ORIGINAL ARTICLE

On the page 62, in the ***IEJ*** volume **2** number **2** (*summer*) the second page of this article was missed, so the article is presented again.

Comparison of sealing ability of lateral and vertical techniques in two different post space preparations

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Abstract

Introduction: The purpose of this study was to compare the apical sealing ability of lateral and vertical compaction techniques following immediate and delayed post space preparation.

Materials and Methods: Seventy-four distal and palatal roots of human extracted molars were instrumented and randomly divided into 4 experimental groups (n=15), two experimental control groups (n=5), and two positive and negative leakage controls (n=2). Canals were filled by lateral (groups 1 and 2) and vertical (groups 3 and 4) compaction techniques using Tubliseal sealer. Post space was prepared immediately after obturation in group 1 and after seven days in groups 2 and 4 using a # 3 Peeso drill. In group 3, post space was prepared immediately during down-packing phase. The teeth were kept in 2% methylen blue dye for seven days. The roots were sectioned buccolingually and the mean score of dye penetration was measured. Data was analyzed with T-test and one way ANOVA.

Results: There was significant difference in dye penetration between delayed and control-lateral compaction groups (p=0.009). There was also a significant difference in dye penetration between immediate and delayed lateral compaction groups (p=0.044).

Conclusion: Less apical leakage in the cold lateral condensation and immediate post space preparation group was observed.

Keywords: Apical seal, Post space preparation, Obturation technique.

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Introduction

Post and core system is one of the most widely recommended methods for crown reconstruction in endodontically treated teeth. Retention of the post is provided by removing the coronal part of root canal obturation, which may affect the quality of the apical seal and may lead to failure of root canal therapy.

Many in vitro studies have been performed to evaluate the quality of the apical seal following post space preparation. The effect of different parameters such as time of post space preparation (1-5), methods of gutta-percha removal (1,4-7), the amount of remaining gutta-percha (4,7-8), type of used sealer, instrumentation and obturation techniques (8-12) has been investigated.

Neagley (8) showed that the apical seal was not significantly affected by rotary instruments regardless of filling material used, if the canals were adequately obturated initially. Madison and Zakariasen (7) suggested no difference between thermal, chemical, and mechanical removal of gutta-percha as well as between immediate versus delayed removal utilizing the lateral condensation method and Roth canal cement. De Nys *et al.* (13) showed that after delayed (48 h) post space preparation using engine-driven root canal reamer, there was no significant difference between sealing ability of silver point technique, lateral condensation, warm vertical condensation, and Hygenic Ultrafil and Obtura technique. Kwan and Harrington (14) noted that immediate removal

of gutta-percha after filling the root canal with Grossman's sealer had significantly less leakage compared to controls. Dickey *et al.* (1) showed that there was significantly more leakage after immediate removal of gutta-percha using Peeso reamers, softening agents and Grossman sealer. Portell *et al.* (3) demonstrated that when 3 mm of gutta-percha was left apically, delayed post space preparation significantly increased leakage when canals were filled using lateral compaction technique.
The aim of this in vitro study was to compare the apical sealing ability of lateral and vertical compaction techniques following immediate and delayed post space preparation.

Materials and Methods

Seventy-four distal and palatal roots of recently extracted permanent human molars with mature apices were used. The crowns were removed; so that the remaining roots length were about 15±1 mm. Working lengths were determined with a #10 file until it was visible at the apical foramen and was then subtraced for one millimeter. All root canals were cleaned and shaped using step-back technique to #40 file (MicroMega, Switzerland). Flaring was accomplished by Gates Glidden burs (Mani, Inc, Japan) #1 through #3. Two milliliter of 2.5% sodium hypochlorite was used as the irrigant after each file use. The roots were randomly divided into four experimental groups of 15 each (8 distal and 7 palatal roots), two experimental control groups (n=5), and two positive and negative leakage controls (n=2).
Canals were obturated by lateral (groups 1-2) and vertical (groups 3-4) compaction techniques. Standard gutta-percha (Roeko, Germany) and Tubliseal sealer (Kerr, Romulus, MI, USA) were used according to the manufacturer's instruction.
For lateral compaction technique, a #40 gutta-percha point with acceptable tug-back was coated with sealer and gently seated at the working length. The B size finger spreader (Maillefer, Switzerland) was introduced within 2 mm of the working length. Once the excess was cut with a flame-heated hand plugger, gutta-percha was vertically condensed.
For vertical compaction technique, a #40 master cone was fitted 0.5 mm short of the working length. After a light coating with Tubliseal sealer, the cone was seated into the prepared root canal. The coronal portion of the master cone was removed with a red-hot heat carrier. The down-packing phase was done by condensing gutta-percha in an apical direction successively with three preselected pluggers (Svenska Dentorama, Sweden) to within 9, 7 and 5 mm from the root apex passively. As needed, additional gutta-percha was inserted, warmed and condensed vertically into the canal until the entire apical third was obturated and the small plugger could condense gutta-percha in 5 mm from the apex. In group 3, obturation was finished at this step. For group 4, back-packing phase was done until the entire root canal was obturated.
Each root was coated with two layers of nail polish (Etude, France) except for the apical 2 mm.
Two experimental control groups of 5 roots each were filled using lateral and vertical compaction methods without post space preparation. Root surfaces were covered with two layer of nail polish except for the apical 2 mm.
In negative leakage control group, one tooth was obturated by lateral compaction technique and the other by vertical compaction method without post space preparation. Their orifices were filled with wax and the total root surfaces from orifice to the apex were covered by two layers of nail polish. The two positive leakage control teeth were not obturated. Their root surfaces were not covered with nail polish, but the orifices were filled with wax in order to prevent the coronal leakage.
All obturated canals were evaluated radiographically. Except for group 3 (immediate vertical compaction) in which post space was prepared immediately during down-packing phase, in other groups post space were prepared using #3 Peeso (Mani, inc, Japan) drill. In all samples 5-7 mm of gutta-percha was kept in the apical portion of the canals. The remained gutta-percha was controlled in all canals, radiographically.
In group 1, post space was prepared immediately after obturation. In groups 2 and 4, post space was prepared after keeping teeth in a humidifier (37˚C, 100% humidity) for 7 days.

Table-1: Mean dye leakage (mm) in all groups

GROUPS	Mean (SD)
1- Immediate-lateral compaction n=15	6.94 (2.26)
2- Delayed-lateral compaction n=15	9.73 (3.75)
3-Immediate-vertical compaction n=15	8.05 (2.46)
4- Delayed-vertical compaction n=15	7.75 (2.63)
5- Lateral compaction control n=5	4.80 (1.68)
6- Vertical compaction control n=5	5.26 (1.24)

After keeping the apical portion of all roots in 2% methylen blue dye for one week, the roots were washed with water and were left to dry for 24 h.

Then nail polish was removed by acetone. Two grooves along the long axis of each root were made using a tapered bur in a turbine handpiece and a little water spray. All roots were then split longitudinally using a chisel. All preparations were completed by a single operator. Apical microleakage was assessed blindly by two examiners measuring the most extensive linear dye penetration under x7.5 magnifications of a microscope (Olympus, Tokyo, Japan) and a caliper.

The mean score was calculated. Finally, collected data was analyzed. One-way ANOVA and post hoc Bonferroni analyses, one for each obturation technique were performed to compare the mean dye leakage among the groups. Differences between means of delayed and immediate post space preparation groups were tested using student's t-test. Significance was established at $p<0.05$.

Results

The negative leakage control demonstrated no dye penetration while the positive leakage control showed dye penetration along the entire root length.

The mean linear dye leakage in all experimental groups are shown in Table-1 and illustrated in Figure 1. There was no significant difference between all experimental groups and their controls except for delayed-lateral compaction group (P=0.009).

There was only a significant difference between immediate-lateral compaction and delayed-lateral compaction groups (p=0.044). There was no significant difference between other groups.

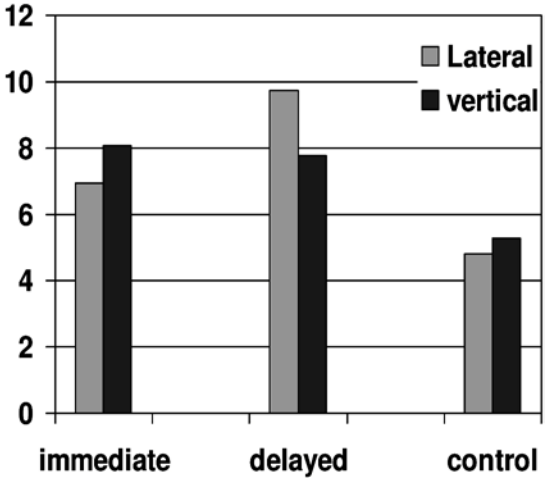

Figure-1: Mean dye leakage (mm) in all groups

Discussion

Cold lateral compaction and warm vertical compaction are the most widely used methods for root canal obturations. This study was designed to compare apical sealing ability of these methods following immediate and delayed post space preparation.

Longitudinal sectioning of roots and linear measurement of dye penetration were used in this study to measure apical leakage. Methylen blue dye was used as the leakage tracer due to its advantages. Matlof *et al.* (15) showed that the dye penetrates voids better than isotopes and reveals microlumina in obturated root canal spaces in greater depth than most other tracing materials. Two examiners measured dye leakage levels in order to eliminate or reduce possible bias and evaluator error.

According to the results of the present study, there was a significant difference between delayed and control lateral compaction groups. In another words, delayed post space preparation can affect the quality of apical seal when canals were filled by lateral compaction method. There was also a significant difference between delayed and immediate lateral compaction groups. This is in agreement with studies performed by Portell *et al.* (3), and Kwan and Harrington (14) and is contradictory to those described by Madison and Zakariasen (7), and Dickey (1). One possible explanation may be that lateral compaction technique leaves voids or spaces between cones and forms a nonhomogenous mass of gutta-percha and sealer. When post space preparation is

made at the time of obturation the sealer has not formed a lasting bond to the gutta-percha or canal wall. The sealer is still within its working time and allows the sealer to set without introducing micro-fractures where the sealer is in contact with gutta-percha and canal wall. When the sealer is set during delayed post space preparation, it is possible that the rotational forces of the peeso drill causes movement of the gutta-percha thus breaking the bond at the sealer interface and affect the quality of apical seal.

There were no significant differences between immediate and delayed vertical compaction groups, but better result in delayed vertical compaction group may be related to back-packing phase which can inhibit gutta-percha shrinkage.

Mean leakage in delayed groups (lateral versus vertical) was not statistically significant, but better result in vertical technique may be related to homogenous obturation mass.

Mean leakage in immediate groups (lateral versus vertical) was not significant; however more dye leakage in immediate vertical group may be related to later shrinkage of gutta-percha.

In another words, according to these results, there was no significant difference between sealing ability of vertical and lateral techniques following immediate and delayed post space preparation. This was similar to the findings reported by Neagley (8) and De Nys (13).

The results of this study are based on measurements conducted over a short period of time. Long term leakage study also should be evaluated. As it seems that the type of sealer is an important factor which can affect the quality of apical seal, further research should be accomplished by different kinds of endodontic sealers.

Conclusion

Under the condition of this study, there was no significant difference between sealing ability of vertical and lateral techniques following immediate and delayed post space preparation using Tubliseal sealer. For cold lateral compaction technique, the clinician will be better able to maintain an apical seal when post space is prepared at the time of obturation.

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