

## THE EFFECT OF DIFFERENT ADHESIVE OBTURATING MATERIALS ON THE FRACTURE RESISTANCE OF ENDODONTICALLY TREATED TEETH

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### **ABSTRACT**

This study aimed to evaluate the fracture resistance of teeth obturated with different adhesive obturation systems. Seventy freshly human extracted single rooted teeth were selected. The samples were biomechanically prepared and classified according to the type of the obturating material into four groups as follows; Group 1; (21 samples) obturated with conventional gutta-percha and AD-seal sealer (META, Chungcheongbuk-do, Korea). Group 2; (21 samples) obturated with ActivGP cones and Activ GP sealer (Brasseler, Savannah, USA). Group 3; (21 samples) obturated with resilon cones and Epipheny sealer (Pentron, Wallingford, USA). Group 4; Control group (unobtured). The samples were further classified according to the observation time into: Subgroup A; (7 samples) after one week. Subgroup B; (7 samples) after one month and Subgroup C; (7 samples) after three month. Samples were loaded vertically after obturation using Universal Testing Machine until fracture. It was found that ActivGP showed the highest resistance followed by Resilon then conventional gutta-percha. It was concluded that Activ Gp obturating system can strengthen the endodontically treated teeth more than Resilon/Epipheny system.

### **INTRODUCTION**

The main problem of endodontically treated teeth is its liability to vertical fracture<sup>(1,2)</sup>. Which is related to multiple factors such as previous weakening by carious lesion, access cavity preparation, biomechanical preparation and chemical materials used either for irrigation or intra canal medications. Many attempts have been made for strengthening of

the endodontically treated teeth. The main purpose of adhesive root canal filling materials is the creation of fluid tight seal<sup>(3)</sup> through the creation of the concept of the monoblock and so offers strengthening of the endodontically treated tooth. This research was done to evaluate the strengthening effect of different adhesive root canal obturation systems

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## MATERIALS AND METHODS

### Samples Preparation

Seventy freshly human extracted single rooted teeth were selected free from any cracks or fracture line and inspected under light microscope (10X). Before canal instrumentation, decoronation of the teeth was performed by using a high-speed carbide bur and water spray to obtain standardized 15-mm long roots.

### Root canal instrumentation

The samples were biomechanically prepared in crown down manner using Revo S rotary system (Micro-Miga, Besancon Cedex, France). Coronal preparation was done for all samples using SC1 file to 10 mm. length. The apical preparation was done using SC2 then SU file to the full working length. Then the apical preparation was finished using AF #40. Irrigation of samples was done using 2.5% (NaOCl). At the end of the preparation the smear layer was removed by irrigation with 10 ml. of 17% Ethylene Diamine Tetra Acetic acid (EDTA) for one minute followed by 10ml of 5.25% NaOCl then dried using ethanol.<sup>(4)</sup>

### Samples Classification

The samples were classified according to the type of the obturating material into four groups as follow: Group 1; (21 samples) obturated with conventional gutta-percha and AD-seal sealer. Group 2; (21 samples) obturated with ActivGP cones and ActivGP sealer. Group 3; (21 samples) obturated with Resilon cones and Epiphany sealer. Group 4; Control group (unfilled). After obturation, the samples were immersed in normal saline. The samples were further classified according to the observation period into: Subgroup A; (7 samples) after one week, subgroup B; (7 samples) after one month and subgroup C; (7 samples) after three months.

### Obturation of samples

Group I; *Conventional GP/AD-seal*; after drying the canals. Master cone was checked to the working length then resin sealer was mixed and applied to the canal using the master cone. Obturation was done using down packing for the apical 5 mm. using gutta-percha cone size 40/0.04 and system B at 200°C. The prefitted plugger was used for back filling using Obtura II system at 160°C..

Group I I; *Activ GP / Activ GP sealer*; the glass ionomer sealer was prepared according to the manufacture instructions (3 drops liquid and 1 spoon powder mixed homogenously). The sealer was introduced into the root canal with the prefitted and radiographically verified master cone size 40/0.04.

Group III; *Resilon / epiphany sealer*; primer was applied to the dentin walls of the root canals using specific intracanal brushes. Epiphany sealer was mixed and applied using prefitted master cone. The roots were obturated using warm vertical condensation technique. With system B and Obtura II system for back-filling

After obturation, all samples were immersed in normal saline according to its subgrouping.

### Mounting of samples

A copper mold formed of a block former and a perpendicular arm was used to form the specimens. The specimen was formed of the obturated samples embedded in self cured acrylic resin.

### Method of evaluation

The acrylic blocks including the samples were mounted on the lower fixed compartment of a Universal Testing Machine (Model LRX-Plus, Lloyd Instruments, Fareham, UK) with a loadcell of 5 kN –secured by tightening screws. Samples were subjected to a slowly increasing vertical load (1mm/min) until the fracture occurred. Data were recorded using computer software (Nexygen-MT-4.6; Lloyd Instruments).

**Statistical analysis:**

Data were analyzed by SPSS software (version 16.0, SPSS, Chicago, IL, USA). Data in each group were compared by the ANOVA and Kruskal-Wallis tests. Also the Dunnett’s test was performed to compare the results between two groups. The level of significance was set at 0.05.

**RESULTS**

**Group I:** Conventional gutta-percha ; the average fracture resistance of samples after one week observation period was 540 N. and decreased by time to reach 530 N. after one month and 528 N. after three months.

**Group II:** Activ GP; the average fracture resistance of samples after one week observation period was 774 N. and increased by time to reach 790N. after one month and 816 N. after three months.

**Group III:** Resilon; The average value of the fracture resistance after one week observation period was 620 N. while it was 612 N. after one month and 615 N. after three months.

**Group IV:** Control; the empty samples showed fracture resistance of 528 N.

The differences between the four groups were statistically significant among the three observation periods used. The samples obturated with ActivGP system showed the highest values followed by Resilon then conventional gutta-percha.

TABLE (1) Fracture resistance ( average and standard deviation) of different groups. (N).

Group / Subgroup	Conventional GP	ActivGP	Resilon	Control	P-value
1 week	540±110	774±170	620±102	528±106	<0.0001
1 month	530±170	790±209	612±96		<0.0001
3 months	528±148	816±144	615±106		<0.0001

*P ≤ 0.05 is considered significant.*

**DISCUSSION**

An ideal root canal filling material should be able to reinforce and strengthen a weakened root canal structure against fracture in addition to proper sealing ability<sup>(5)</sup>. Numerous in vitro studies have shown that gutta-percha obturated teeth leak at high rates, so there has been an effort to develop adhesive obturation materials such as Resilon / Epiphany system and ActivGP system which may provide better seal of the root canal by providing a monoblock concept<sup>(6)</sup>. Several studies have shown that bonding to root dentin enhances the resistance of endodontically treated teeth to vertical fracture<sup>(7-9)</sup>. Ghoneimetal<sup>(10)</sup> stated that the type of

the core filling and the bond it would create with the sealer proved to have a significant effect on the fracture resistance.

Activ GP is an innovated root canal filling material that is formed of gutta-percha coated with glass ionomer which can bond chemically to root canal dentin through the use of glass ionomer sealer<sup>(11,12)</sup>. Tay and Pashley<sup>(13)</sup> classified it as tertiary monoblock through the presence of three interfaces between the root canal dentin and the core material.

Resilon is a synthetic polymer and thus resin sealer attaches to it as well as to the bonding agent or primer which penetrates easily to dentinal tubules<sup>(5)</sup>.

The results of this study showed that there was statistically significant difference in the resistance to the vertical fracture between the three tested materials with the ActivGP showing the highest values. Karapinar Kazandag<sup>(14)</sup> reported a significant increase in the fracture resistance with the use of ActivGP system which can be related to the chemical bond developed between the ceramic particles found in ActivGP sealer and the glass ionomer coating the core<sup>(15-16)</sup>. There was no chemical or mechanical bond was created between the conventional gutta-percha and the resin sealer used<sup>(17)</sup>. These findings were in disagreement with Celiktenetal<sup>(18)</sup> and Baser Can et al.<sup>(19)</sup> who stated that the Activ GP system has a high volume of voids.

It was also found that Resilon/ Epiphany system showed higher fracture resistance than conventional gutta-percha with resin. This finding was in agreement with Ashraf etal<sup>(5)</sup> who concluded that Resilon/Epiphany system has the potential to enhance the root fracture resistance which is attributed to the adhesive potentiality achieved between root dentin, obturating resin core and sealer.

The values for ActivGp were higher than Resilon. This may be attributed to the type of the bond created between the core, sealer and dentin where glass ionomer form chemical bonding with the hydroxyapatite crystals of dentin, while resin materials offer mechanical interlocking.

## CONCLUSION

ActivGp obturating system can strengthen the endodontically treated teeth more than Resilon/ Epiphany system.

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