

## RESILON - "ENDOBONDICS"

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### Abstract

*To evaluate and compare the new Resilon obturation material with Gutta percha for Fracture Resistance, Marginal gap and Solubility. Fracture resistance: Forty extracted human teeth were sectioned at the cemento-enamel junction, biomechanical preparation carried out and they were obturated as follows:*

*G1 = Lateral condensation of Gutta-percha with AH plus sealer. G2 = Vertical condensation of Gutta-percha with AH plus sealer. G3 = Lateral condensation of Resilon with epiphany sealer. G4 = Vertical condensation of Resilon with epiphany sealer.*

*After obturation, the teeth were tested under the universal testing machine. Teeth obturated with Gutta percha and Resilon were sectioned and evaluated under Scanning Electron Microscope (SEM) to study gap formation. Solubility of Resilon with various solvents was evaluated compared to Gutta percha. Better fracture resistance and absence of gap between tooth wall and resilon material was found in contrast to gutta percha. It was also found that resilon was soluble in organic solvents like chloroform and xylol only.*

**Key words :** Resilon, fracture resistance, solubility, scanning electron microscope

### Introduction

The specialty of endodontics has evolved and changed over the years like many other dental and medical specialties. Many of these changes have occurred in the last 10 years. The use of the microscope, ultrasonic units, computerized apex locators, flexible nickel-titanium files in rotary engines have increased. These changes are pushing the specialty of endodontic practice on to the twenty first century with greater precision, fewer procedural errors, decreased discomfort to patients, and faster case completions.

The success of endodontic therapy depends not only on adequate access and thorough biomechanical preparation but also on proper obturation. Several techniques and materials have been used since time immemorial for root canal obturation. The most popular and tested material of choice is gutta percha (GP). However GP had its own advantages and

disadvantages. Some of the disadvantages are lack of bonding to root dentin leading to micro leakage, increased shrinkage when used in the form of thermo plasticized material and non re-enforcement of the root structure.

The tooth structure that remains after endodontic treatment is undermined and weakened by all of the previous episodes of caries, fracture, tooth preparation, and restoration. Endodontic manipulation further removes important intracoronal dentin and endodontic treatment changes the actual composition of the remaining tooth structure. The combined results of these changes is increased susceptibility to fracture.

The strength of an endodontically treated tooth is related directly to the method of canal preparation and to the quantity of remaining sound tooth structure. According to Bender and Freeland, the greatest incidence of vertical root fracture occurs in teeth that undergo endodontic therapy.<sup>[1]</sup>

Recently, a new material RESILON has been introduced (JENERIC / PENTRON, NY.) as a superior alternative to GP. This synthetic polymer reportedly, not only provides a better seal but also reinforces the tooth structure through a combination

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of primer, dual cure sealer and resin obturating material. The polyester chemistry containing bioactive and radio opaque fillers have been developed and tested. It performs, handles and looks like gutta-percha; in addition, when used in conjunction with a resin based sealant or bonding agent it forms a monoblock within the canals that bonds to the dentinal walls. As the resin core, sealant and dentinal wall are all “attached,” it appears logical that they have the potential to strengthen the walls against fractures. Fabricio B. Texeira et al concluded in a in-vitro study that, this new resin based obturation material increased resistance to fracture of endodontically treated single canal extracted teeth as compared to gutta percha.<sup>[1]</sup> Guy Shipper et al studied the microbial leakage in roots filled with Resilon material compared with Gutta percha, and concluded that resilon showed excellent resistance to micro leakage which was significantly less than Gutta percha.<sup>[2]</sup>

### Aims and objectives

1. To compare the resistance to fracture after root canal obturation by resilon with those treated with gutta percha.
2. To evaluate by scanning electron microscope (SEM) the relative amounts of gap left behind by resilon treatment as compared to GP.
3. To compare the solubility of resilon and Gutta percha in five different solvents (chloroform, xylol, turpentine and eucalyptol).

### Materials and methods

#### 1. Fracture resistance

Instrumentation and obturation: Forty extracted single rooted maxillary central incisors were collected and examined to rule out any teeth with pre existing root fractures. These were sectioned at the cemento enamel junction with a diamond disk. Root specimens that were at least 15mm in length were used. All the teeth were instrumented to size 50no master apical file using a conventional method and irrigation was done with 5.25% sodium hypochlorite and EDTA with the help of 27 gauge needle.

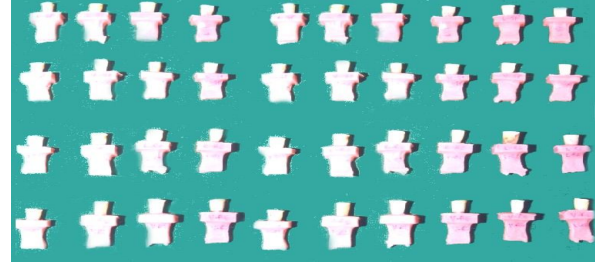


Fig: 1 Teeth embedded in acrylic resin

After completion of instrumentation, all specimens received a final flush with 10ml of neutralized 17% EDTA followed by 10ml of sodium hypochlorite (NAOCL) to remove the smear layer. Following this, 10ml of sterile water was used to remove any remaining NAOCL residue. The canals were dried with sterile paper points. The specimens were randomly assigned to 4 experimental groups (n=10 per group) as follows: Group I: Lateral condensation of GP with AH-plus sealer

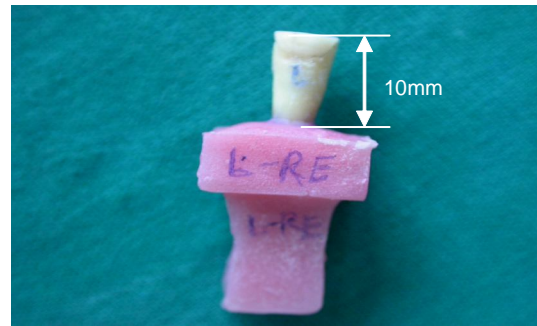


Fig: 2 Teeth embedded in acrylic resin

Group II: Vertical condensation of GP with AH-plus sealer

Group III: Lateral condensation of Resilon with epiphany sealer

Group IV: Vertical condensation of Resilon with epiphany sealer

After obturation, the specimens were stored in normal saline to achieve 100% humidity for one week to allow the sealer to set completely.

#### 2. Preparation of teeth for universal testing machine

After one week, the specimens were prepared for mechanical testing. The apical root ends were

embedded individually in acrylic resin leaving 10mm of each root exposed (Fig 1 and Fig2). The temporary material was then removed and the root canal shaped to accept the loading fixture.

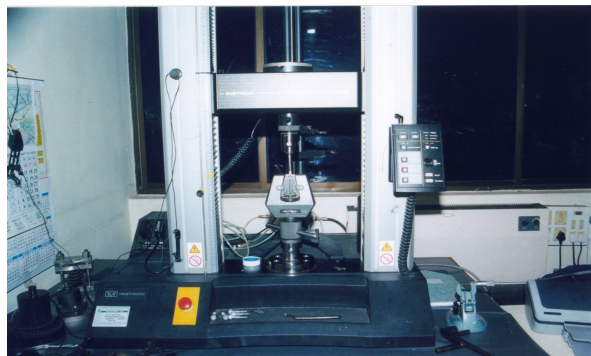


Fig 3 : Universal testing machine

The application of a vertical loading force to fracture was similar to the technique used in the study by Sedgley Messer.<sup>[3]</sup>

All the other specimens were prepared as described previously. All mounted specimens were then aligned to a loading fixture with a spherical tip with center of the canal opening of each specimen. Each of the specimens were loaded at a crosshead speed of 1.0 mm/min until the root fractured under the universal testing machine.<sup>[1]</sup>



Fig 4: Tooth before fracture



Fig 5: Tooth after fracture

The data was subjected to analysis of variance or ANOVA, SCHEFF'S multiple comparison test and comparison by student unpaired T- test.

### 3. Gap analysis by SEM

This in vitro study was carried out on the teeth that were obturated with resilon or gutta percha. Each specimen was longitudinally sectioned so that the dentin-filling interface could be obtained. Gold

sputtering was done. The specimens were then viewed under SEM at high & low magnification and images were photographed.

### Solubility test

Softening time of GP cones and resilon cones were studied in vitro using five chemical solvents i.e. Chloroform, d-limonene, xylol, turpentine and eucalyptol.

Equal amounts of solvent (20ml) were placed in each of two petri dishes. GP was placed in one dish and resilon in the other. Time taken for GP and resilon cones

Table I: Summary statistics

Groups	Mean	SD
L-GP	453.8000	31.5626
V-GP	452.0000	25.8360
L-RE	574.0000	23.5797
V-RE	559.0000	19.1964

L-GP = Lateral condensation gutta percha; V-GP = Vertical condensation gutta percha; L-RE = Lateral condensation resilon; V-RE = Vertical condensation resilon

to soften was noted. In the same way, each of the chemical solvents was tested separately and softening time was recorded.

## Results

### Fracture resistance

Table I, shows means and standard deviations of each experimental group. The results of ANOVA test for the comparison of all 4 groups indicate that there was a statistically significant difference ( $p < 0.01$ ) between the groups (Table II). Scheffe's multiple comparison test between pairs of groups revealed that there was no statistically significant difference between L-GP and V-GP and between L-RE and V-RE (Table III).

The results of Scheffe's test also shows that there was statistically significant difference ( $p < 0.01$ ) between L-GP and L-RE and between L-GP and V-RE (Table III).

Table II: Comparison of all four groups by ANOVA

S.V	AF	S.S	M.SS	F-VALUE	P-VALUE	SIG.
BETWEEN GROUPS	3	65095.40	21698.4700	33.5344	<0.01	S
WITHIN GROUPS	16	10352.80	647.0500			
TOTAL	19	75448.20	-			

Table III: Scheffe's multiple comparison test between pairs of groups

GROUPS	L-GP	V-GP	L-RE	V-RE
MEAN	453.800	452.000	574.000	559.000
L-GP	-			
V-GP	>0.05,NS	-		
L-RE	<0.01,S	<0.01,S	-	
V-RE	<0.01,S	<0.01,S	>0.05,NS	

Table IV: Comparison of gutta percha and resilon groups by student's t-test

GROUP	MEAN	S.D	DIFF	T-VALUE	P-VALUE	SIGN
GP	452.9000	27.2089	113.60 (25.08%)	-10.3115	<0.01	S
RE	566.5000	21.7575				

GP = gutta percha; RE = resilon

The results also indicated that there was a statistically significant difference ( $p < 0.01$ ) between V-GP and L-RE and between V-GP and V-RE (Table III).

The results of Student T-test shows that there was statistically significant difference ( $p < 0.01$ ) between GP and RE groups, with the Resilon groups showing 25.08% greater fracture resistance than GP groups (Table IV).

The dentin filling interface under the low-power magnification of SEM (X 50) of the longitudinal root filled with Gutta-percha and AH plus sealer section

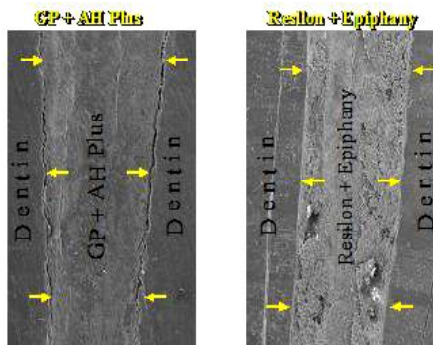
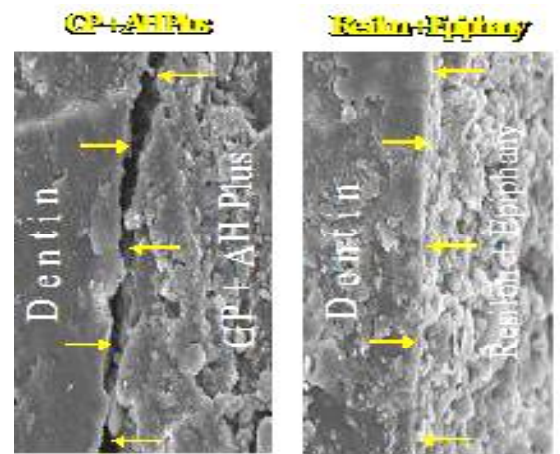


Fig 6: Specimens at low magnifications

showed a uniform gap in the gutta-percha filling and the dentin (Fig 6).



GAP MEASURES 10-12  $\mu$

NO GAP IS EVIDENT

Fig 7: Specimens at High magnification (x 1000)

In contrast gap was evident between the Resilon filling and the dentin (Fig7). On high magnification SEM (X 1000) this gap was approximately 10-12 microns

Table 5: Showing comparison of solubility

Material	Chloroform	d-Limonine	Xylol	Turpentine	Eucalyptol
GP	Dissolves (< 1.5 mins)	Dissolves (< 1 minute)	Dissolves (< 2 mins)	Dissolves (< 2 mins)	Dissolves (< 2 mins)
Resilon	Dissolves (< 1 mins)	Does not dissolve	Dissolves (< 2 mins)	Does not dissolve	Does not dissolve



Figure 8a: Chloroform

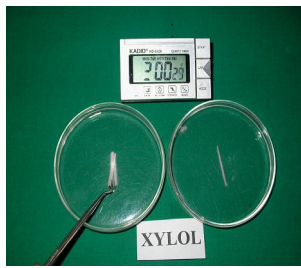


Figure 8b: Xylol

between GP and dentin (Fig7). There was no gap at higher power SEM between the Resilon Filling and the Dentin (Fig 7).

### Solubility

The most effective chemical solvents for both GP and resilon were chloroform and Xylol. Among them, chloroform more rapidly softened the resilon compared to Xylol. None of the other solvents dissolved the resilon (Fig 8a,b)

### Discussion

Gutta Percha has been the standard obturating material for almost 100 years. As endodontic success rates continue to increase, research has begun to focus on the coronal seal and on the endodontic-restorative continuum. Many endodontists are currently placing bonded flowable composites over canal orifices to improve the seal prior to restoration and thereby decrease the likelihood of long-term coronal leakages. The next step in the evolution of endodontic filling materials is to provide a 'gutta-percha-like' material that actually bonds to the dentin of the canal walls. Resilon ("Epiphany" Jeneric/Pentron), at present, is the most promising material for the replacement of Gutta-percha. Resilon is a thermoplastic synthetic polymer-based root canal filling material which has the same handling properties of gutta-percha.<sup>[2]</sup>

A polyester polymer, resilon contains bioactive glass, bismuth oxychloride and barium sulphate. The overall filler content is approximately 65% by weight. Epiphany (resilon) Sealer is a dual cured dental resin composite sealer.<sup>[2]</sup>

The resin matrix is a mixture of Bisphenol A gamma methacrylate (BISGMA), ethoxylated bisGMA, Urethane dimethacrylate (UDMA) and hydrophilic difunctional methacrylates. It contains fillers of calcium hydroxide, barium sulfate, barium glass and silica. The total filler content in the sealer is approximately 70% by weight. Forty seconds of exposure to light cures the coronal 2 mm of the canal while the entire filling will self-cure in approximately 15 to 30 min.<sup>[2]</sup>

Clinically, resilon looks and feels like GP but is slightly stiffer. It can be thermo plasticized at lower temperatures and obturated by various obturation techniques like lateral condensation, vertical condensation, thermo plasticized (obtura II & system B). The sterilization protocol is the same as for GP i.e. placing cones for 60 sec in suitable disinfection solutions. The radio-opacity of resilon is more than GP.<sup>[2]</sup>

One of the main advantages of the Resilon obturating material is immediate coronal seal by light curing for 40 sec at canal orifices, thereby resisting micro leakage 6 times better than GP.<sup>[2]</sup>

When resilon cones are used in conjunction with a resin-based sealer it forms a monoblock within the canals that bonds to the dentinal walls.<sup>[1]</sup> In our fracture resistance study, Resilon groups showed a statistically significant difference ( $p < 0.01$ ) from GP groups. (Resilon groups: 25.08% greater fracture resistance than GP groups).

The excellent sealing capability of resilon was demonstrated by the high power SEM micrograph, which showed that the GP filling pulled away from the AH plus sealer in contrast to resilon which remained

intact. The 10-12 micron gaps between gutta-percha and sealer may create an avenue for micro leakage. However, there was no gap seen in low power SEM scan between the Resilon filling and the dentin.

Although resilon material is bonded to the tooth, it is as easy to remove as GP. Resilon obturation material completely dissolves in chloroform and xylol. This sealer can be removed using files and therefore it is easy to retrieve.

### Conclusion

1. Fracture resistance: Resilon shows 25.08% greater resistance than GP.
2. SCM showed gap (10-12 microns) between GP and dentin (Fig 7) as shown.
3. SEM (X 1000) showed no gap between Resilon and dentin.
4. The most effective chemical solvents for both GP and resilon were chloroform and Xylol and amongst them, chloroform more rapidly softened resilon compared to Xylol.

Bonding is one of the revolutions in contemporary dentistry. Success in endodontics depends on the best possible seal achieved 3 dimensionally in order to prevent percolation and leakage. As Reinforcement of the endodontically treated tooth is a goal that has eluded success to date bonding is the answer to endodontic perfection, and Resilon promises that success. Its ability to bond directly to root canal dentin can result in higher resistance to fractures and the absence of gaps promises the best possible seal. Its

gutta percha mimicking characteristics like good solubility, good radio opacity and excellent handling make it the 21<sup>st</sup> century answer to successful obturation. Endobondics is here to stay and revolutionize endodontics.

### Acknowledgements

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