

# Review on Design and Optimization of Human Teeth using FEA

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## Abstract

In this study, Static structural analysis of a molar tooth was performed by using FEM. The commercial finite element package ANSYS version 14.5 was used for the solution of the problem. The molars or molar teeth are large, flat teeth at the back of the mouth. They are more developed in mammals. They are used primarily to grind food during chewing. Sometimes we are using artificial teeth instead of human molar tooth during broken. Here we optimize the molar teeth using different materials like acrylic, porcelain, zirconia and silver. Taking into consideration of forces acting on the top of the molar teeth, the deformation, strain and stress are tabulated. And here we are studying about the molar teeth as well as developing our skills in software like solid works and ansys.

**Keywords:** 3D CAD modal, FEA, mandibular, maxillary

## I. INTRODUCTION

The molars or molar teeth are large, flat teeth at the back of the mouth. They are more developed in mammals. They are used primarily to grind food during chewing. The name molar derives from Latin, molaris dens, meaning "millstone tooth", from "mola", millstone and dens, tooth. Molars show a great deal of diversity in size and shape across mammal groups.

The human mouth contains upper (maxillary) and lower (mandibular) molars. They are: maxillary first molar, maxillary second molar, maxillary third molar, mandibular first molar, mandibular second molar, and mandibular third molar

## II. LITERATURE REVIEW

John Timothy Wright – This research paper conclude that Developmental defects of the dentition are diverse in their etiologies and clinical presentations. There can be alterations in the number, position, eruption, structure and composition of the teeth creating unique treatment challenges. Optimal management of developmental dental defects is predicated on establishing a diagnosis and often requires a team approach due to the diversity of the clinical manifestations. It is increasingly likely that the molecular etiologies of developmental defects of the dentition are known and having this information is helpful in predicting prognosis, identifying appropriate and emerging therapies, and ensuring patients receive appropriate information regarding their condition. Many developmental defects of the dentition are associated with systemic manifestations further adding to the importance of establishing a correct diagnosis.

Erin K. Mahoney<sup>1</sup>, R. Rohanizadeh<sup>2</sup>, F.S.M. Ismail<sup>3</sup>, N.M. Kilpatrick<sup>4</sup>, M.V. Swain<sup>5</sup>, - In this research Isolated enamel defects are commonly seen in first permanent molar teeth but there has been little work on the physical and morphological composition of affected molars. The aim of this study was to determine the mechanical and morphological properties of hypomineralised first permanent molar teeth, utilising the Ultra-Micro-Indentation System (UMIS) and scanning electron microscope, respectively. Further investigations using Energy Dispersive X-ray Spectrometry (EDS), Back Scatter Electron (BSE) Imaging, and X-ray diffraction were employed to attempt to determine the chemical composition, mineral content and crystalline structure of the hypomineralised tissue, respectively, of eight first permanent molars with severe enamel hypomineralisation. The hardness and modulus of elasticity were found to be statistically significantly lower (0.5370.31 and 14.4977.56GPa, respectively) than normal enamel (3.6670.75 and 75.5779.98GPa, respectively). Although the fractured surface of the hypomineralised enamel was significantly more disorganized and the relative mineral content was reduced by approximately 5% in comparison to sound enamel, the mineral phase and Ca/P ratio was similar in hypomineralised and sound enamel. The dramatic reduction in the mechanical properties of first permanent molar teeth has ramifications when clinicians are choosing restorative materials to restore the defects. The reason for the dramatic reduction in mechanical properties of hypomineralised first permanent molar teeth is at present unknown. © 2004 Elsevier Ltd. All rights reserved.

E. Mahoney<sup>1</sup>, A. Holt, M. Swain<sup>2</sup>, N. Kilpatrick<sup>3</sup>- Baseline information on the mechanical properties of and the effect of load upon dental hard tissue is important in the development of successful dental materials. Existing methods of measuring such properties of tissue are subject to significant experimental error. This study reports on the use of an Ultra-Micro-Indentation system (UMIS) to measure the hardness and elastic modulus of primary enamel and dentine.

Siegward D. Heintze<sup>1</sup>, Dominik Monreal<sup>2</sup>, Valentin Rousson<sup>3</sup>- There is no standard test to determine the fatigue resistance of denture teeth. With the increasing number of patients with implant-retained dentures the mechanical strength of the used denture teeth requires more attention and valid laboratory test set-ups. The purpose of the present study was to determine the fatigue resistance of various denture teeth using a dynamic load testing machine.

Mortaza Bonakdarchian<sup>1</sup>, Navid Askari<sup>2</sup>, Masood Askari<sup>3</sup>- The purpose of this study was to determine mean maximum bite force in adults with normal occlusion and to evaluate effect of face form on it.

### III. IDENTIFIED GAPS IN LITERATURE

In most of the recent journals and papers published, whole study is been carried out on human teeth. But in this paper I had focused on first molar teeth with the use of different material (Porcelain, Acrylic, Silver, Zirconium) at maximum bite force.

### IV. PROBLEM FORMULATION

In the existing studies analysis was been carried out on very high compression loads either on lower compression load than 450 N which is maximum force which a first molar teeth can sustain. In this Project I am addressing analysis comparison on the basis of total deformation, equivalent strain, equivalent stresses.

### V. OBJECTIVE

In this project I am undertaking a detailed investigation of existing study various teeth are being studied and on the basis of this literature review , modeling and analysis is been carried out with the use of CAD software on different material. Models are fabricated; to evaluate its results and to compare it with the results of analysis.

### VI. RESEARCH METHODOLOGY

- 1) Getting details of existing design.
- 2) CAD modal generation of existing design.
- 3) F.E.A of existing design.
- 4) Studying the properties of different materials.
- 5) Optimization.
- 6) Comparing the results

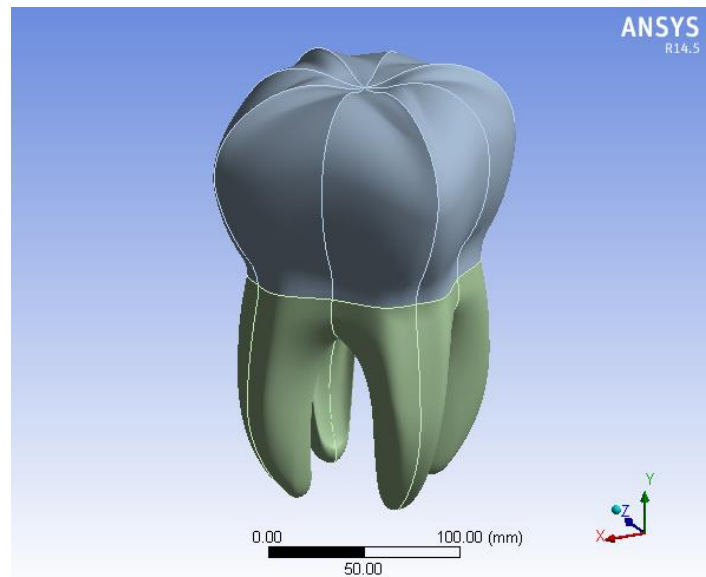


Fig. 1: Geometry View of Molar Teeth In Ansys Workbench

### VII. CONCLUSION

Analyzing results for human teeth under force. Analysis has been carried out Porcelain, Zirconia, Acrylic and silver. The results such as total deformation, equivalent elastic strain and equivalent stress for each material are determined. Comparing these materials, Zirconia material has the low values of total deformation and strain. Hence it is concluded that Zirconia material is suitable for the human teeth.

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