

Evaluation of apical seal after lateral compaction with three types of spreaders

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Abstract:

This study was conducted to evaluate the apical seal after lateral compaction with three types of spreaders. thirty mesial canals of mandibular molars were prepared using the step-back technique and laterally condensed with gutta-percha and ZOE sealer. The roots were classified into three groups (I, II, III) and obturated as follows: group (I) was obturated with hand spreaders (ISO#30). Group (II) was obturated with stainless steel finger spreaders. Group (III) was obturated with nickel titanium finger spreaders. After 48 hours in an incubator, the roots were coated with two layers of nail polish followed by one layer of sticky wax and were then submerged in 2% methylene blue. The roots were then split longitudinally and the apical leakage measured and compared for each group. The result showed that group III (with nickel titanium finger spreaders) has statistically the lowest mean of dye penetration followed by group II (with stainless steel finger spreaders). Group I (with hand spreaders) showed the highest mean of dye penetration.

Keywords:

Root canal obturation, apical seal, spreader.

Introduction:

Modern endodontic therapy is based on the endodontic triad of complete debridement, sterilization, and obturation of the root canal system in three dimensions⁽¹⁾. Although debridement and sterilization of the root canal are more important in successful endodontic therapy, the quality of obturation remains a significant factor⁽¹⁾. lateral condensation of gutta-percha is by far the most popular technique of obturation, both in practice and as taught in most dental schools⁽²⁾.

Master cone adaptation in lateral compaction technique is considering an important factor in the development of a fluid tight seal at the apical extent of the root canal preparation and the total obturation of

the root canal space. Most authors^(1, 2, 3) agree that a zone that closely fits the apical area of the canal space is objective of master cone adaptation: however their, criteria and technique for determining the adequacy of adaptation is vary. Allison et al.⁽⁴⁾ showed that deep spreader penetration was important in preventing apical microleakage. Thus, careful adaptation of the master cone may not be critical if the spreader molds the plastic gutta-percha into the apical portion of the preparation.

Spreaders are supplied in multiple sizes, shapes, length, and tapers, including hand spreaders with a bent binangle shaft, and small straight finger spreaders. Nickel titanium has also available with improved flexibility⁽¹⁾. Different types of spreaders can be used in lateral compaction technique

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method of root canal obturation, selection of condensation instruments and gutta-percha cones can be determined by the final shape of the canal preparation, personal choice, or available material⁽³⁾.

The anatomy of root canals influences the quality of endodontic treatment. Root curvature affords the greatest difficulties in preparation and obturation. Mann et al.⁽⁵⁾ in a microleakage study compared the amount of day leakage in apical third of the root canal; he found that linear leakage in curved canal greater than in straight canal. Luks⁽⁶⁾, an early advocate of finger spreaders, proposed that filling of a root canal was either facilitated or impeded by the design of the spreader. In addition to condensing gutta-percha laterally and apically, he proposed that spreader should also create a tapered space large enough to receive an accessory cone⁽⁶⁾.

To achieve an adequate condensation in curved canal, Gani et al.⁽⁷⁾ recommended using spreaders that are slightly conical pointed and flexible than conical or flat-end spreaders. In addition to the spreader design Speier and Glickman⁽⁸⁾ found that in small curved canals uses of nickel titanium spreaders can achieve root canal fills with greater density of filling materials than spreader made of stainless steel.

The purpose of this study was to evaluate the apical seal in curved canals prepared using the step-back technique and filled by lateral compaction with three types of spreaders.

Materials and methods:

1- Specimen Preparation:

Thirty mesial canals of extracted mandibular molars were used in the study. Criteria for selection included: No visible fractures or cracks

of roots, completely formed apex, a patent apical foramen, and all canals range in the same degree of curvature (20 - 30 degree).

Removed of soft tissue was accomplished by placing the teeth in 5.25% NaOCL for 15 to 20 min. and stored in normal saline until use. A photograph of the radiograph was processed according to the method of Schneider⁽⁹⁾ to determine the degree of curvature (Fig.1). Evaluation was performed according to the classification of Mullaney⁽¹⁰⁾. The crowns of all teeth were sectioned at the cemento-enamel junction with a diamond disc.

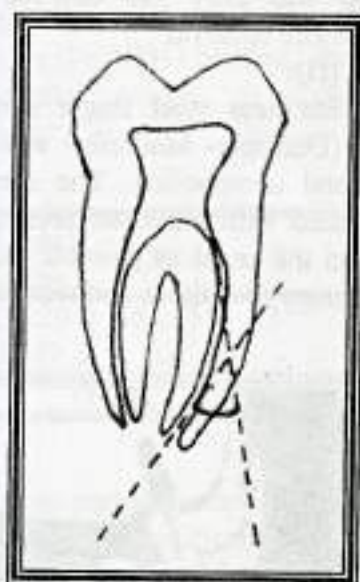


Fig.1

2- Canal Instrumentation:

The patency of each canal was checked by passing No.15 K file 1 mm beyond the apex and a measurement then made with #15 file to establish the working length. The canals were instrumented according to step-back technique as recommended by Weine⁽³⁾ with K-Flexofile (Dentsply-Maillefer), to ISO size #35 at the apex. After completion of apical preparation flaring was begun with 1 mm shorter stepping back to size 60. Canal patency was maintained by passing #15 k-file

through apical foramen. Recapitulation to full working length with master apical file was done after each file size. Throughout procedure, 1 ml of 2.5% NaOCL irrigation solution was used between file sizes to flush out debris.

Canal Obturation:

The teeth were randomly divided into three experimental groups, 10 canals for each:

Group (I):

Hand spreader (ISO# 30; Dentsply-Maillefer) was used for lateral compaction. The spreader was placed with moderate pressure as apical in the canal as possible; the rotation was only 180 degrees four times before removal⁽¹¹⁾.

Group (II):

Stainless steel finger spreader size B (Dentsply- Maillefer) was used for lateral compaction. The spreader was placed with moderate pressure as apical in the canal as possible, rotated 360 degrees four times and removed⁽¹¹⁾ (Fig.2).



Fig.2

Group (III):

Nickel titanium finger spreader size B (Dentsply- Maillefer) was used for lateral compaction in the same manner as in group 2.

The apical portions of all teeth were covered with water moistened gauze to prevent dehydration of the roots. All groups were obturated using lateral compaction technique. The canal walls were coated with ZOE

sealer (Dorifill, Doridant) with a file one size smaller than the master apical file. A specific powder to liquid ratio, which was consistent with the manufacturer directions, was used for each canal.

Canals were obturated using a standardized gutta-perch master cone fitted to the working length. ISO #25 gutta-percha accessory points (Dentsply-Maillefer) were used in all groups^(3,12). To control rebound of gutta-percha, no more than 5 seconds were allowed to elapse after removing the spreader before placing an accessory cone⁽¹³⁾. Condensation was continued until the spreader could no longer be inserted into the canal. One operator experienced with all spreader types obturated all canals.

The excess gutta-percha was removed with a heated instrument and all canals were sealed coronally with cavif. Then the teeth were radiographed to determine if the root canals were properly filled. All obturated teeth were wrapped in saline moistened gauze for 48 hours at 37°C in an incubator.

Each root was coated with 2 layers of nail varnish, and then with one layer of sticky wax except for the apical 2 mm. the apical two thirds of the roots were suspended in 2% methylene blue at 37°C for 2 weeks. Vertical grooves were then cut along the buccal and lingual sides of the roots with slow-speed diamond disk, after which the roots were split in half occlusal-apically.

Statistical Analysis:

The amount of leakage was measured in millimeters from the apex to the most coronal extent of dye penetration in both halves of each root using a co-ordinate vernier microscope. The average of two measurements of the half of each root was considered for statistical analysis.

The analysis of variance (ANOVA) test was performed to determine if there was a significant difference in microleakage among the three experimental groups, and then least significant difference (LSD) test was used for multiple comparisons between the three experimental groups.

Results:

The mean leakage (M) value in millimeters and standard deviation (S.D.) for each experimental group are shown in (Table -1).

Table (1): Descriptive statistics for the three experimental groups

| Groups | No. of canals | Mean of dye penetration | S.D |
|--------|---------------|-------------------------|----------|
| I | 10 | 4.64 | 0.802233 |
| II | 10 | 3.14 | 0.341402 |
| III | 10 | 1.605 | 0.531167 |

Statistical analysis of data by using analysis of variance (ANOVA) was done, which showed that there was

a very high statistically significant difference ($P < 0.001$) between the three experimental groups, as shown in (Table-2).

Table (2): ANOVA Test

| Source of variation | Sum of squares | D.f | Mean square | F | Sig |
|---------------------|----------------|-----|-------------|--------|-----|
| Between Group | 46.058 | 2 | 23.029 | 66.285 | *** |
| Within groups | 9.380 | 27 | 0.347 | | |
| Total | 55.439 | 29 | | | |

*** very highly significant difference

The least significant difference (LSD) test revealed that group I had a very highly significant difference ($P < 0.001$) compared to group II and

III. By comparing group II and group III a highly significant difference ($P < 0.01$) was found (Table-3).

Table (3): Least significant difference test (LSD)

| Comparison groups | Mean Difference | Statistical Significant |
|-------------------|-----------------|-------------------------|
| I Vs. II | 1.5000 | *** |
| I Vs. III | 3.03500 | *** |
| II Vs. III | 1.53500 | ** |

*** very highly significant difference ($p < 0.001$)

** highly significant difference ($p < 0.01$)

Discussion:

Apical seal has been considered an important factor in attaining clinical success. The completeness of seal, as indicated by amount of apical microleakage after lateral compaction,

has been investigated by many authors^(3,5). Many factors that could affect the apical seal have been examined; some of these factors are different obturating materials, well-condensed versus poorly condensed

gutta-percha and comparisons of different sealers.

One goal of the research was to simulate clinical conditions. Therefore obturation was accomplished by an operator instead of a machine that uses a constant load for spreader penetration⁽¹³⁾. The gutta-percha in the present study was performed under optimal conditions. According to Mullaney⁽¹⁰⁾ the canal with 20 degree of curvature or more consider as severe canal curvature, in this study all canal were ranges in the same degree of curvature(20-30). The access was facilitated by removing the crown. Inter operator variability was eliminated, and the satisfactory quality of obturation was confirmed radiographically. The size selection of all type of spreader was based on the recommendation that have been given by Weine⁽³⁾ and Cohen & Burns⁽¹²⁾.

The results of the present study have been indicated that nickel titanium finger spreader showed the lowest mean of dye penetration as a group. The significant difference is not surprising; it seems logical since nickel titanium finger spreader is more flexible than stainless steel. Berry et al.⁽¹⁴⁾ reported that nickel titanium penetrates to significant greater depth than dose stainless steel finger spreader. Allison et al.^(4,15) suggested that the spreaders play a very important role in achieving adaptation of the principal cone. Their deforming action of the principal gutta-percha cone in the vicinity of the apex closes the communication with the periapical area. Further more spreaders contribute to formation of gutta-percha mass to fill the canal. These authors report that apical condensation of gutta-percha increases with the proximity between spreader and the apex.

Group II with stainless steel finger spreader showed higher dye penetration than group III and the

difference was highly statistically significant ($P < 0.01$). The lack of condensation of gutta-percha at the apex may be attributed to the fact that stainless steel spreader, similarly to other endodontic instruments tend to follow a straight line within a curved canal. The tip of the spreader may reach the irregularities that resulted from the step-back instrumentation on the outer wall of the curvature but not on the inner wall. A pressure is thus transmitted to the dentin wall rather than to the gutta-percha cone that would thus undergo no condensation whatsoever. This results reinforced by the results of a study have been conducted by Gani et al.⁽⁷⁾ that compared the quality of apical seal using stainless steel finger spreaders with different tip design. Lack of condensation of gutta-percha at the apex was a frequent finding of their study especially in the outer wall even with slightly conical finger spreader.

Groups I showed the highest mean of dye penetration than the other groups and the difference was a very highly significant. ($P < 0.001$). This finding agrees with Simon et al.⁽¹¹⁾ and Jerom et al.⁽¹³⁾. Walton and Torabinejad⁽²⁾ thought that handled spreaders are stiff than finger spreaders because they are made of annealed while stainless steel finger spreaders are not annealed and therefore more flexible.

Also when the spreader is forced against the gutta-percha in lateral condensation, it grooves it and sticking might result. Therefore, the spreader should be completely separated from the gutta-percha mass before it is withdrawn from the canal, or the master cone may be displaced coronary. Also, occasionally the master cone is "speared" by the spreader, and that as well as may result in it is coronal displacement. Possibly the ability to rotate spreader acts to

separate it completely from the master cone. While a finger spreader may be rotated 360 degrees, the rotation of hand spreader is 180 degrees at the most, being restricted by its handle contracting, the rubber dam frame and the patient's lip. Thus hand spreader may not completely separate from the master cone and dislodgment occurs.

Number 25 accessory cones were used in the study, because Jerom et al.⁽¹³⁾ found them superior to conventional fine-fine accessory cones. And greater penetration depth occurred with size 25 cones. Fewer voids and over filling and better fusion of gutta-percha occurred with standardized size 25 accessory cones than with conventional.

Gound et al.⁽¹⁶⁾ stated that accessory cone should be considerably narrower than the spreader in this way it would penetrate comfortably with minimum pressure, and its thin soft and pointed tip would not bend or be obstructed.

References:

- 1-Ingle J I, Bakland L K: Endodontics 5th ed. BC Decker Inc, 2002.
- 2-Walton R, Torabinejad M: Principles and practice of endodontics 2nd ed. Philadelphia WB Saunders Co, 1996
- 3-Weine F S: Endodontic therapy 5th ed. St Louis CV Mosby Co, 1996
- 4-Allison D A, Weber C T, Walton R E: The influence of the method of canal preparation on the quality of apical and coronal obturation. *J of Endod* 1979; 5: 298-304.
- 5-Mann S R, Walter G M: Evaluation of apical seal and placement control in straight and curved canals obturated by laterally condensed and thermoplasticized gutta-percha. *J of Endod* 1987; 13(1):10-7.
- 6-Luks S: Practical endodontics. Philadelphia J B Lippincott Co 1974; 104-11.
- 7-Gani O, Visvisian C, Caso C: Quality of apical seal in curved canals using three types of spreaders. *J of Endod* 2000; 26(10): 581-85.
- 8-Speier M B, Glickman G N: Volumetric and densitometric comparison between nickel-titanium and stainless-steel condensation. *J of Endod* 1996; 22:195.
- 9-Schneider S W: A comparison of canal preparation in straight and curved roots canal. *Oral Surg* 1971; 32: 271-75.
- 10-Mullaney T P: Instrumentation of finely curved canals. *Dent Clin North Am* 1979; 23: 571-88.
- 11-Simons J, Ibanez B, Friedman S, Trope M: Leakage after lateral condensation with finger spreader and D-11-T spreader. *J of Endod* 1991; 17(3): 101-4.
- 12-Cohen S, Burns: Pathways of the pulp 8th ed. St Louis CV Mosby Co St Louis Misso 64146, 2002
- 13-Jerom C E, Hick M L, Pellue G B: Compatibility of accessory gutta-percha cones used with two types of spreaders. *J of Endod* 1988; 14(9): 428-34.
- 14-Berry K A, Loushine R J, Prmack P D: Nickel-titanium versus stainless-steel finger spreaders in curved canals. *J of Endod* 1998; 24(11): 752-4.
- 15-Allison D A, Michlich R, Walton R E: The influence of master cone adaptation on the quality of the apical seal. *J of Endod* 1981; 7(2):61-5.
- 16-Gound T G, Riehm R J, Odgaard E C, Makkawy H: Effect of spreader and accessory cones size on density of obturation using conventional or mechanical lateral condensation. *J of Endod* 2001;27(5):358-61.