

Original Article

AN INVITRO COMPARATIVE EVALUATION OF FRACTURE RESISTANCE OF ENDODONTICALLY TREATED TEETH OBTURATED WITH RESILON AND GUTTA-PERCHA

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Abstract:

Aim: To compare and evaluate *in-vitro* the fracture resistance of endodontically treated teeth obturated with resilon & epiphany sealer and guttapercha using different sealers. Epoxy resin based sealer AH-plus and zinc oxide eugenol based sealer-TubliSeal (EWT).

Methodology : sixty four human single rooted maxillary anterior teeth, cleaned stored in 0.9% saline. All the teeth were decoronated to root length 14mm and bucco-lingual diameter of 5-7mm, After access openings teeth were instrumented using K3 .06 up to final apical size 30/.06 and randomly allocated into 4 experimental groups (n=16 per group). Group 1(Control group): teeth were instrumented but not obturated, Group 2: Resilon cones and epiphany SE-sealer. Group 3: guttapercha cones and epoxy based sealer AH plus. Group 4: guttapercha and Tubli seal EWT. Coronal seal was done using IRM cement. Each of the specimens were tested for fracture resistance by instron universal testing machine.

Results : Higher fracture resistance values were observed for group 2 (Resilon & Epiphany SE sealer) followed by group 3(Guttapercha & AH Plus sealer) and group 4(Guttapercha & TubliSeal EWT) when compared to group1 (control-instrumented but not obturated).

Conclusion: filling the root canals with contemporary polymer based root canal obturating system- Resilon increased the *in vitro* fracture resistance of endodontically treated teeth.

Keywords : Fracture resistance, resilon, guttapercha.

Introduction :

Endodontically treated teeth are widely considered to be more susceptible to fracture than the vital teeth. The reasons most often reported have been the loss of structural integrity¹, loss of collagen cross-linking and water loss², dehydration of the dentine after endodontic therapy, removal of tooth structure during several endodontic procedures³, such as access cavity preparation, cleaning & shaping, root canal irrigation⁴, and excessive pressure during obturation⁵. It is commonly believed that the loss of dentine results in an increased susceptibility to fracture⁶.

Obturation of the root canal system is an important step for the success of endodontically treated teeth. Currently, there are a plethora of materials and condensation techniques available that must meet the basic requirements of obturation phase. Guttapercha with a root canal sealer has widely been used for years as a root canal filling material due to its biocompatibility, dimensional stability, thermoplasticity, and ease of removal. But, its limited ability to fill and seal the root canal system has been reported for the majority of root canal failures. However, despite of their limited ability to achieve an impervious seal along the dentinal walls of the root canal, it remains the material of choice against which the other obturating materials are compared⁷.

Root canal sealers should strongly adhere to dentine.

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Increased adhesiveness to dentine may lead to greater strength of the restored teeth, which may provide greater resistance to tooth fracture and clinical longevity of an endodontically treated tooth and therefore, decreasing the chances of endodontic failure⁸

Although few materials have seriously challenged guttapercha and sealer in majority of filling situations, research continues to find alternatives that may seal better and mechanically reinforce compromised roots. Resin based sealers have been used for several years to take advantage of adhesion to the dentinal walls which results in less micro leakage and is considered to provide some strengthening effect to the teeth.⁹

Resilon a synthetic polymer based obturating material broadens the dimensions of endodontic adhesion. This system consists of a combination of primer, dual cure sealer and resin obturating material¹⁶ and creates a monoblock filling. This is created by the adhesion of resilon cone to resin based sealer, which adheres to the dentinal wall and penetrates into dentinal tubules.^{10,11} Shipper et al called it as "Resilon Monoblock system" (RMS), which has the potential to strengthen the root canal walls against the fracture and decrease the micro leakage.

The purpose of this in-vitro study was to compare the fracture resistance of endodontically treated teeth obturated with Resilon & Epiphany SE sealer with that of conventional Guttapercha using different sealers Epoxy resin based sealer-AH Plus and Zinc oxide Eugenol based sealer-TubliSeal EWT.

Methodology:

Sixty four human single rooted maxillary anterior teeth recently extracted for periodontal reasons, root length of at least 14mm and bucco-lingual dimensions of 5-7mm confirmed with the help of digital Vernier callipers were used. Examined under 20x magnification under a microscope to rule out any cracks, caries, and fractures or craze lines and radiographed to determine the presence of a single canal were included for the present study. The teeth were cleaned off soft tissue, calculus and stains with

the help of sharp hand scalers thoroughly washed and stored in 0.9% saline at room temperature until use.

All the teeth specimens were decoronated using a double sided diamond coated disc, so that the remaining root length was 14mm and the bucco-lingual diameter of 5-7mm. In all the 64 specimens access openings were prepared using #4 round bur and working length was determined by placing a No 10 K file (Mani) in to the root canal, until it was just visible at the apical foramen and then withdrawing it by 1 mm. The teeth were instrumented using K3 .06 (SybronEndo, USA) Ni-Ti rotary instrument system in an Anthogyr gear reduction hand piece (Dentsply) at 250 rpm using a gentle in and out motion, to final apical size 30/.06.

Copious root canal irrigation using 5ml of 3 % sodium hypochlorite solution using a syringe and 27 gauge needle was performed finally flushed with 5ml of 17% EDTA solution followed by 5ml of 3 % sodium hypochlorite solution in order to remove the smear layer for 1-2 minutes. This was followed by a final irrigation with 5ml of 0.9% Normal saline. Each of the root canal specimens were dried with sterile paper points.

All the 64 specimens were randomly allocated into 4 experimental groups (n=16 per group) as follows.

Group 1: (Control group) teeth were instrumented but not obturated.

Group 2: Obturation was done using resilon cones and epiphany SE sealer.

Group 3: Obturation was done using guttapercha and AH plus

Group 4: Obturation was done using guttapercha cones and tubli seal EWT.

In all the groups the specimens were obturated using lateral condensation technique, the sealers were mixed according to the manufacturer's instructions and applied using lentulo spirals. Finally 1 mm coronal seal was done using IRM cement.

Preparation for mechanical testing:

An acrylic block was fabricated to allow for adequate

stabilization of the specimens during testing procedures. A 20x20x25 mm aluminium mould was used. Self curing acrylic resin was introduced in to the mould in dough stage and then root ends were embedded in to resin in a vertical plane and long axis of each root was vertically aligned using a protractor. Later on the acrylic blocks were polished and allowed to set at room temperature. IRM cement is removed using carbide bur and each of the specimens were tested for fracture resistance by Instron Universal testing machine.

Each of the mounted specimens was placed on a metal base under the Instron universal testing machine. A spherical tip of radius 2mm was used to apply a vertical loading force at a cross head speed of 1mm per minute until fracture occurred. Fracture resistance was defined as the point at which a sharp decline and instantaneous drop greater than 25% of the applied load was observed for each root and so the machine was adjusted to terminate the test when a 25% reduction of force applied was observed. At that time the maximum force to fracture the specimen was recorded.

The loads at which different root specimens fractured were recorded in Newton's and the data was subjected to appropriate statistical analysis (table 1).

RESULTS :

Data were summarized as Mean ± SD. Considering this statistical situation a more detailed analysis One Way ANOVA test was done (table 2). Further this was substantiated with multiple comparisons through Post hoc Scheffe multiple comparison test (table 3). The following results were drawn from the study.

- | Higher fracture resistance values were observed for group 2 (Resilon & Epiphany SE sealer) followed by group 3(Guttapercha & AH Plus sealer) and group 4(Guttapercha & TubliSeal EWT) when compared to group1 (control-instrumented but not obturated).
- | Significant difference between group 1 and group 2, Group 1&group 3.
- | However there was no significant difference between group 1 and group 4.
- | Group 2 compared to group 1 and group 4 showed highly significant difference.
- | Group 3 showed significant difference when compared to group 1 and group 4.
- | No Statistically significant difference was observed between group 2 and group 3.
- | Similarly no statistical difference was observed between group 1 and group 4.

Table 1: Descriptive statistics of the loads to fracture different specimens.

Group	No.	Minimum Load	Maximum Load	Mean	Standard deviation	Std. Error of mean
Group 1 Control	16	173.83	263.01	215.2975	22.74279	5.77497
Group 2 Resilon	16	344.67	447.95	399.5850	27.65964	6.66491
Group 3 AH Plus	16	346.12	434.78	378.8906	25.94616	6.48654
Group 4 Tubliseal EWT	16	193.58	284.75	224.7513	23.09989	5.68570

Table 2 : One Way-ANOVA Analysis

ANOVA Dependent Variable	Sum of squares	Degree of freedom	Mean squares	F value	Significance
Between groups	508933.5	3	69644.511	78.702	.000
Within groups	36521.686	60	608.695		
Total	545455.2	63			

F value – 278.702

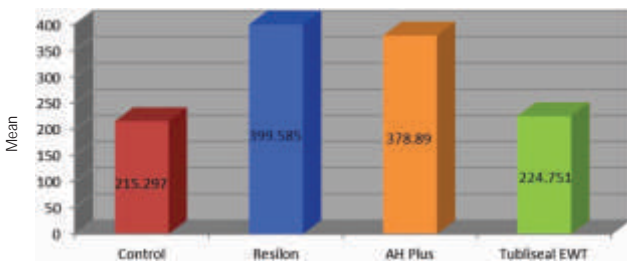
ANOVA revealed very highly significant difference between the groups i.e., P<0.001.

Table 3 : Post Hoc Scheffe multiple comparison tests for comparing the fracture loads of specimens of several test groups.

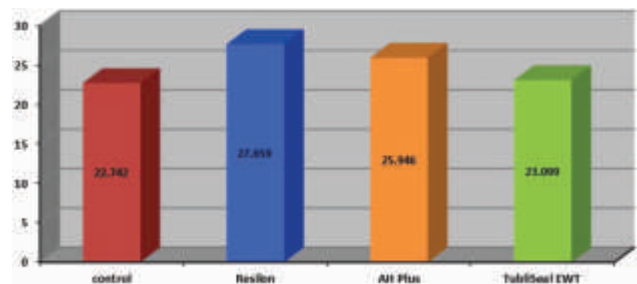
(I) Type Of Material (groups)	(J) Type Of Material	Mean Diff. (I-J)	Std. Error	Sig.	95% confidence interval	
					Lower boundary	Upper boundary
Control (Group1)	Resilon	-184.28750*	8.72278	.000	-209.3785	-159.1965
	AH Plus	-181.59313*	8.72278	.000	-206.6842	-156.5021
	Tubliseal EWT	-9.45375	8.72278	.760	-34.5448	15.6373
Resilon (Group2)	Control	184.28750*	8.72278	.000	159.1965	209.3785
	AH Plus	2.69438	8.72278	.867	-22.3967	27.7854
	Tubliseal EWT	174.83375*	8.72278	.000	149.7427	199.9248
AH Plus (Group3)	Control	181.59313*	8.72278	.000	156.5021	206.6842
	Resilon	-2.69438	8.72278	.867	-27.7854	22.3967
	Tubliseal EWT	172.13938*	8.72278	.000	147.0483	197.2304
Tubliseal EWT (Group4)	Control	9.45375	8.72278	.760	-15.6373	34.5448
	Resilon	-174.83375*	8.72278	.000	-199.9248	149.7427
	AH Plus	-172.13938*	8.72278	.000	-197.2304	-147.0483

*The mean difference is significant at the .05 level.
Dependent Variable (Force Newton)

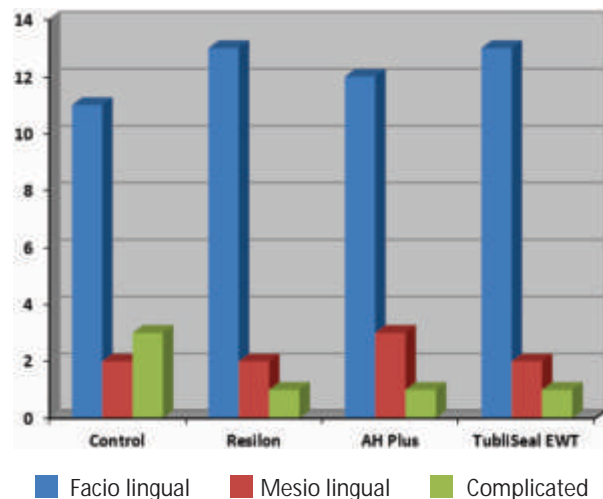
Graph 1: Graphical representation of the mean load values to fracture roots.



Graph 2: Graphical representation of the mean standard deviation values to fracture



Graph 3: Pattern of fractures in different root specimens



that as removal of tooth structure increases, fracture resistance of the tooth decreases.^{3, 7} It has been reported that incidence of vertical root fractures is greater in root filled teeth than in the vital teeth.^{7,9,10,11} Addition of wedging forces of the spreader during lateral condensation or excessive removal of dentin to facilitate pluggers for vertical condensation, enhance the potential for root fracture^{1,5} Any material that can compensate for this weakening effect would be useful.^{1,6}

The primary goal of endodontics is not only to treat the diseased pulp of a tooth, but also to increase the inherent strength of the remaining tooth structure. Resilon a synthetic polymer based obturating system has been claimed to be the most promising material as an alternative to guttapercha. Clinically, resilon appears similar to guttapercha and has the same handling characteristics, biocompatible, radio-opaque, dimensionally stable and

Discussion:

Root canal instrumentation is an essential stage in endodontic treatment. There is a perception that endodontic treatment weakens the tooth structure and predisposes teeth to fracture^{2,3,4,5,6}. Studies have suggested

has good flow properties,¹² easily retrievable if needed¹³, can be utilized in various obturation techniques such as lateral condensation, vertical condensation and thermoplasticized techniques,¹⁴ it forms a superior seal to coronal & apical leakage when compared with guttapercha techniques.

In the present study, root canal obturation was done by lateral condensation technique because it is a more widely recommended and a proven classic technique¹⁵

From the results of the present study, it was noticed that majority of the test specimens fractured in faciolingual directions which is in accordance to Lertchirakarn et al (2002)¹⁶.

The development of bonded obturating materials is in congruence with the efforts to provide a more effective seal apically as well as coronally. The adhesion between dental structures and resin based sealers is the result of a physicochemical interaction across the interface, allowing the union between filling material, sealer and root canal wall. Because the resin core, sealant and the dentinal wall all are "attached", it appears logical that they have the potential to strengthen the walls against fracture.¹²

The fracture resistance of the specimens in group 1

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(control) which were instrumented but not obturated was the least compared to all other groups with obturation. However clinically one can never leave an empty canal, but it suggests that the roots after endodontic treatment without any filling materials are not strong enough and have lower mean fracture resistance values and so in other words, all the filling materials appeared to strengthen the roots.^{10,12} According to the present study the comparison between Resilon and guttapercha groups showed highly statistically significant difference indicating that the monoblock concept is important not only to resist the microleakage through the material but also to hold the roots together, thereby increasing the resistance to fracture.^{7,10,12.}

Conclusion:

Based on the methodology and within the limitations of the present study finally it can be concluded that filling the root canals with contemporary polymer based root canal obturating system-resilon increased the in vitro fracture resistance of endodontically treated teeth. However additional *in-vivo*, *in-vitro* tests and clinical long term studies are desirable in order to elucidate the effectiveness and confident use of this material.