# 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

continuous or pulsed modes. Diode lasers which have been introduced in endodontics generally use lines in the 800-980 nm range, which is poorly absorbed by water, and are operated in contact method using a flexible fiber optic delivery system (6).

Following development of the laser technique and device, the diode laser has gained increasing importance due to its compactness and low cost (1). Previous reports demonstrated the bactericidal effects of 810nm wavelength (7-11). Safety in clinical use, the effects of diode laser on removal of smear layer and debris and degree of apical leakage in obturated teeth have been reported (12).

Research studies have shown that laser radiation can produce some alterations on the root canal wall. These alterations can change dentin permeability and hence decrease the penetration of fluids inside dentin tubules (1,3,5,9,13-15). It has been shown that micro-organisms invading a root canal can penetrate into dentinal tubules far distant from the root canal wall and therefore cannot be totally destroyed by irrigating solutions or disinfecting materials. One of the main reasons for laser treatment is the possibility of occluding dentinal tubules and thereby entrapping invading microorganisms.

However, to date, the potential application of 808-nm wavelength diode laser on root canal walls has seldom been addressed. Previous research study was focused on the ability of laser radiation to remove the smear layer (1); however, it has been shown that many new low cost rapid techniques could be employed for this purpose (16-17).

The aim of this study was to investigate the effect of 808nm diode laser on dentinal tubules after removing the smear layer.

## Materials and Methods

This study was approved by The Ethic Committee of Kerman University of Medical Sciences and The Human Ethic Committee of Australian National University (protocol No.2006/215). In this study, twelve extracted non-carious single-rooted maxillary human teeth with straight canals were used. The root surfaces of all specimens were cleaned before the experiment. Crowns were resected at the cementoenamel junction with a high-speed diamond bur under water irrigation and then discarded. The canals were cleaned and shaped by the crown down technique with K3 instruments (SybronEndo, Orange, CA, USA). The working length was visually determined 1 mm shorter than anatomic apical foramen. The root canals were irrigated with 3 mL of 5.25% NaOCl (Golrang, Tehran, Iran) between each file. After root canal preparation, the smear layer was removed by the application of 17% EDTA (Asiachimiteb, Tehran, Iran) for 1 minute followed by the irrigation with 5.25% NaOCl and finally the canal was irrigated with distilled water and dried with paper points (Aria, Tehran, Iran). The teeth were then randomly divided into experimental and control groups of 6 teeth each.

A 808-nm wavelength GaAlAs diode laser device (Photolase, Milan, Italy) was used in this experiment. The maximum output was 2.5 W, and continuous mode was used. The delivery system consisted of flexible fiber that had 200μm diameter. Six teeth in group 1 were irradiated according to the manufacturer's recommendation in the continuous mode at 2.5 W. During laser irradiation, each fiber tip was introduced into the root canal 1 mm shorter than working length and were kept in contact with the root canal walls, while moving in a circular motion at the cervical and central area and in a back and forth motion at the apical area of the root canal. The irradiation time was 10 second and this procedure was repeated for three times. Total irradiation time for each root canal was 30 seconds. The 6 teeth in control group were not irradiated.

All the teeth in both groups were longitudinally bisected by pliers after a single longitudinal groove was made on the labial and lingual root surfaces with a diamond disk. Each sample was put in an oven and allowed to dry at 50°C for 24 h. After drying, all samples were gold-coated using an Emitech (Ashford, UK) K550X sputter coater. A Cambridge Instruments Stereoscan 360 (Cambridge Instruments, Cambridge, UK) was used for imaging and observing basic morphology of dentinal tubules at an accelerating voltage of 15–20 kV.

Samples were viewed and evaluated at a magnification of x 800 - 1500 and x 5000 for

**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) |

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.

## 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.

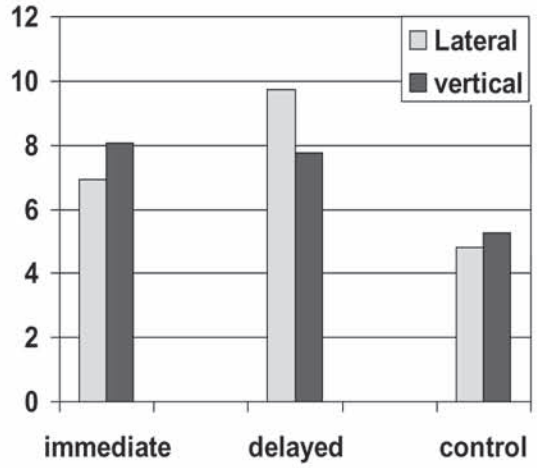


Figure-1: Mean dye leakage (mm) in all groups

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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