STRENGTH ESTIMATION OF TEETH REINFORCED WITH DIFFERENT TYPES OF POST SYSTEMS

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1. Introduction

Posts are permanent, single-tooth and periodontal restorations consisting of a crown segment which reconstructs significantly damaged tooth crowns and the root part placed in a root canal of endodontically treated tooth. The custom posts, made of metal alloys (chrome cobalt, gold, chrome-nickel or silver-palladium), have been used over the years. The development of modern material technology allowed to produce of prefabricated posts. These restorations are made of metals (precious metal alloys, stainless steel, titanium and its alloys), ceramics (zirconium oxide) and a composite reinforced with fiber glass or carbon fiber. In the clinical practice it is often a question which one to choose. The aim of the work is to compare and estimate the upper medial incisors reconstructed with the custom posts and prefabricate composites posts reinforced with fiberglass using the finite element method (FEM). There is frequently the problem of selecting the appropriate posts due to durability, adhesion method, the principles of treating tooth tissues, the possibility of removing the posts, aesthetics, biocompatibility and clinical aspects of sustainability restoration in the practice.

2. Material and methods

The material of the study were two groups of numerical models of teeth. In the first group the teeth were strengthened with custom posts and a prosthetic crown. In this group posts were made of metal – alloy CoCr and zirconia – ZrO_2 stabilized with yttrium. The second group included teeth supported with the standard composite posts with fiberglass and later restored with the composite material and the crown. All the virtual models had periodontium modeled. During the chewing, forces make the tooth with crown-root post undergo complex stresses. The vertical component (along the long axis) burdens the toot causing compressing. That is why, to prevent it from cracking the surface of the contact is increased – one performs a flat bearing surface and the restoration is fixed in the canal with cement. The horizontal component of the chewing force makes the tooth bend – both the tooth and the restoration. The labial root surface may be broken. Thus, the tooth is burdened by the forces of chewing to torsion. In case of front teeth, the forces act from the lateral side on the incisal edge. The forces generate stress in teeth and in the surrounding tissues. The most significant task for the post is to provide even and safe distribution of stresses. The post must be strong enough to take in all the stresses without the risk of causing the effort of the tissues. The models were fixed on periodontium. Stresses of 150N were applied on the palatal surface with the help of vectors with directions resulting from the biomechanical analysis and turn to the surface of the tooth.

3. Results of tests

The strength tests show that the higher Young's modulus of the material from which the posts is made, the larger stresses concentrate in it, and smaller stresses are transmitted on the root,

crown and cement. For this reason, the best, in terms of mechanical terms, are posts made of metals of high value of Young's modulus. The custom posts have 7-fond higher flexural strength (1542MPa) than dentine (213MPa), while the fibers glass posts only 4-times (879MPa). The teeth rebuilded with metal and zirconium posts are more resistant to breakage of the posts than the ones from composite material reinforced with fibers glass. That is why, FRC posts are contraindicated at significant occlusive burdens. The destructive force usually causes the damage of less resistant dentine and not post, irrespective of its type. The fractures of teeth with FRC usually occur in the neck of the tooth, in contrast with the badly promising fractures of teeth with custom metal posts and zirconium ones (occuring inside the root).

4. Conclusions

Modeling and numerical analyses give possibility to evaluate the reconstruction of teeth using individual and standard posts. The use of the roots of teeth for prosthetic rehabilitation should be widely used because of the function of periodontium. In the periodontium occurs depreciation of displacements originating from the forces of occlusion and stresses stimulate compressionaly the alveolus in the physiological range. The original solution presented in this work is to take into account the periodontium in the research model. The obtained distributions of stresses confirm clinical observations of damages of teeth reinforced with various types of posts – eg. cervical fracture of teeth strengthened with posts of FRC.

5. References

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