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STUDY OF THE CORRELATED ELEMENTS BETWEEN THE DENTAL PREPARATION AND THE STRESS

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ABSTRACT. The study seeks to highlight the correlation between the different geometric shape of the marginal cervical limit of the prepared teeth for prosthetic restorations, together with the distribution, the value of tensions and deformations that occur in the tooth during occlusal stress. In order to achieve our goal, we used finite element methods, which assured us to obtain data for the optimal form of the dental preparations, generating a favorable prognosis for the prosthetic treatment, along with the established therapeutic methods in order to increase therapeutic and prophylactic efficiency for the fixed dentures. From this point of view the round edges of the fixed prosthetic limits are the most favorable.
KEYWORDS: stress, form, marginal, threshold, limits.

INTRODUCTION

Mechanical tests are also important in the medical field. To limit the costs involved in live experiences, virtual simulation methods became inevitable, which is an integral part of modern scientific process. Experimental studies by finite element method were used in the biomedical field. Finite element method is considered the best way to predict and analyze deformation parameters performance, extensive knowledge is necessary but anisotropic material properties and constitutive relations (Craig, 2011).

Thus we intend to study the correlation between different geomatrică limit as cervical marginal teeth with restorations prepared to cover prosthetic and distribution, value stresses and strains occurring occlusal tooth requests by finite element method.

Geometric methods were obtained using a three-dimensional scanner (SCAN 3D ENGINE), the scan of extracted human molar and then prepared (fig. 1, 2) with different shapes in the neck by preparing circumferential marginal limit (knife-edge) Preparation shoulder with rounded narrow (mini chamfer) Preparation shoulder with rounded wide (chamfer), rounded shoulder preparation threshold (rounded shoulder) (fig. 3, 4). Data were processed with CATIA software, and were then imported into the finite element analysis software ANSYS (Craig, 2011, Magne, 2007).

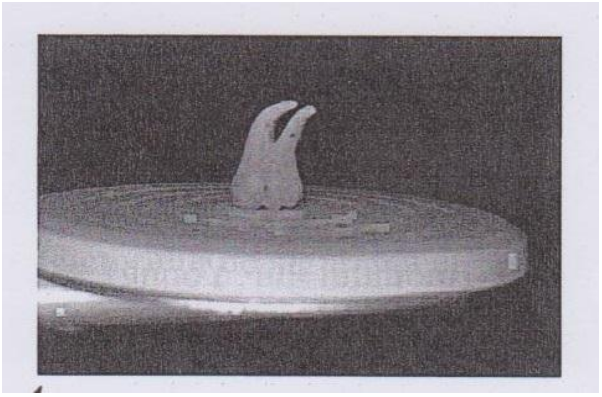

Fig.1. Molar prepared ready for scanning.

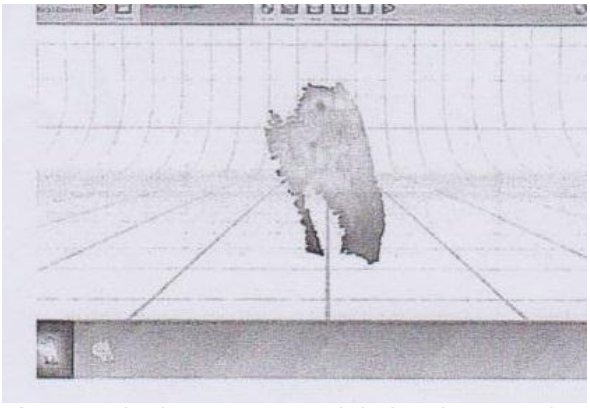

Fig. 2. Molar image captured during the scanning process.

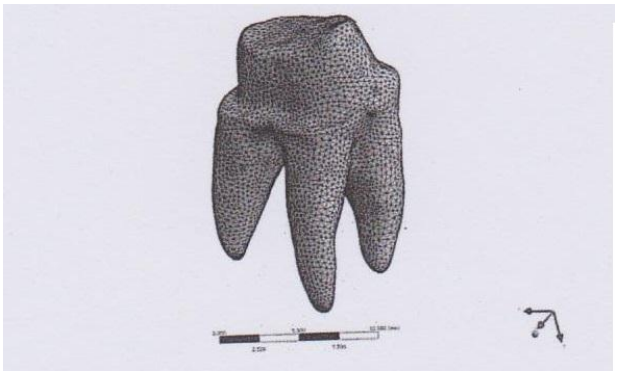

Fig 3. The molar geometric prepared wide shoulder with rounded obtained by 3D scanning.

To simulate occlusal stresses exerted on the teeth during static and dynamic functions maxillary, we applied the methods geometric obtained a request 400N occlusal force distributed on the surface or concentrated on one of the slopes cuspidiene (fig. 4).

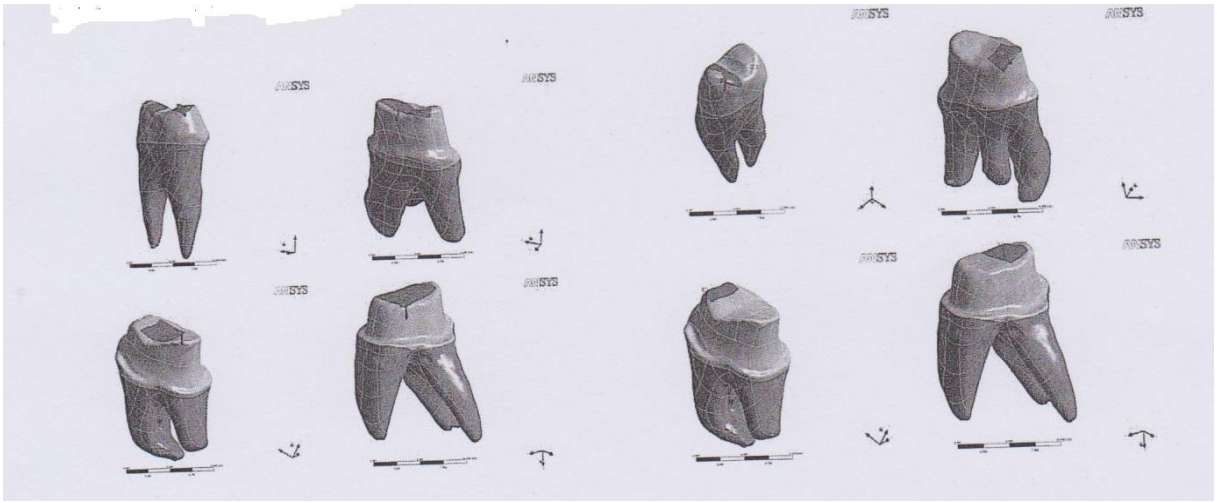

Figure 4. Protocol for the distribution of forces of the molars geometric pattern different geometrical limit to the cervical edge.

Physico-mechanical properties of the material for enamel, dentin, pulp, that value modulus (Young's modulus) and Poisson's ratio were taken from literature (Craig, 2011, Frățilă et al., 2012, Magne, 2007). For each geometric model of teeth prepared in various forms to the cervical marginal limit, both centric and eccentric request, they were calculated following results: Main voltage (Maximum Stress Princep); Equivalent deformation (elastic Equivalent Strain); The maximum displacement (Total deformation); The safety factor (Safety Factor) which is the ratio of breaking and maximum voltage limits (Frățilă et al., 2013).

RESULTS AND DISCUSSION:

Using finite element analysis can determine values specific strains, displacements, stresses and safety factor at all levels with different tooth profiles to limit its terminals and in section centric and eccentric at the request of one of the cusps (Table 1).

Table 1. The value of blood safety and equated the geometric model of teeth with different geometries preparations cervical marginal limit.

Solicitare de 400N		Preparația la limita marginală cervicală			
		Tangențial (Knife edege)	Prag rotunjit îngust (Mini-chamfer)	Prag rotunjit lat (Chamfer)	Prag în umăr rotunjit (Rounded shoulder)
Solicitare centrică pe întreaga suprafață	**Factor de siguranță**	5,24	3,23	4,25	**6,20**
	Tensiunea echivalentă (MPa)	76,34	123,84	94,02	**64,47**
Solicitare excentrică pe unul din cuspizi	**Factor de siguranță**	2,84	2,42	3	**6,07**
	Tensiunea echivalentă (Mpa)	140,6	165,21	132,94	**65,85**
Rounded shoulder este cea mai favorabilă					

Note that under identical conditions of application, the most favorable value of tension was the case in the shoulder preparations threshold rounded (rounded shoulder). The same is observed in the variation of safety at the highest threshold in the shoulder preparation with rounded (rounded shoulder) cervical limit, which is explained by the radius which removes tension concentrators (Fig. 5).

We found that the same intensity of the request, the voltage equivalent is greater when the application of force concentrated on one of the cusps (request eccentric) compared to the request by force distributed over the surface (application centric) regardless of the geometric shape of cervical marginal limit (table 1) which confirms and supports the importance of adapting prosthetic occlusal restoration work according to the principles of functional occlusion (Frățilă et al., 2013).

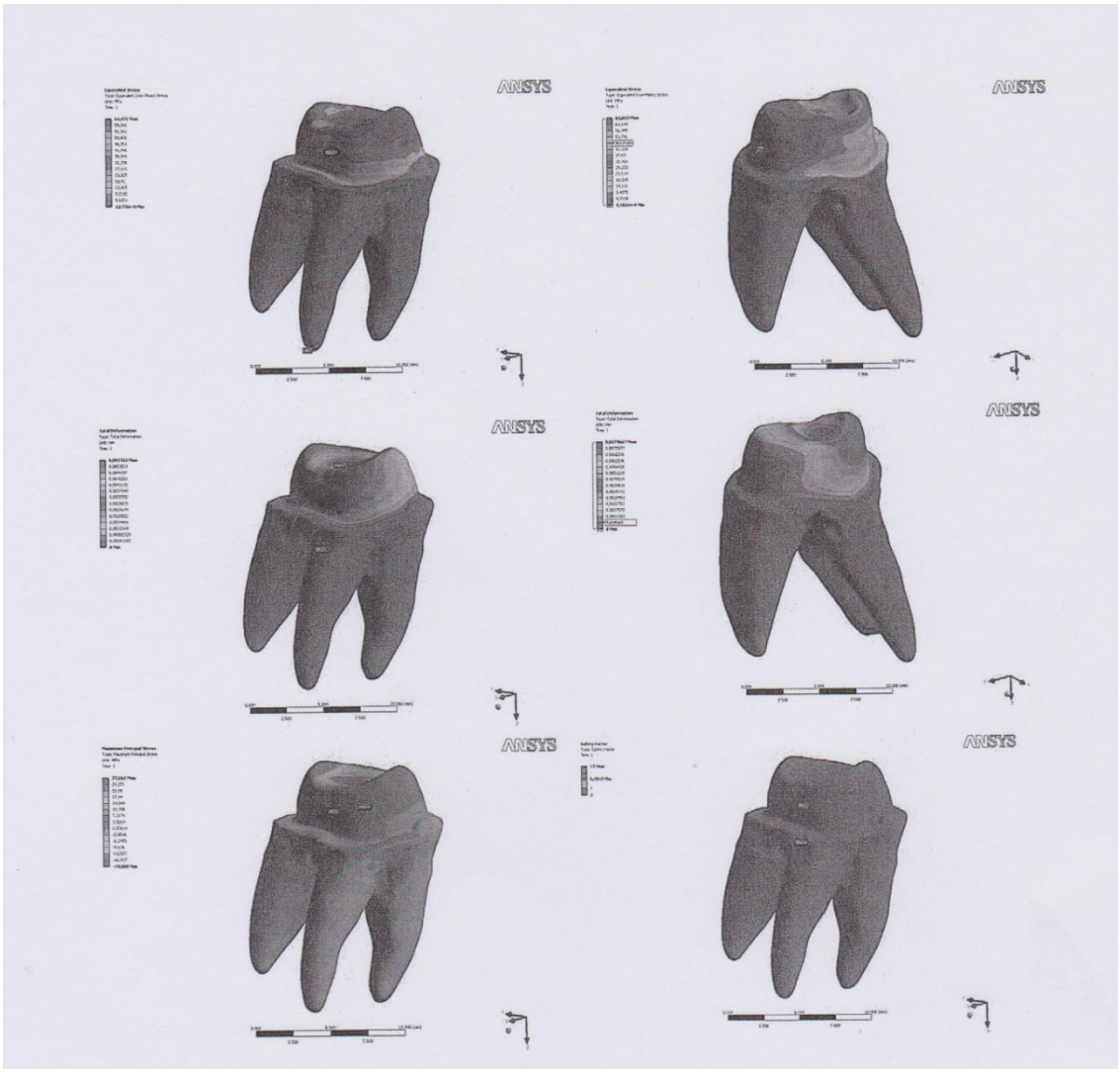

Fig.5. Imagery relevant to the value and distribution of stresses and strains, the safety factor in the geometric model with rounded shoulder.

Prosthetic restoration incorrect morphological elements that do not comply in relation to the marginal periodontium (restoration of proximal contact, aperture, shaping coronary cervical margins, marginal adaptation neck) and periodontal support (reports harmonious occlusal) may have potential iatrogenic periodontal (Frățilă et al., 2013, Sebeșan, 1996, Sebeșan, 2002), inducing a pathology periodontal (gingivitis, periodontitis, occlusal trauma).

Closing correct at marginal incremental limit dental preparations fixed prosthetic restoration can be achieved only when the preparations are made in the exact limit or threshold (Craig, 2011, Dumitriu, 2012).

Profile of the marginal limit of the preparation of dental restorations, determines the thickness and profile of the edges of the prosthetic internal adaptation of the cement expressed by the thickness of the film (Craig, 2011, Sebeșan, 2002), marginal adaptation expressed by their ability to protect dental abutment and septic moist environment of the oral cavity (Bratu et al., 2006) .

Marginal limit → profile internal adjustment → marginal adaptation

The correlation between cervical limit and adaptation profile prosthetic restorations.

CONCLUSIONS:

The study by finite element allows viewing areas at the main tensions arising in the tooth structure under the influence of popular demands exerted on geometric patterns made for the purpose. Finite element analysis yields data needed to determine the optimal form of dental preparations by knowing the correlation form - request to a favorable prognosis prosthetic treatment with determining how therapeutic and prophylactic efficiency of fixed dental prostheses.

Data qualitative and quantitative analysis of major tensions and equivalent strain and the safety factor showed marginal threshold limits rounded (rounded shoulder) Bizot, are most favorable, a fact explained by radius which removes tension concentrators.

Benefits of using finite element study are important both for researchers and for prosthetists specialists because it can identify potential problems since the beginning of treatment. This study has a

beneficial economic impact and provides intuitive education in understanding and applying biomechanical principles in fixed prosthesis. Interfering research in various fields of mechanical engineering, dentistry, constitutes an impetus to the development and evolution of modern clinical and laboratory techniques in dentistry.

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