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Influence of root canal obturating materials on root fracture resistance

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Abstract

Aim of study: To evaluate the fracture resistance of roots obturated with different root canal filling materials.

Materials and methods: A total of 15 decronated single canal lower premolar human teeth were used. Specimens were prepared by conventional manual instrumentation method from size (15_45) using K_file. Canal Irrigated with (5.25%) sodium hypochlorite (NaOCl) after each file and finally canals irrigated with17% EDTA. Specimens divided into three groups according to obturation materials 1) obturation with Endosequence Bioceramic system 2) obturation with Bioceramic sealer and conventional gutta percha 3) obturation with AH_plus resin sealer and conventional gutta percha. Specimens were embedded in acrylic molds and subjected to the fracture resistance test in which a compressive loading (0.5 mm/min) was applied on the coronal opening of the canal until root fracture.

Result: Data was analyzed by one way ANOVA followed by Tukey test at 0.05 level of significance. There was a significant difference between groups with higher value obtained with Endoseuequence system and lower value obtained with AH_plus resin root canal sealer ($p<0.05$).

Conclusion: Types of obturating materials influence the fracture resistance of root.

Key words: bioceramic sealer, Active getta percha, root fracture resistance.

Introduction

One of the most serious complications of root canal treatment is the vertical root fracture that can occur after root canal obturation.[1] To reinforce roots, stress concentrations at the dentin-material interface should preferably be minimized by using materials reinforcing roots after treatment.[2] Bonding endodontic obturation materials to radicular dentin is another approach to increase fracture resistance of endodontically treated teeth such as resin sealer, In recent years different filling materials and sealers have been developed on the basis of dentin adhesion technology in an attempt to seal the root canal more effectively, and to increase fracture resistance of root filled teeth.[3] Furthermore, manufacturers have further incorporated adhesive dentistry in Endodontics by introducing obturation systems with a specific focus on obtaining a “monoblock” in which the core material, sealing agent, and root canal dentin form a single cohesive unit.[4] Recently, the introduction of Endosequence technology is considered a game changer in endodontic obturation ,which is consist of an Active gutta percha cone and Bioceramic sealer, gutta percha is a system which utilizes special coated gutta percha cone to create a true single cone monoblock obturation.[5] The bioceramic sealer is a premixed, ready-to-use and hydraulic cement paste. It is composed of calcium phosphate, calcium silicate, calcium hydroxide, zirconium oxide, filler and thickening agents, one of its advantages is its ability to form hydroxyapatite during the setting process and ultimately create a bond between the dentinal wall and the sealer.[6] Little information available about the influence of different adhesive sealers and obturating materials on the fracture behavior of the roots filled with such materials. Therefore the objective of this study is to evaluate the effect of different obturating materials on fracture resistance of the root. The hypothesis to be tested in this study is that there is no difference in the fracture resistance of the root obturated with different root canal filling materials.

Material and Methods

fifteen sounds human single-root mandibular premolars were collected from department of oral surgery and orthodontics, Mosul University of Mosul, Iraq. The teeth were scaled and thoroughly cleaned with pumice, The teeth were examined under stereomicroscope to detect the presence of cracks or any other defects then stored in water until their use. Teeth were decoronated using a stainless steel disc with a straight hand piece to achieve a standardized root length of 14 mm. The roots were accessed, and pulp removed with barbed broach and irrigated with normal saline. The working length for each root was determined by subtracting 1 mm from the length of an inserted #15 K-file with its tip visualized at the apical foramen under magnification.

Root Canal Preparation

Specimens were prepared with conventional manual instrumentation from size 15_45. Canals irrigated with 2 ml of the sodium hypochlorite NaOCl after each file. After completion of the root canal preparation. The canal irrigated with17% EDTA and dried with paper points.

Obturation of root canals:

Specimens divided into three groups according to obturation materials Group (1): Root canals were obturated with Endosequence system which consist of (Bioceramic-based sealer, ActiV GP cones and paper point).The tip of sealer syringe inserted into the canal till the reach apical part then sealer injected through the canal until it filled , then ActiV GP cone size #45 was inserted and the cone was subsequently seared off with a hot plugger. Group (2): roots canal was obtuarted with Endosequence Bioceramic sealer, the sealer was injected through the intracanal tip to fill the canal, then conventional GP cone size #45 was inserted and The cone was subsequently seared off with a hot plugger. Group (3): Roots canal filled AH_plus resin sealer then master GP size #45 was inserted and The cone was subsequently seared off with a hot plugger.

Fracture Resistance Test:

Specimens were prepared for mechanical testing by mounting the specimens vertically in a plastic tube of 1cm high and 1.5 cm diameter and filled with self-cure acrylic resin. The apical 5 mm of each root was embedded in the resin exposing the remaining 9 mm The acrylic blocks were mounted on the lower fixed compartment on a universal testing machine , then secured by tightening screws. The upper plate of the machine included a cone-shaped rod (3mm in diameter, metal rod with a blunt tip) that was mounted directly over the canal opening of the root. specimens were then subjected to a slowly increasing vertical load at (0.5m/min) until root fracture. The load at failure was measured and expressed in Newton's.

Statistical Analysis

Data on fracture resistance were collected and subjected to statistical analysis using one-way analysis of variance (ANOVA) followed by the Tukey post hoc test for comparison between the groups when the ANOVA test was significant. The level of significance was set at $P<0.05$.

Result

The mean values of fracture resistance of the studied groups are presented in Table (1.1) one-way analysis of variance (ANOVA) showed a significant effect of obturating materials on fracture resistance. Tukey test demonstrated that group obturated with AH_plus resin sealer show significantly lower value in comparison with other groups at ($P<0.05$). There is no significant difference between the Endosequence system and Bioceramic sealer with a conventional GP group ($P<0.05$).

Table (1.1): Mean and SD of root fracture resistance obturated with different sealer

Obturation methods		
Endosequence Bioceramic system	Bioceramic with conventional gp.	AH_plus with conventional gp
Mean SD	Mean SD	Mean SD
890.23 214.73	841.23 168.46	575.06 184.29

Discussion

here is no doubt that canal preparation would weaken the tooth structure predisposing it to fracture.[7] Selecting a material or a combination of materials to fill the root canal that has the ability to reinforce the tooth structure and strengthen it against fracture is crucial for success of root canal therapy[8]. Endosequence bioceramic sealer with active gutta percha cone promising in increasing the fracture resistance of root.

In the present study obturation with a combination of following material as group 1 (Biocermic sealer / Active GP cones) exhibited the significantly highest fracture resistance between the tested groups. This could be due to the nature of the sealer (Endosequence bioceramic sealer) that having a self adhesive ability which forms a chemical bonding with root canal dentin that leading to production of hydroxyapatite during the setting process. One of the main properties of this sealer is that when material exposed to the moisture condition as that presents within the dentinal tubules.[9] It will react to produce different by product which form bonding another reason for high fracture resistance could be also from the bonding between the glass components in the bioceramic sealer to Active GP (glass ionomer–coated cones). 9These bonding will increase the fracture resistance of root and leading to the strengthening of the tooth structure, Active GP shows higher fracture resistance than conventional GP cones because it will result of one unit structure or what is called monoblock. Karapinar Kazandag[10], who reported a differ root fracture resistance when using Bioceramic sealer one time with conventional GP and anther time with Active GP cone saw increasing fracture resistance with Active GPs This could be occur due to the chemical bond that form between the ceramic particles found in both sealers and in the Active GP cones as previously mention[11,12] group 2 (Bioceramic / conventional GP) show no significant differences with group 1 this may be a return to the strong effect of the sealer in strengthening of the root in comparison to the gutta percha . group 3 (AH_plus / conventional GP) Obturation of the canals with AH Plus in this study did not strengthen the canals significantly compared with canal obturatted with bioceramic sealer because resin sealer depends on mechanical bonding rather than Bioceramic sealer which show mechanical and chemical bonding with root canal dentin .

Conclusion

The root fracture resistance of the roots obturated with different filling materials was different according to the material condition used in obturation.

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