.9209Mpa and maximum deformation of 0.0001483 mm at load 1.0Mpa applied. From the Static analysis results Au-Ag produces less stress compared Journatl of E ngoineering S ciences other two materials, Because of low young's modulus and the use of Zirconium material we avoid both toxic and stress shielding effect. Finally, we conclude that Zirconium is better material suitable for Basal Osseo integrated implant.

REFERENCES

1. PRAKASH, VODNALA VEDA, and BOMMANA SHRAVN KUMAR. "IMPROVING NANO MATERIAL COTING OF GAS TURBINE BLADES MODEL ANALYSIS."
2. KUMAR, A. K. A MANAGERIAL APPROACH TOWARDS RELIABLE MAINTENANCE OF HIGH PRODUCTIVE MACHINE.
3. McClarence E, Close to the Edge-Branemark and the Development of Osseointegration, Quintessence Books, Berlin, Germany, 2003
4. Prakash, Vodnala Veda, and S. Chakradhara Goud. "A Schematic Design and an NDT Approach for a Radiator Tubes Using Nano fluids."s
5. Kumar, A. K., Laxmaiah, G., & Babu, P. R. Process Parameters Optimization And Characterization Of RTM Manufacturing Process For High Performance Composites.