Evaluation of retrievability using a new soft resin based root canal filling material

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ABSTRACT

The aim of this study was to evaluate the retrievability of Resilon as a root canal filling material. Twenty-seven human single-rooted extracted teeth were instrumented utilizing a crown down technique with Gates-Glidden burs and ProFile system. In group1 (n = 12) canals were obturated with gutta percha and AH-26 plus sealer using a continuous wave technique and backfilled. In group 2 (n = 15) Resilon was used as a filling material. Then teeth were sealed and kept in 37°C and 100% humidity for 7 days. For retreatment, the samples were re-accessed and filling material was removed using Gates-Glidden burs and ProFiles. Teeth were sectioned longitudinally to compare the general cleanliness and amount of debris (× 75) using SEM. Chi-square test was used (α = 0.05) to analyze the data. The total time required for removal of filling materials was expressed as mean ± SD (min) and analyzed by the Student *t*-test (α = 0.05). Required time for retreatment was 3.25 ± 0.32 minutes for gutta percha/ AH 26 plus sealer and 3.05 ± 0.34 minutes for Resilon. There was no statistically significant difference between the two experimental groups. There was no significant difference between the groups in the cleanliness of the root canal wall. This study showed that Resilon was effectively removed by Gates-Glidden burs and ProFiles. 〔J Kor Acad Cons Dent 31(4):323-329, 2006〕

Key words : Retreatment, Resilon, ProFile, The cleanliness of root canal wall, Scanning electron microscopy, Retrievability

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Ⅰ. INTRODUCTION

For more than 100 years, gutta percha has been the most commonly used material to obturate the root canal system. It fulfills many of the requirements as a root canal filling material suggested by Grossman[1]. One of characteristics for the ideal canal filling is its retrievability. Endodontic retreatment is indicated when initial root canal treatment has failed and the problems may be corrected through further canal debridement and obturation. In this aspect, all root canal filling materials should be removed by standardized techniques[2].

There have been several studies that investigated the efficient ways of removing gutta percha and sealer using different methods[3-10]. Techniques described for gutta percha removal included the

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use of rotary instruments, heat carriers and solvents. In many studies the use of NiTi rotary instruments has been recommended for gutta percha removal and various studies have reported its efficacy, cleaning ability and safety. Hulsmann and Bluhm[6] demonstrated that ProTaper rotary instruments were time saving for removing gutta percha. They also showed that the use of solvent was not significantly effective in removing the filling material from the root canal.

Recently, a new root canal filling material was introduced. Resilon (Epiphany, Pentron, Wallingford, CT, USA) is a thermoplastic synthetic polymer-based root canal filling material containing bioactive glass and radiopaque fillers[11]. According to the manufacturer's claim, it performs like gutta percha and has similar handling properties. Epiphany sealer is a dual curable resin composite sealer with various fillers. Resilon is emerging as an alternative to gutta percha and has been used clinically in many practices for more than 2 years. Regardless of the manufacturer's claims, it is expected that the removal of this material will be necessary in some situations. However, there are only few studies regarding the removal efficacy of this new filling material[12-14].

The purpose of the present study was to determine the retrievability of Resilon compared with conventional gutta percha and sealer obturation.

Ⅱ. MATERIALS AND METHODS

Preparation of the teeth

Twenty-seven extracted human anterior teeth and premolars were obtained and stored in normal saline after sterilization. The total root length was adjusted to 12 ㎜ by removing a part of crown portion. A radiograph was taken for each tooth and only roots with radiographically visible single canals were selected. A size 10 K-file was passed 0.5 ㎜ beyond the apex under the microscope (Carl-Zeiss, Oberkochen, Germany) and the working length recorded as being 1.00 ㎜ less than that length.

All canals were prepared by the same operator using a standardized manner. Sizes 4,3 and 2 Gates-Glidden burs were used for coronal flaring. The canals were instrumented with sizes 15 and 20 K-files to the working length. This was followed by preparation with a series of ProFiles (Dentsply, Tulsa, OK, USA) rotated at 300 rpm. Preparation was completed when a 0.04 taper ProFile with a tip equivalent to ISO size 35 reached the working length. All canals were irrigated with 3.0% NaOCl and 17% EDTA. RC Prep (Premier, Plymouth Meeting, PA, USA) was used as a lubricant.

The teeth were randomly divided into two groups to receive either gutta percha or Resilon as the obturation material.

Group 1 (n = 12): obturation using gutta percha and AH 26 plus sealer

A fine-medium gutta percha cone was trimmed using a gutta gauge (Dentsply, Tulsa, OK, USA) to fit at the working length or at most 1.0 ㎜ short from the working length. An equivalent sized system B plugger (SybronEndo, Orange, CA, USA), prefitted to the 4 ㎜ short of the working length,was selected. Canals were dried with paper points and the gutta percha cone was lightly coated with AH 26 plus sealer (Dentsply, Tulsa, OK, USA). The system B unit was set at 230℃ and power 10 for obturation. After inserting the system B plugger to cut the coronal part of gutta percha, downpacking was performed to the previously determined length. Canals were backfilled with Obtura II (Spartan, Fenton, MI, USA) and condensed with S-Kondensors (Spartan, Fenton, MI, USA).

Group 2 (n = 15): obturation using Resilon

Preparation of the canals before obturation was the same as group 1 except for the final rinse. Instead of 3.0% NaOCl, 2% Chlorhexidine was used as a final irrigant. Obturation was done following the manufacturer's instructions. The self-etching primer (Epiphany Primer) was introduced into the canals with paper points to coat the root canals walls. In 25 seconds, excess primer was removed with new dry paper points. Then, fine-

medium sized Epiphany core was applied into the canal after being coated with Epiphany sealer. The system B unit was set at 150℃ and power 10 for obturation. For backfilling Epiphany pellet was inserted to Obtura II unit and the temperature setting was 150℃.

Retreatment

The samples were kept at 37℃ and 100% humidity for 7 days after the coronal and apical portion was sealed with utility wax.

Initially, sizes 4,3 and 2 Gates-Glidden burs were used to remove the coronal portion of the filling material. ProFiles were run at 500 rpm to remove the remainder. Light apical pressure was applied to work the files apically to the working length. RC Prep and 3% NaOCl were used during the instrumentation. Canals were enlarged to one size larger than the previous master apical size. The total time for retreatment was recorded commencing after the initial removal of filling material with Gates Glidden burs and ending when canals were instrumented by an ISO size 40, 0.04 taper ProFile.

After final instrumentation, all canals were irrigated with 3.0 ㎖ of 3% NaOCl, soaked with 1.0 ㎖ of 17% EDTA for 5 minutes and finally rinsed with 3.0 ㎖ of sterile water. The time required for the final irrigation was not included in the total retreatment time.

Sample analysis using SEM

The teeth were grooved vertically with burs and discs in the buccal and lingual surfaces. After being split longitudinally with a chisel, the samples were prepared for scanning electron microscopy. General cleanliness (× 75) of the coronal, middle, and apical thirds was evaluated using 5 scoring system:

1 : clean, less than 10% of surface was covered by debris
2 : 10 - 30% of surface was covered by debris
3 : 30 - 60% of surface was covered by debris
4 : 60 - 90% of surface was covered by debris
5 : more than 90% of surface was covered by debris

For selected representative samples from each group, the observation was performed with higher magnifications (× 500 - 1,500) to examine whether the dentinal tubules were patent after filling materials were removed.

Statistical analysis

Time required for material removal in two groups was measured in minutes and expressed as mean ± SD. Group comparison was done using a Student *t*-test. A Chi-square analysis was performed to analyzed canal cleanliness and debris removal. A p value of < 0.05 was used to determine significance. All sample preparation, treatment was performed by a single operator. Evaluation for cleanliness was done by two dental students after calibration, and they made an agreement on each SEM picture.

Ⅲ. RESULTS

Time required for complete removal of filling material

Time for retreatment in group 1 which was filled with gutta percha and AH 26 plus sealer was 3.25 ± 0.32 minutes. In group 2, removing the Epiphany core and sealer from the canal took 3.05 ± 0.34 minutes. There was no statistically significant difference between two experimental groups ($p > 0.05$).

Cleanliness of root canal walls

The results for root canal cleanliness are summarized in Table 1. There was no significant difference between the two experimental groups. Generally most of the specimens demonstrated clean surface with small amount of sealer. More debris remained in the apical and middle thirds than in the coronal part. The openings of dentinal tubules were detected under higher magnifications in both experimental groups (Figure 2).

Table 1. SEM evaluation of cleanliness of root canal wall after filling material removal

score	1	2	3	4	5
Gr1 : GP + AH26 (n = 12)					
Coronal	4	5	3	0	0
Middle	1	5	6	0	0
Apical	1	6	4	1	0
Gr2 : Resilon (n = 15)					
Coronal	6	6	3	0	0
Middle	2	9	2	2	0
Apical	3	9	2	1	0

Gr 1 : Group 1, in which canals were filled with gutta percha and AH 26 plus sealer;
Gr 2 : Group 2, in which canals were obturated with Resilon.
Five graded scoring system was used for evaluation (1 : clean, less than 10% of surface was covered by debris, 2 : 10 - 30%, 3 : 30 - 60%, 4 : 60 - 90%, 5 : more than 90%). Data mean the number of samples which were evaluated as a specific category.

However, dentinal tubules were not always patent. More smear layer was observed in the apical root wall.

Ⅳ. DISCUSSION

Removing as much sealer and filling material as possible may be critical for the success of retreatment. In this study for removing the previous obturation, Gates-Glidden burs and ProFiles were used. There have been several studies evaluating the usage of NiTi rotary files in conventional retreatment[3-10]. Even though Barrieshi-Nusair[4] showed that the use of SS hand file was faster compared with NiTi files in gutta percha removal, most researchers reported that NiTi rotary files were efficient to retrieve old canal filling materials[3,5].

Speed set up for removing gutta percha was slightly variable depending on the instrument types and operators. For example, Bramante and Betti[15] used Quantec rotary files at 1500 rpm for filling material removal. On the other hand, Ferreira et al.[5] used ProFiles rotated at 300 rpm for gutta percha removal. In the present study speed was adjusted to 500 rpm for removing the filling materials.

After material removal, more debris remained in the apical and middle thirds than in the coronal part. This is in accordance with other studies on gutta percha removal techniques. Masiero and Barletta[8] reported the apical third had the most remaining material regardless of removal technique. Also Kosti et al.[7] claimed that none of the methods used for the removal of root filling was totally effective, especially in the apical third. The result for this study demonstrated that canal enlargement to one size larger than original preparation might not be enough to render the dentinal wall clean and the tubules patent.

Ezzie et al.[13] showed that Resilon was faster to remove than gutta percha. And de Oliveira et al.[12] reported that the mean time required for removing gutta percha/AH 26 sealer and Resilon was 1.10〔SSJ1〕 minutes and 0.89 minutes respectively. However, no significant difference was found in the efficacy of retreatment between gutta percha and Resilon groups in the present study.

As a summary the study showed that Resilon

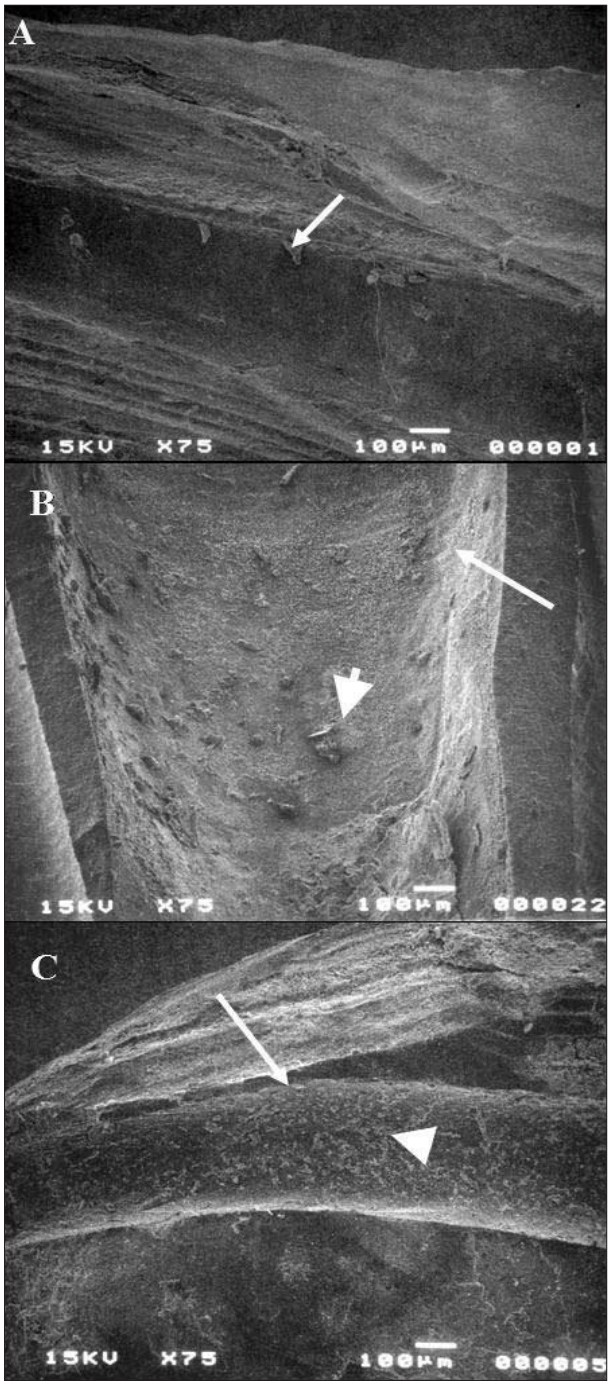

Figure 1. SEM pictures of sectioned roots after Resilon was removed by ProFiles.
Arrows indicate the root canal wall and arrow heads indicate the debris after retreatment. A : Middle portion of root canal wall revealed a clean surface after Resilon filling was removed (score 2). B : Coronal part of root showed multiple sealer debris (score 3). C : Apical root canal wall showed an unclean surface with debris (score 4).

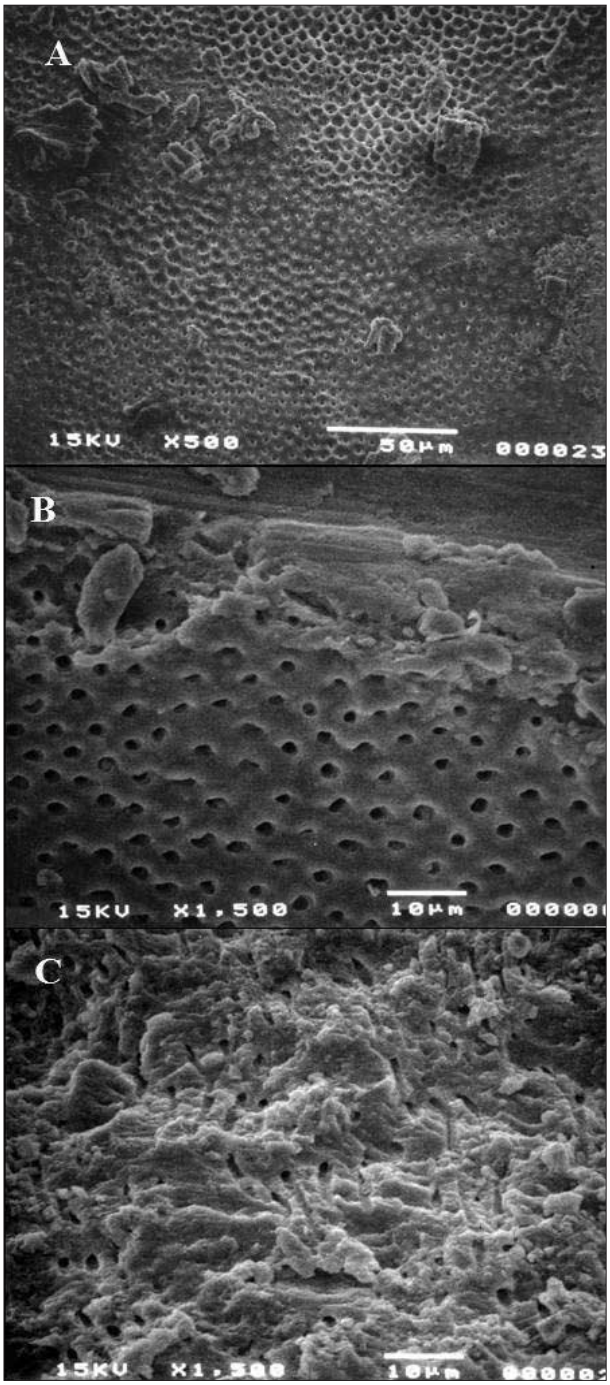

Figure 2. SEM pictures under high magnifications for observation of the patency of dentinal tubules after Resilon removal. Some of specimens showed a clean surface and patent dentinal tubules (A and B). However, in some specimens, the surface was covered with smear layer (C).

was effectively removed by Gates Glidden burs and ProFiles. Its general handling properties for retrieval were similar to those of gutta percha.

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국문초록

레진 계통의 근관 충전재의 제거 용이성에 대한 평가

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본 실험의 목적은 새로운 레진계통의 근관 충전재로 개발된 Resilon (Epiphany, 미국 Pentron사)의 재 치료시 제거의 용이성을 평가하는 것이었다. 27개의 발거된 단근치를 사용하였으며, 치관부를 삭제하여 치근의 길이가 12 ㎜가 되도록 조정하였다. Crown-down방법에 따라 ProFile system 을 이용하여 3%의 차아염소산 나트륨 용액과 17% EDTA 용액으로 세척하면서 ISO 크기 35번, 0.04 taper ProFile이 근관장에 도달할 때까지 근관 형성을 시행하였다. 제 1군 (n = 12)은 가타퍼챠와 AH26 플러스 실러를 사용하여 열가소성 가압 충전법으로 충전하였으며, 제 2군 (n = 15)은 같은 방법으로 제조사의 지시에 따라 Resilon으로 충전하였다. 충전 후 표본은 밀폐를 하여 습도 100%, 섭씨 37도가 유지되는 곳에 일 주일간 보관하였다. 재 치료를 위하여 Gates Glidden bur와 ProFile system을 이용하여 근관 충전 물질을 제거하였으며 이전 근관 형성보다 한 단계 더 큰 크기의 ProFile이 근관장에 도달하는 시점까지의 시간을 기록 하였다. 최종 세척은 3% NaOCl, 17% EDTA 그리고 증류수가 사용되었다. 그 후 치아는 수직 절단 하여 주사전자 현미경 하에 근관의 전반적인 청결도 및 충전 물질의 잔존 정도를 치근단, 중간,치관부로 나누어서 75배 확대상으로 평가하였다. 근관 충전 물질을 제거하는 데에 걸린 시간은 분 단위로 기록되어서 실험군 간의 차이는 Student-t 검정을 사용하여 그 유의성을 검증하였다 (오차범위 0.05 미만). 주사전자 현미경 사진은 두 명의 관찰자가 5단계로 평가하였으며 Chi-square 검정을 통해서 통계학적 유의성을 검증하였다 (오차범위 0.05미만).

충전 후 충전재의 제거에 걸린 시간은 제 1군이 3.25 ± 0.32분, 제 2군이 3.05 ± 0.34분으로 두 실험군간 통계학적으로 유의성 있는 차이가 없었다. 근관 충전재의 제거 후 근관 벽의 청결도는 두 실험군 모두에서 치관부 1/3이 중간이나 치근단 1/3보다 우수한 결과를 보였으며 두 군 간의 차이는 없었다.

본 실험을 통해서 새로운 근관 충전재료인 Resilon이 기존의 가타퍼챠와 실러를 사용한 충전과 비슷한 정도의 제거 용이성 및 근관 벽의 청결도를 보였음을 알 수 있었다.

주요어: 재치료, 레진계 근관충전재, ProFile, 근관벽의 청결도, 주사전자 현미경, 제거 가능성