An in vitro comparison of three endodontic techniques for primary incisors

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Introduction

Maintaining the integrity of the primary dentition until normal exfoliation is a major goal of modern dentistry. Primary endodontic techniques provide treatment options to save teeth with advanced pulpal pathosis resulting from caries or trauma. The most common of these techniques use the pressure syringe[1] and the lentulo spiral.[2]

Comparison of these techniques has not been tested under controlled conditions. In this study, the effectiveness of the incremental technique will be tested and compared with the lentulo spiral and pressure syringe techniques.

Methods and materials

Fifty-four extracted primary maxillary central incisors with some incisal edge intact as a reference point and no more than 25% of root resorption, signs of canal obstructions, or root anomalies were included.[3] The sample was equally and randomly distributed to pressure syringe, lentulo spiral, or incremental groups. Immediately following extraction, each tooth was placed in 10% formalin then placed in saline for 1 hr. Then each tooth was dried and its apex protected with a small piece of paper and covered with a ball of wax approximately 4 mm in diameter. The apical one-third of the root was then embedded in plaster of Paris. After the plaster hardened, pink base plate wax was placed over the hardened plaster. Another mix of plaster then was poured above the wax sheet to the level of the cervical area of each tooth.

After the second layer hardened, the apical plaster block was separated. The inner wax layer, the soft paper, and the wax ball around the apex of each tooth were peeled off to create an apical void. The two separate plaster pieces then were sealed back together with cyanoacrylate. Each tooth was assigned to a predetermined sequence to control for improvement of the operator's skills and also to allow each technique equal chance of being first, second, and third in the order of treatment. The teeth were classified as having either an open or a closed apex based on their radiographic appearance. Before preparing the teeth for endodontic treatment, the principal investigator practiced by filing and obturating 15 teeth (not included in this study) divided equally among the three techniques. Anterior/posterior (AP) and lateral baseline standardized radiographs were exposed for each tooth. The canal length was determined only from the AP radiograph. Access to the pulp was obtained with #2 and #3 high-speed carbide burs; a barbed broach was used to remove it. The working length of the canal was established 1 mm short of the radiographic apex. Biomechanical preparation of root canals was initiated with a number 10 H-file and finished with number 60. The canal then was irrigated and dried.

The incremental filling technique

An endodontic plugger, corresponding to the size of the canal, with rubber stop was used to place a thick mix of zinc oxide-eugenol (ZOE) (USP) paste into the canal. The length of the endodontic plugger equaled the predetermined root canal length minus 2 mm. The ZOE mixing ratio was 4 scoops of powder and 2 drops of liquid as supplied by the manufacturer. The thick mix was prepared and rolled into a flame shape, corresponding to the size and shape of the canal. A ZOE block measuring approximately 2 mm, starting from the tapered part of the rolled mix was carried into the canal, and tapped gently into the apical area. Additional increments of 2-mm blocks were added until the canal was filled to the cervical area.

The lentulo spiral technique

A fine lentulo spiral instrument, on a slow-speed, contra-angle, was measured to the predetermined canal length minus 1 mm. The mixing ratio of ZOE was 2 scoops of powder and 2 drops of liquid. The lentulo spiral was dipped into the mixture and then introduced into the canal to its predetermined length and rotated into the canal. Additional amounts of paste were gradually introduced until the canal was filled.

The pressure syringe technique

A 22-gauge pressure syringe needle was selected and prefitted in the canal, with the length of the needle equalling the predetermined canal length minus 2 mm. The needle was placed in the prepared root canal to its previously observed depth. During continued filling of the canal with additional paste, the needle was withdrawn slightly to break contact with the side walls of the canals.

The comparison among the three techniques was determined by evaluating the following:

1. **Apical Seal** was defined as the measurement (mm)

between the apical end of the filling material and the radiographic apex, measured from AP and lateral radiographs.

2. **Quality of Filling** was defined as the measurement (mm) of the largest dimension of any voids within the filling material, measured from AP and lateral radiographs.
3. **Extrusion** was defined as the measurement (mm) of the largest dimension of any extruded material beyond the radiographic apex, measured from AP and lateral radiographs.

At the completion of the experiment, standardized lateral and AP radiographs were exposed for each tooth with a 1-mm grid attached. All measurements were made by counting the squares shown on each radiograph with the help of a sharpened Boley gauge. All measurements were rounded to the nearest mm. The apical seal, quality of the filling (voids), and extrusion were assessed using three 3-point scales. On these scales, 1 indicated the best possible results while 3 was the worst. All records were coded and the judges were blinded to the techniques used.

Results

Intra- and interjudge reliability testing was performed on 18% of the sample. Apical seal, extrusion, and voids were assessed from both AP and lateral radiographs. There was an average of 90% agreement for intrajudge comparisons of the total AP and lateral radiograph measurements and 93.3% agreement for the interjudge comparisons.

Chi-square analysis was conducted to compare the three techniques with respect to apical seal, quality (voids), and extrusion. There were no significant differences among the three techniques with respect to apical seal (AP P = 0.19, lateral P = 0.36); voids (AP P = 0.75; lateral P = 0.66); and extrusion (AP P = 0.18; lateral P = 0.18) (Table 1).

Values obtained from AP and lateral radiographs for each group, when evaluating each variable, were combined and the means for apical seal, voids, and extrusion were calculated. One-way analysis of variance was conducted to compare the obtained means for the three techniques. There were no statistically significant differences with respect to apical seal (P = 0.24), voids (P = 0.6) or extrusion (P = 0.1). With respect to classifying the teeth relative to their anatomical root apices being closed or open, there was no obvious tendency for the teeth with open apices to have more extrusion than the teeth with closed apices on the basis of percentages observed.

Discussion

The results of this investigation showed no statistically significant differences among the three techniques tested when apical seal, quality (voids), and extrusion were evaluated from both AP and lateral radiographs.

Previous studies[1,5] comparing the lentulo spiral and the pressure syringe techniques showed that the lentulo technique was superior to the pressure syringe. Aylard and Johnson[4] compared the two techniques regarding depth of canal filling in simulated plastic canal molds. The investigators demonstrated no significant differences between the lentulo and the pressure syringe techniques when filling straight canals. In curved canals, the lentulo was superior. The comparison between the lentulo and the pressure syringe in Lee's study[5] was based on evaluating only ZOE adaptation to the canal walls of primary posterior teeth. Despite the obvious differences between the two previous investigations and this study, the general conclusions seem comparable in favoring the lentulo over the pressure syringe. Belanger[6] recently described a technique similar to the incremental technique presented in this study, but made no attempt to assess its effectiveness.

When the findings of the present investigation for each variable were evaluated for tendencies, the incremental technique yielded the best apical seal while the pressure syringe resulted in the fewest voids and the lentulo spiral yielded the least extrusion. The scales used in this study were based on giving each variable tested, (apical seal, voids, and extrusion) equal importance. The clinical significance of each of these variables is not fully known in primary dentition. However, if one extrapolates from the findings of the endodontic dental literature, extrusion and apical seal may represent a more important aspect of endodontic care than the presence of voids.[7,8]

Four of the teeth treated with the pressure syringe were rated 3.0 with the most extrusion, whereas only one tooth in the incremental group was rated 3.0 and none of the lentulo group was rated 3.0. This may suggest that the incremental and the lentulo spiral techniques would reduce the chances of extrusion when delivering ZOE into primary canals.

On the basis of 162 observations taken from AP and LA views; (54 for apical seal; 54 for extrusion and 54 for voids); there was total agreement in 156 instances. Therefore, statistical analysis was deemed unnecessary, and AP values from AP observations were used.

Other variables that were not evaluated in this study

Table. Comparison of apical seal, voids, and extrusion

Treatment	*Apical Seal*			*Voids*			*Extrusion*		
Scale	1	2	3	1	2	3	1	2	3
Pressure syringe	12	6	0	7	9	2	11	3	4
Lentulo	9	8	1	4	10	4	15	3	1
Incremental	15	2	1	6	10	2	15	2	1
Totals	36	16	2	17	29	8	41	8	6

N = 54

may include technical factors and operator's time. The relative complexity of the pressure syringe and the need to disassemble it to load additional filling material consumes more of the operator's time than the other two techniques. In addition, both the difficulty of cleaning the syringe and the need for immediate cleaning to prevent hardening of the filling material, make the pressure syringe the least desirable among the three techniques tested.

Conclusions

There were no statistically significant differences among the three techniques tested when apical seal, quality (voids), and extrusion were evaluated from both AP and lateral radiographs.

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