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ANALYZES OF FRACTURE RESISTANCE OF ENDODONTIC TEETH, RESTORED WITH TITANIUM, FIBER AND ZIRCONIUM POSTS

Dentistry

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ABSTRACT

Objective: The superstructure must have long-lasting and reliable retention of the crown or bridge and enable proper load transfer to the entire root and surrounding supporting tissues. Needs for better esthetics and biocompatibility of restorations provided new improved technologies for titanium and translucent nonmetal restoration systems. The purpose of this examination are mechanical properties of different types of post, we set the goals of this experimental study. **Material And Methodology:** In this study 3 types of posts were used: titanium, FRC and zirconium posts - divided into three groups. **Results:** The different material of the post with a diameter of 1.2, 1.35 and 1.5 mm gives significant differences in the fracture resistance of the post. **Conclusion:** Aesthetics encourages the use of superstructure systems that with their good features increasingly meet the needs of patients.

KEYWORDS

INTRODUCTION

The superstructure must have long-lasting and reliable retention of the crown or bridge and enable proper load transfer to the entire root and surrounding supporting tissues (1). Needs for better esthetics and biocompatibility of restorations provided new improved technologies for translucent nonmetal restoration systems. The rigidity of metal factory post (titanium posts) significantly increases the risk of fracture of the tooth root (2). FRC post are an alternative to many conventional materials. Compared to titanium post, they indicate a reduced incidence of tooth root fracture, while zirconium post in use today have a high modulus of elasticity (3.4). The mechanical and physical characteristics of the post are crucial to the quality and duration of the prosthetic superstructure, hence the protocol of this experimental study to examine the fracture toughness and flexural strength of the various posts used to restore endodontic treatments (5).

LITERATURE REVIEW

The length of the post affects the stress distribution at the root and thouse affects the fracture resistance. The diameter of the posts and the remaining dentin also play a major role in preventing root fracture (6.7). One view is that the width of the peg should not exceed one third given considering that preserving the remaining dentin is very important. The design of the post affects the retention and the success of the restoration (8.9). Ready-made titanium post have several advantages. Compared to cast metal posts, they have better retention capabilities and save time in manufacturing (10.11). Zirconium post offer possible advantages in terms of aesthetics and biocompatibility and have greater strength and fracture resistance. Zirconium post are strong but on the other hand very fragile without elasticity (12.13). In the early 1990s, ready-made polymerized FRC post were introduced to the market. Their use has led to the realization that their elastic modulus is similar to that of dentin (14.15).

OBJECTIVE

Respecting the numerous literature and scientific knowledge that emphasize the role and mechanical properties of different types of post, we set the goals of this experimental test.

1. Comparison of fracture strength between titanium, FRC and zirconium post
2. Testing the bending strength between titanium, FRC and zirconium post.
3. Determining the correlation between fracture strength and flexibility of titanium, FRC and zirconium post.
4. Comparisons:
   1. between different post of the same diameter;
   2. between the same post of different diameters;
   3. how diameter affects - is there a significant difference between groups and in which groups;

METHODOLOGY

- The following are used for the realization of the set goal:

titanium, FRC and zirconium posts - divided into three groups, with three subgroups - 10 samples.

Subgroup I - with a diameter of 1.2 mm post; Subgroup II with post diameter 1.35mm; and Subgroup III with a diameter of 1.5 mm.

- I - group: Titanium post- „Nordin"- Switzerland.
- II - group: FRC post -„Nordin"- Switzerland.
- III - group: Zirconium post- „Nordin"- Switzerland.

The tests were performed at the Faculty of Mechanical Engineering - Shimadzu Universal Testing Machine. The posts were placed at the same distance and force was applied to all, uniformly. The force of the fracture was registered on a special software system connected to the machine "Shimadzu". For the test we used the so-called "three-point bending test". Tertiary load method - titanium, FRC and zirconium (test of bending in three places). Bending strength (δf) and modulus of bending strength (Ef) were calculated in the formula of (Torbjörner et all).

- Formula 1: $\delta f = 8\ Fmax\ 1 / \pi d^3$
- Formula 2: $Ef = S\,4\ l^3 / (3\pi d^3)$

RESULTS AND DISCUSSION

RESULTS:

- The difference between the fracture force;
- Bending strength;
- Strength of elasticity.

Tabel 1: Fracture force of posts

Fracture force of post of different material with diameter D=1.2mm			
Subgroups	Titanium post	Fiber post	Zirconium post
Means	161,6880	45,3790	34,8090
Std.Dev	0,07150	0,00510	0,00624
Std.Err.	0,02261	0,00161	0,00197
Minimum	161,5750	45,3690	34,7980
Maximum	161,8180	45,3870	34,8210
Confidence – 95%	161,6369	45,3754	34,8045
Confidence + 95%	161,7391	45,3826	34,8135

Tabel 2: Bending strenght of posts

Bending strength of posts of different material with diameter D = 1.2 mm, 1.35mm, 1,5mm			
Subgroups	Titanium posts	Fiber posts	Zirconium posts
Means	1430,361	401,442	307,935
Std.Dev.	0,6325	0,0451	0,0552
Std.Err.	0,20001	0,01426	0,01745
Minimum	1429,361	401,354	307,838
Maximum	1431,511	401,513	308,041
Confidence - 95%	1429,908	401,410	307,896
Confidence + 95%	1430,813	401,474	307,975

Tabel 3: Elastic strength of posts

Elastic strength of posts of different material with diameter D = 1.2mm, 1.35mm, 1.5mm			
Subgroups	Titanium post	Fiber posts	Zirconium posts
Means	3,168756	2,943465	3,044698
Std.Dev.	0,001489	0,002387	0,003637
Std.Err.	0,000471	0,000755	0,001150
Minimum	3,166986	2,939120	3,038446
Maximum	3,171706	2,947828	3,050977
Median	3,167691	2,941758	3,042096
Confidence - 95%	3,169822	2,945173	3,047299
Confidence + 95%	3,168756	2,943465	3,044698

DISCUSSION

The different material of the post with a diameter of 1.2, 1.35 and 1.5 mm gives significant differences in the fracture resistance of the post. The diameter of different types of post gives different mechanical qualities that affect the fracture resistance differently. Titanium post showed the highest values of bending strength compared to fiber and zirconium post. The larger diameter of the post significantly increases the fracture resistance relative to the smaller two diameters used in the study. Larger diameter, higher bending strength values, as well as lower material elasticity values contribute to better mechanical qualities of titanium post compared to fiber and zirconium post. Fiber post have the highest average elastic strength, followed by zirconium post and finally titanium post. In terms of bending resistance, FFRC post show approximate results with titanium post, and better values than zirconium post.

CONCLUSION

Aesthetics, as one of the most important world trends in modern dentistry, encourages the use of superstructure systems that with their good features increasingly meet the needs of patients.

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