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Original Article

Comparative Evaluation of Fracture Resistance of Endodontically Treated Teeth with Epoxy Resin-based Sealer AH Plus and Zinc Oxide Eugenol: An *In Vitro* Study

M Harihara Sabari

Senior Assistant Professor, Department of Dental Surgery, Tirunelveli Medical College Hospital, Tirunelveli, Tamil Nadu, India

Abstract

Introduction: Endodontic treatment while trying to save a tooth reduces the tooth structure which, in turn, reduces the fracture resistance of the tooth. Certain root canal sealers by improving the bond between the root canal filling materials and the tooth structure increase the fracture resistance of the tooth.

Aim: This study aims to evaluate and compare the fracture resistance of endodontically treated teeth obturated with gutta-percha using two sealers, AH Plus and zinc oxide eugenol.

Materials and Methods: A total of 60 single-rooted mandibular premolars, decoronated at cementoenamel junction, were divided into two groups (n = 30 each). Cleaning and shaping of root canals were done using ProTaper rotary files and 3% sodium hypochlorite irrigation. Obturation was done using sealers, AH Plus in Group 1 and zinc oxide eugenol in Group 2 and gutta-percha. The teeth were subjected to vertical loading using a universal testing machine, and the readings were recorded at the point at which fracture of the roots occurred.

Results: According to the study, it was found that AH Plus showed better fracture resistance than zinc oxide eugenol. Statistically significant difference was found between the two groups.

Conclusion: AH Plus showed better fracture resistance than zinc oxide eugenol when used as root canal sealer with gutta-percha.

Key words: AH Plus, Root canal sealers, Root fracture zinc oxide eugenol

INTRODUCTION

Endodontic treatment reduces fracture resistance of teeth.[1] The amount of remaining tooth structure plays a key role in the strength of the endodontically treated teeth.[2] When the tooth had vertical root fracture, extraction is the only remaining choice to be done. Vertical root fracture usually had the poor prognosis. Predisposing factors for vertical root fracture are root canal configuration and anatomy, dehydration, caries with extensive tissue loss, trauma, craze lines, and loss of bone support. Iatrogenic factors that lead to vertical root fracture include instrumentation, the effect of irrigation solutions, prolonged use of calcium hydroxide, condensation pressure exerted during obturation, and intracanal post space preparation.[3-5] By selecting appropriate root canal filling material, we can reinforce the dentin, and hence, increasing the fracture resistance of the tooth.[10]

Glass ionomer cement or composite resins were used to reinforce the endodontically compromised teeth, were better than zinc oxide eugenol cement.[6,7] Root canal sealers should strongly adhere to dentine, which increases the strength of the restored teeth. Bondable root canal sealers create monoblocks. The use of adhesive root canal obturating material is known as monoblock effect.[8,9]

The success of endodontically treated teeth depends on the obturation of the root canals. Gutta-percha has been

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Corresponding Author: Dr. M Harihara Sabari, Department of Dental Surgery, Tirunelveli Medical College Hospital, Tirunelveli, Tamil Nadu, India. Phone: +91-9095740705. E-mail: hariconsendo@gmail.com

the most frequently used material for root canal obturation. Resin-based sealers have the advantage of adhesion to the dentinal walls that, in turn, results in less microleakage and some strengthening effect to the teeth.[9] Studies have shown that the bond strength of AH Plus, the epoxy resin-based sealer, was significantly higher than zinc oxide eugenol, glass ionomer, and calcium hydroxide-based sealers.[10]

The purpose of this *in vitro* study was to compare the fracture resistance of endodontically treated teeth obturated with conventional gutta-percha using epoxy resin-based sealer AH Plus (Dentsply, Germany) and zinc oxide eugenol sealer.

Aim

This study aims to evaluate and compare the fracture resistance of endodontically treated teeth obturated with gutta-percha using two sealers, AH Plus and zinc oxide eugenol.

MATERIALS AND METHODS

A total of 60 samples, divided into 30 in each group extracted single-rooted mandibular human incisor teeth were selected with their buccolingual, and mesiodistal dimensions were similar. Teeth were immersed in 5% sodium hypochlorite (NaOCl) solution for 2 h for surface disinfection. Pre-operative radiographs were taken to ensure that the collected teeth did not have open apices, calcifications, many canals, and fractures. All teeth were decoronated using a flexible diamond disk in a slow speed handpiece to a standardized length of 12 mm as measured from the apex to the facial cement-enamel junction (CEJ). The teeth were divided into two experimental groups, 30 in each group. Coronal access was made. The working length was determined. Cleaning and shaping of the root canals were completed with ProTaper rotary NiTi files (Dentsply Maillefer, Switzerland) at a speed of 300 rpm. Finally, F1 master cone gutta-percha (Dentsply, Maillefer) was placed into the canal and checked radiographically.

Grouping method:

- Group 1: Obturation with gutta-percha and sealer as AH Plus.
- Group 2: Obturation with gutta-percha and sealer as zinc oxide eugenol.

Sealers were mixed according to the manufacturer instructions. Root canals were coated with sealers using Lentulo spirals and obturated using F1 ProTaper gutta-percha points. Post-obturation radiographs were taken for all the experimental root samples. The filled roots were stored in an incubator for 7 days at 37°C with 100% relative humidity to allow the sealer to set completely. Each tooth was mounted vertically to a depth of 2 mm below the CEJ in polystyrene resin block. The universal testing machine was used to test the resistance against vertical root fracture. The amount of force required for fracture was recorded in Newton's. A load of fracture in Newton's was converted to megapascals.

The fracture load data were subjected to statistical analysis using SPSS software version 16. Comparisons among the two groups were performed by independent sample *t*-test. The statistical analysis was performed at 95% confidence level.

RESULTS

The number of samples after analyzing the values of all the 60 samples, 30 for each group AH Plus proved to be better than zinc oxide eugenol. The resin sealer AH Plus (27.65) showed higher fracture resistance than zinc oxide eugenol (18.89), the results were statistically significant ($P < 0.0001$) [Table 1 and Figure 1].

DISCUSSION

Endodontic procedures such as access preparation, use of calcium hydroxide as an intracanal medicament, instrumentation, and irrigation with NaOCl and EDTA reduces fracture resistance of endodontically treated teeth. A study concluded that instrumented but unfilled roots are much weaker than filled roots that, in turn, increases fracture.[11]

Finite element analysis study results showed that circular canals have more uniform stress distribution than oval canals. Oval canals have greater stresses present at the labial and lingual canal extensions and the cervical and middle thirds.[12]

Table 1: Comparison of two groups with respect to fracture resistance in megapascals by independent sample *t*-test

Group	*n*	Mean±SD	*P* value
AH plus	30	27.65±2.51	<0.0001
Zinc oxide eugenol	30	18.89±2.45	

SD: Standard deviation

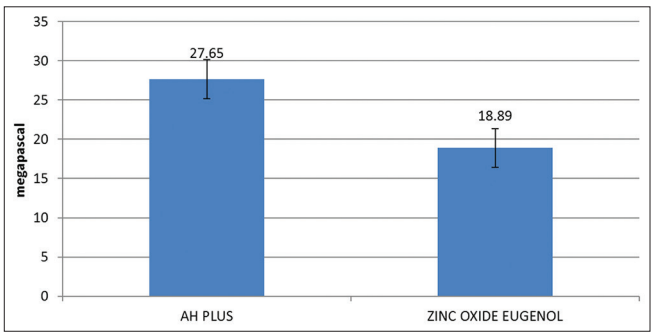

Figure 1: Comparison of fracture resistance of the two sealers

The aim of three-dimensional obturation is to attain a fluid tight seal within the root canal system to prevent reinfection and to provide a favorable biological environment for tissue healing.[13] Some studies report that rotary instrumentation increases the risk for craze lines and dentin cracks and reduced root fracture resistance when compared to hand files.[14] When the cleaning and shaping are done up to the root canal length, apical cracks are more likely to appear. It is better to confine shaping 1.0 mm short of the root apex.[15]

Apical enlargement was done with ProTaper F1 in this study. EDTA and sodium hypochlorite were used to remove the smear layer which, in turn, enhances bonding of the materials to the dentinal surface of the roots.[16] The two key factors that improve the fracture resistance of endodontically treated teeth are stable adhesion to root canal dentin walls and an elastic modulus similar to dentin.[17]

AH Plus is an epoxy-based endodontic sealer. It can be used with gutta-percha. It comes as a two paste system.[18] It has a working time of 4 h and setting time of 8 h, has good adhesion to dentin and gutta-percha.

Zinc oxide eugenol sealer has a powder base and liquid catalyst. This radiopaque canal sealant is a non-toxic and non-irritating formulation that has a long history of clinical success. Phukan *et al.* in their study showed that AH Plus had significantly high resistance to fracture than all other tested root canal sealers including zinc oxide eugenol and calcium hydroxide-based sealers.[19]

Mandava *et al.* in their study concluded that teeth obturated with AH Plus + GP are more resistant to fracture than those obturated with Resilon-Epiphany, with zinc oxide eugenol the least resistance to fracture.[20] AH Plus showed the higher fracture resistance than MetaSEAL and MTA Fillapex.[21]

In the present study, there was a definite statistically significant difference between AH Plus and zinc oxide eugenol sealer in the fracture resistance of endodontically treated teeth. AH Plus sealer showed much higher fracture resistance of endodontically treated teeth than the zinc oxide eugenol sealer.

CONCLUSION

The bonding of endodontic sealers to intraradicular dentin after obturation might enhance the resistance to fracture of endodontically treated teeth. Within the limitations of the present study, it can be concluded that AH Plus showed higher fracture resistance than zinc oxide eugenol sealers. The results were statistically significant ($P<0.0001$).

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