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Stress reduction in implant using improved abutment

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Abstract - *The dental implant is used whenever real teeth failed. Dental implant is very important part in the field of dentistry. The production of dental implant helped to provide the dentist to planning it, placing into jaw bone and to restoring of missing teeth whenever it fails.*

An abutment is a part of dental implant which is used to fix over the implant part and below the crown. The crown is made by porcelain material which is used to be attached directly on the implant part. An abutment part which is used to fixed in implant to make dental implant strong and to improve the stability into jawbone. The dental abutment provides the retention into the implant, to support, to improve the stability and for the increase the final restoration in jawbone where it is fixed.

***Key Words*: Dental Implant, Abutment, Stress, Crown.**

1. Introduction

Teeth loss is a common problem in day to day life so for that the dental implant process is used. There are uses of dental implants on missing teeth is also a common thing to replace the real teeth. There are so many researches are done on dental implant designs to make proper and well-shaped. Its material is biomaterial which is convenient for body and the variations in technique of the implantation has increased more. In the field of dentistry many of work included related to the dental implant. Use of proper shape and sizes in design of dental implant, biomaterials which helps to avoid infection and surface modification is very essential to improve the durability of the dental implant.

In the dental implant there are various types of dimensions that are presently used for various types of bone quality. In dental implant, different types of abutments such as angular and straight are also presents.

2. Design of Dental Implant

In the dental implant, there are various types of sizes and shapes are available. These are helps to dental implants to fit in jawbone easily. There are changes in shapes and sizes of implant, types of threads, and its thickness is stated. There are number of design and sizes of abutment, crown are available. Proper size, shape of dental implant and quality of bone improve stability of dental implant in the jaw bone. There are parts which present in dental implant are given further.

1)Length:-

When forces act on dental implant the stress distribution is depends on its length and its diameter in the jawbone which is surrounded to implant. There are some lengths of dental implants which are increases from 6mm to 20mm.

2)Diameter:-

In the sizes of diameter of dental implant there are many of variability available. Diameter is important factor for the stability and retention of implant when it fixed into jawbone. When point related range is concern then diameter from 3mm to 7mm are used. If the dental implants diameter is wide then it helps to improve the stability. There are variations available for different type of bone quality.

3)Geometry:-

Dental implant has a many types of geometry such as cylindrical type of dental implant, conical type of shape and screw shape hollow cylindrical shape is also present. Some related studies are shows or focus on the conical implant surfaces that it occurs higher type of stresses as compared to use of screw shaped of geometry of dental implant.

4)Thread:-

In lower position of dental implant, threads are important part to fix into jawbone. It improves stability in jaw bone. Threads are also help to minimizing or reduce the stresses in the bone and implant when forced. In threads classification, the depth pitch thread, thread as flank angulation, some with the top radius of curvature and also the straight part present at the position of bottom side of the thread in implant.

3. CAD models of Dental Implant

All attachment in dental implant parts are made or generated with the help of Pro/E software. Crown, abutment, implant, bone and gums are made in the Pro/E software to make complete dental implant. Some images of three dimensional modeling are shown below.

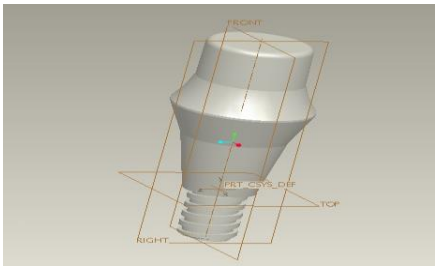

Fig -1: Abutment

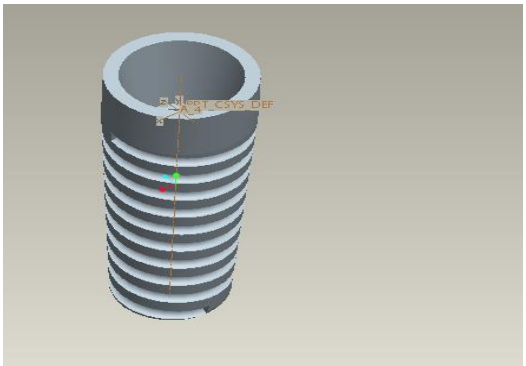

Fig -2: Implant

4. Finite Element Analysis – FEA

Finite element analysis is a computerized method. It is used to analyze the stresses on object when it is subjected by the some forces on various directions. This ANSYS software is used to find results. We can able to clear the view about the object that how object is going to results when forces occur over the surface of it. The finite element analysis focuses on the products or objects part or area when it was designed for the analysis. In the process of product development it can find or search out what is happening with the product or object at the time while it using condition.

Software such as finite element analysis results by divide problem into a large number of finite elements. Software included mathematical equation which helps to find out the behavior action of each and every element which working on it then in computer add the individual parts to check behaviors of object.

The finite element method is a numerical technique method. It helps to find out the solutions or results to boundary value problems for the partial differential equations. This finite element method helps to create or to convert major problems into smaller. Hence it is also called as finite element.

Table -1: Engineering Data

ATTACHMENT	MATERIAL	YOUNGS MODULUS (Gpa)	POISSION'S RATIO (Gpa)
Abutment & Implant	Titanium	110	0.35
Bone	Cortical bone	13.7	0.3
	Cancellous bone	1.37	0.3
Crown	Porcelien	40	0.35

5. CAD model and Analysis:-

When step of meshing is done then for the further step selection of the three dimension model of dental implant for the masticatory forces to find out the von misses stresses. In the boundary condition we fixed the surfaces in ANSYS software for the results. Engineering data used for the implant, crown, bone and the abutment to analysis. Dental implant acted by the forces to calculate the stresses on dental implant.

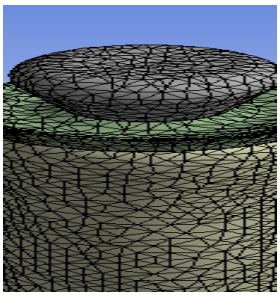

Fig -3: Meshing of Dental Implant

After design the CAD model of dental implant with the help of Pro/E software then further there are some ANSYS process. When completed all steps in ANSYS then for the next step it leads to the solution process for the masticatory force.

In the result, stresses occur at the neck of dental implant. Total deformation and Von misses stresses on dental implant system are calculated and are given below.

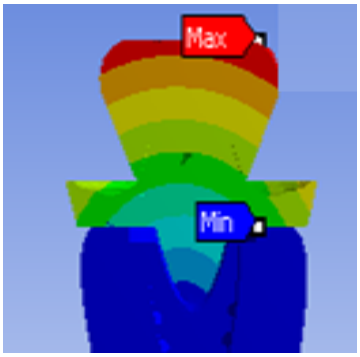

Fig -4: Total deformation

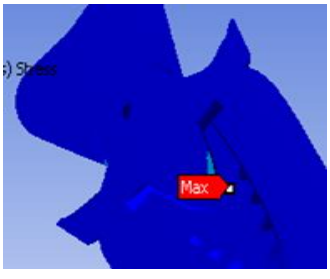

Fig -5: Von-Misses stress

Values of Total deformation and Von-misses stress for 100N force given below.

Masticatory Force		
Force(N)	Total Deformation	Equivalent Stress(MPa)
100 N	2.1413e-002mm	271.63MPa

6. Set up of Dental Implant

The biomaterials are used in biological systems to avoid the infection which occur due to materials. The value of biomaterials is high in materials when it concerns about body, as comparative to other material. Biomaterials are also included in the various types of departments such as in chemistry field, science field and also in biology and medicine fields.

Silicone is the material which is very soft and it is also used into dental implant. It is placed with abutment. When set up of silicon is done then further process is analysis done with the three dimension model of dental implant for the calculation of stresses of masticatory forces.

Masticatory Force		
Force(N)	Total Deformation	Equivalent Stress(MPa)
100 N	0.002	68.43

7. Results

After analysis of three dimensional models of dental implant with and without biomaterial then there are some values of total deformation and Von-misses stresses of 100N force. Values are given below.

Masticatory Force				
Force(N)	Total Deformation		Equivalent Stress(MPa)	
100 N		Silicon filled		Silicon filled
	0.021	0.002	271.63MPa	68.43

8. Conclusion

CAD models are design by software such as Pro/E. Analysis done by FEA software ANSYS , analyzing of three dimensional design to find out the masticatory force result whenever it acts on dental implant.

Result shows that maximum von misses stresses are found on dental implant without silicon. It minimizes the value in results when biomaterial is used. It minimizes the von misses stresses which occur when masticatory force applied on the crown at the time of chewing or biting condition.

We evaluated the von misses stresses to find out the stresses on the area or part of dental implant. The results which are found by the ANSYS software show that stresses occur at contact of abutment and implant. Total deformation and equivalent stress shows when force acted. Dental implant applied by the masticatory force.

Dental implant effectiveness is also depends on the quality of bone where implant is inserted by some machines. When bone soft in quality then deformation found more than strong and hard bone. Hence the type of bone quality is also important factor in the selection of dental implant to avoid failure.

REFERENCES

1) Dr. Ravi P. Popat, Dr. Neeta V. Bhavsar, Dr. Parita R. Popat, Peri-Implantitis:- Management of Ailing, Failing & Failed Dental Implants in IOSR Journal of Dental and Medical Sciences e-ISSN:- 22790853, pISSN:- 2279 0861.Volume 13, Issue 1 Ver. 8 in Feb. 2014, PP 43-46

2) Smriti Kapur Dewan, Aman Arora, Monika Sehgal, Anika Khullar, Implant failures:- A broader perspective, Journal of Dental Implants -Jan - Jun 2015 – Volume no. 5 -Issue 1

3) Aravind Buddula; bacteria and dental implants A review; journal of dental implant| jan_jun 2013|volume 3 |issue 1

4) Zhihong Mao,Nanning; Design of dental implant system by FEA in 2014 IEEE Workshop on Electronics, Computer and Applications

5) Manish Goutam, Madhvi Singh, Deepak Patel; A literature review on effects of smoking on the success of dental implants in Journal of Dental Implants - Jan - Jun 2013 Volume no. 3 - Issue 1

6) Renata Faria, Liliana Gressler May, Diego Klee de Vasconcellos, Claudia angela Maziero Volpato, Marco Antonio Bottino; Evaluation of the bacterial leakage along the implant:abutment interface in Journal of Dental Implants Jul - Dec 2011- Vol -Issue 2

7) Roseline Meshramkar, Aishwarya Nayak, Abhishek Kavlekar, Ramesh K Nadiger, K Lekha; A study to evaluate the effect of taper on retention of straight and angled implant abutment; Journal of Dental Implants in Jan - Jun 2015 - Vol no.5 - Issue 13

8) G. Arun Kumar, B. Mahesh, Dadu George; Three Dimensional Finite Element Analysis of Stress Distribution Around Implant with Straight and Angled Abutments in Different Bone Qualities; J Indian Prosthodont Soc in Oct-Dec 2013-13-4:466–472|
Published online:- 6 January 2013

9) Ana Paula Martini, Amilcar Chagas Freitas Jr, Eduardo

Passos Rocha, Erika Oliveira de Almeida, Rodolfo Bruniera Anchieta, Sidney Kina, and Guilherme Bortolon Fasolo; Straight and Angulated Abutments in Platform Switching:- Influence of Loading on Bone Stress by Three Dimensional Finite Element Analysis in The Journal of Craniofacial Surgery and Volume no. 23, Number 2, March 2012

10) K Raghavendra Reddy, Prafulla Thumati; Influence of implant with different dimensions and designs in ideal stress distribution in bone for application in compromised situations: Analysis by three-dimensional finite element method Journal of Dental Implants _Jul - Dec 2014 _ Vol 4 _Issue 2

11) D. mihov, b. katerska; some biocompatible materials used in medical practice faculty of medicine, medical university of sofia in Bulgaria trakia journal of sciences, vol.no. 8, suppl. 2, pp 119125, 2010

12) R.c. van staden, H. guan & Y.c. loo, N.w. johnson , N. meredit; stress distribution characteristics in dental implant influenced by its wall thickness, online publication griffith research online |griffith university.

13) F.J. Gil, M. Herrero Climent, P. Lazaro, J. V. Rios; implant abutment connections: influence of the design on the microgap and their fatigue and fracture behavior of dental implant; j mater sci mater medspringer science business media|published online 2014.

14) Syafiqah Saidin, Mohammed Rafiq Abdul Kadir, Eshamsul Sulaiman, Norhayaty Abu Kassim, finite element analysis on internal hexagonal and internal conical abutment, 2010 ieee embs conference on biomedical engineering & sciences, kuala lumpur, Malaysia.

15) Eren shemtov yona, Daniel rittel, Eli e machtei, Liran levin, Effect of dental implant diameter on fatigue performance part ii failure analysis clinical implant dentistry and related research, volume , number , 2012.