Original Article

A Comparison of the Effectiveness of Chloroform in Dissolving Resilon and Gutta-Percha

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Abstract:

Objective: Application of chemical solvents especially in problematic canals is usually a part of the retreatment process.This study was performed to compare the solubility of Gutta-Percha and Resilon in chloroform and to find the effect of sample thickness as well as the time of shaking on their solubility.

Materials and Methods: Specific weight of Resilon and gutta-percha was placed in a sample tube and after adding 1.0 ml of chloroform at 37ºC, the tubes were capped and shaked for 1, 3 and 5 minutes. The amount of non dissolved material was determined by reweighting of each sample and the percent of solubility was assessed according to the exact weight loss of the samples. The procedure was repeated three times for a given thickness and time of shaking. The difference in the solubility of Gutta-Percha and Resilon as well as the effect of sample thickness and time of shaking on solubility were assessed by repeated measurement ANOVA ($p<0.05$).

Results: Resilon has significantly higher solubility than Gutta-Percha in chloroform ($p<0.05$). Resilon as well as Gutta-Percha Solubility are increased significantly over the time .The amount of solubility is not affected by sample thickness.

Conclusion: Comparison of Resilon and Gutta-Percha solubility in chloroform shows that one of the advantages for Resilon could be the chance for using possible safer organic solvents during retreatment.

Key Words: Solubility; Chloroform; Resilon sealer; Gutta-Percha; Solvents

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INTRODUCTION

In spite of defects, such as poor sealing ability and lack of providing additional strength, it is more than 100 years that gutta-percha in combination with a root canal sealer has been the most commonly used root canal filling material. [1-3].

Resilon (Pentron Clinical Technologies, Wallingford, CT) is a synthetic thermoplastic polymer-based root canal filling material which has been introduced to endodontic since 2004. A resin-based sealant or bonding in conjunction with Resilon may be a possible replacement for Gutta-Percha. By production of an adhesive bond between the solid core material and the sealer, Resilon forms a monoblock within the canals bonding to the dentinal walls as well.

Furthermore, as the handling properties of Resilon are similar to Gutta-Percha, it could be used with any current obturation.

For retreatment purposed Resilon might be heat-softened or dissolved with solvents such as chloroform.

Fillers which compose approximately 70% of Resilon weight are added to facilitate the removing of materials from root canal during retreatment. [4,5].

Since resin-based obturation systems (Resilon) are developed as viable alternatives to Gutta-Percha, their acclaimed superiority have been investigated in different aspects of root canal treatment. Based on preliminary investigations, advantages of these new systems include a better biocompatibility than GP [6], increase in the resistance of instrumented roots to vertical fracture [7-9] and increased resistance to micro leakage [4,10].

Polymerization shrinkage [11] and susceptibility to biodegradation [12,13] were considered as its disadvantages.

Judging the advantages claimed by companies, it appears that in the close future a considerable number of treated root canals will be filled with Resilon; consequently, for comparable reasons such as inadequate debridement and filling of the root canal system, procedural errors or reinfection of the primary sealed root canal caused by coronal or apical leakage, Resilon filled root canals may also need nonsurgical endodontic retreatment as well. Moreover, no obturation system yet claims to have a 100% success rate. [14]

The methods for removal of root filling materials are thermal, mechanical, chemical or the combination of the above three [15]. In other words, apart from the different techniques and equipments which could be used, application of heat and chemical solvents, especially in problematic canals is usually a part of the retreatment process.

Different solvents for Gutta-Percha as well as various root canal sealers have been very well researched in the past. Based on those researches, chloroform is known as the most efficient organic solvent of Gutta-Percha as well as various root canal sealers. [16-18].

The manufacturer suggests that Resilon filled root canals are retreatable by current retreatment techniques and they might be heat softened or dissolved with solvents such as chloroform. According to Ezzie [1] and coworkers, who studied the efficacy of retreatment techniques, in addition to having lower melting temperature, Resilon may dissolve easier than Gutta-Percha in chloroform.

This could be considered as a contributing factor which results in cleaner canal walls in teeth obturated with Resilon when compared to Gutta-Percha.

However, they suggested that this issue needs to be confirmed by further investigation. So, this study was designed to compare the solubility of Gutta-Percha and Resilon in chloroform and to find the impact of sample thickness as well as the time of shaking on their solubility.

MATERIALS AND METHODS

Samples were prepared from specific weights (range, 0.08-0.085 gm) of Resilon and Gutta-Percha in form of disks with various thicknesses (1.6, 0.8 and 0.4 mm). Weighting of samples were preformed using a Melter PM 480 balance. Shimadzu SSP 10A Solid Sample Press and micrometer (Shimadzu Corp., Kyoto, Japan) were used for preparing various thicknesses.

Each sample was placed in a sample tube and after adding 1.0 ml chloroform at 37ºC, the tubes were capped and shaken for 1, 3 and 5 minutes with the speed of 600 vibra tion/min. Shaking of the samples were performed using IKA-VIBRAX-VXR, JANKE & KUNKEL VX8 vibrator (Germany).

Then, the mixture was filtered on a weighted filter paper and was dried on Harvard/LTE QUALIVAC vacuum dryer (United Kingdom, England).

The amount of non-dissolved material was determined by reweighting of each sample and the percent of solubility was assessed according to the exact weight loss of the samples.

The procedure was repeated three times for a given thickness and time of shaking. Chloroform was purchased from Merck Company.

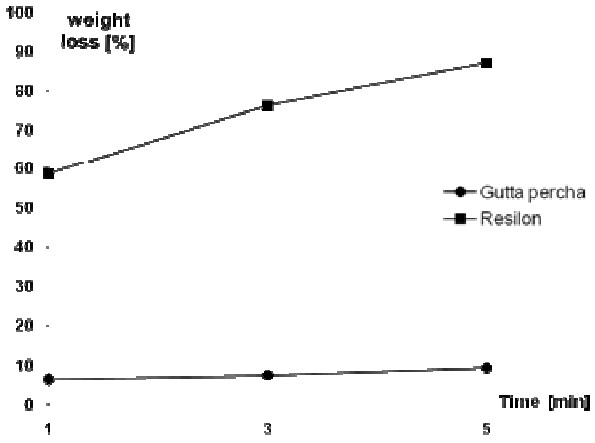

Fig 1. Dissolution of Gutta-Percha and Resilon in chloroform over time.

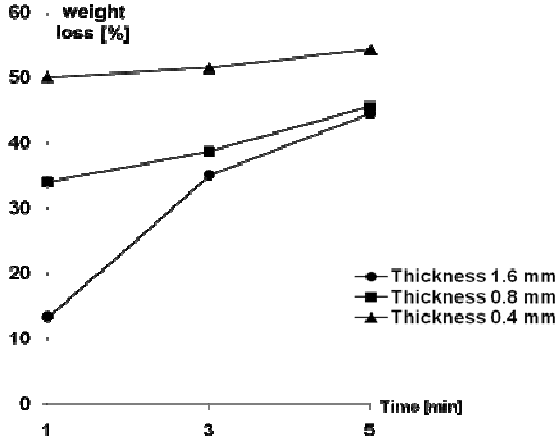

Fig 2. Dissolution of various thicknesses of samples in chloroform over time.

Gutta-Percha and Resilon were purchased from SUREDENT CORPORATION (Korea) and Pentron Clinical Technologies (USA) companies, respectively. The difference between the solubility of Gutta-Percha and Resilon as well as the effect of sample thickness and time of shaking on solubility were assessed statistically by repeated measurement ANOVA ($p<0.05$).

RESULTS

Table 1 shows that irrespective of time, there is a significant difference between the amount of weight loss (solubility) of Gutta-Percha and Resilon in chloroform and Resilon has a significantly higher solubility than Gutta-Percha ($p<0.05$).

In addition, as it is shown in Fig 1, the weight loss of the samples, which is actually indicated the amount of solubility, increases significantly over time and there is an interaction between the amount of weight loss and time.

Table 2. shows the Mean Percentage of Weight Loss (solubility) of various sample thicknesses in chloroform for each immersion period .Solubility is not affected significantly by the sample thicknesses ($p> 0.05$) Fig 2 has shown that regardless of time, sample thickness has no significant effect on solubility and the percentage of the weight loss of the samples (dissolution changes) were comparable among different thicknesses.

Table 1. Mean Percentage (±SD) of Weight Loss for Gutta-Percha and Resilon in Chloroform for Each Immersion Period

Material	**% Solubility (Mean±SD)**			**P Value**
	1 minute	3 minutes	5 minutes	
Resilon	58.75±20.53	76.20±13.85	87.04±8.4	0.000
Gutta-Percha	6.27±1.33	7.39 ± 1.13	9.30 ± 0.96	

DISCUSSION

Ideal root canal filling material should be easily removed whenever necessary for retreatment purposes [19]; regardless of significant statistical evidence for better prognosis, non surgical endodontic retreatment of previously filled root canals has priority to surgical intervention for the management of endodontic failures [20,21].

In well condensed obturated canals, removal of the obturating material could be tedious and time-consuming; whereas, purely mechanical means are dangerous and may lead to root perforation, canal straightening or alteration of the original canal shape.

Generally, hand or rotary instruments are used in combination with heat or solvents for com plete elimination of filling materials from the root canals.

The use of solvent both reduces the time of retreatment and the amount of residue [22].

Since Resilon was introduced to dentistry, apart from the different techniques used, several studies have reported its superior retreatment ability compared to Gutta-Percha. Its lower melting point and higher molecular weight as well as better solubility in chloroform compared to GP have contributed to this issue [1,2,22-24].

Chloroform was selected as a solvent in this study as it is known to be more efficient than other organic solvents in dissolving root canal filling materials [16,18,25,26].In addition, it has been recommended by the Resilon manufacturer for the retreatment procedure.

Regardless of its undesirable properties such as being a possible carcinogen, hepatotoxic ,nephrotoxic and locally toxic in contact with periradicular tissues, chloroform is the most used solvent in clinic [2].

In addition according to Vajrabhaya et al other GP-Solvent was not less cytotoxic than chloroform [27].

Methods which were used in the present study are compatible with numerous basic researches conducted on Gutta-Percha and root canal sealer solvents in which the dissolving efficacy of solvents were assessed by the difference between the original pre-immersion weight and the post-immersion weight [16,28].

CONCLUSION

In conclusion, considering the observed higher solubility of Resilon in chloroform and the fact that there is no need for complete solution of obturating material during the retreatment procedure, there is a possibility for using safer and weaker solvents.

This claim is somewhat supported by the fact that over the years, retreatment of Gutta-

Table 2. Mean Percentage of Weight Loss for Various Sample Thicknesses in Chloroform for Each Immersion Period

Sample Thickness	% Solubility (Mean±SD)			P Value
	1 minute	3 minutes	5 minutes	
1.6 mm	13.41±4.63	35.11±15.31	44.56±19.35	
0.8 mm	34.04±15.25	38.72 ± 17.25	45.60± 19.52	
0.4 mm	50.09±23.12	51.56 ± 23.41	54.37± 24.08	0.627

Percha filled root canal has been preformed successfully and even if an appropriate substitute for chloroform is not found, there is still a chance to use a weaker dose of it in the form of pastes and gels.

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