Finite element stress analysis of endodontically treated teeth restored by prefabricated posts

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Abstract

Recently, the reconstruction of endodontically treated teeth with greatest loss of tooth structure is done by using prefabricated post because its easy to be used with a consequent saving of time and money. The stress distribution of masticatory function in endodontically treated teeth restored with post and core can cause root fracture. Many clinical observations indicated that endodntically treated tooth is more fragile than teeth with vital pulp.

The development in the researches area allowed the appearance of a method that provides sufficient and accurate information, like Finite Element Method that has been widely used in engineering, and in last two decades has proved to be extremely effective in dentistry as well.

The purpose of this study is to analyze the stress distribution in endodontically treated teeth restored with prefabricated posts, Parallel-threaded post (Radix-Ancher post with two set of thread number) and Tapered-threaded post (Unimetric post with two different coronal diameter) with two types of materials (Stainless steel, Titanium) based on the Dentsply-Maillefer System, by the finite element method.

In this study a two-dimensional finite element method has been used for stress analysis in eight models as follows:

1- Model (A): tooth restored with parallel-threaded stainless steel post (4 threads).
2- Model (B): tooth restored with parallel-threaded titanium post (4 threads).
3- Model (C): tooth restored with parallel-threaded stainless steel post (8 threads).
4- Model (D): tooth restored with parallel-threaded titanium post (8 threads).
5- Model (E): tooth restored with tapered-threaded stainless steel post (1.64mm coronal diameter).

6- Model (F): tooth restored with tapered-threaded titanium post (1.64mm coronal diameter).
7- Model (G): tooth restored with tapered-threaded stainless steel post (1.83mm coronal diameter).
8- Model (H): tooth restored with tapered-threaded titanium post (1.83mm coronal diameter).

All models were loaded with 100N separated static loads directed vertical on the incisal edge, oblique (45°) on the palatal surface and horizontal on the labial surface.

The result shows that the load direction has much greater effect than post design on the stress distribution. Also the thickness of the dentin wall is directly proportional to the ability of the tooth to withstand the occlusal loads.

The study shows that both designs produced same pattern of stress distribution but the parallel post produced more uniform stress distribution and less stress concentration because parallel post. Post shapes had relatively small effect on stress concentrations while post materials introduced higher effects, stainless steel posts presents the highest stress level of stress concentration, followed by titanium posts because of high modulus of elasticity of stainless steel.

The ideal post is the one that has the stiffness as close as possible to the dentinal tissue with smaller post diameter to preserve as much as possible of dentin tissue.