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Lateral Perforation in Parallel Post Space Preparations

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Abstract

This study evaluates the amount of remaining tooth structure and possibility of producing lateral perforation following the use of different diameters of parallel-sided Parapost drills in groups of different canal curvatures (0˚-15˚, 16˚- 25˚, 26˚<) in distal canals of first and second mandibular molar teeth.

After enlargement of root canals using the crown-down pressureless technique, Parapost drills #1, #2, and #3 were used in the different canal groups for the preparation of a post space. Standardized digital radiographs were taken before the post space preparation and after each Parapost drill application. Four horizontal lines (a, b, c, and d) were drawn at equal distances on these images, starting from the pulp chamber floor moving apically at 2 mm increments. There were no significant differences between the different curvature groups at the a, b, c, and d levels for the critical level of the remaining tooth structure (multiple comparison test; $p>0.05$). However, in considering root perforation, both at the inner and outer side of the roots, there were statistically significant differences at “c” and “d” levels in group 3 (#3 drill) without taking into account the root curvature (ANOVA; $p< 0.5$). None of the specimens showed strip perforation.

Keywords: Post space preparation, lateral perforation Introduction

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Introduction

The major function of an endodontic post is to provide a retentive foundation for the fabrication of a restoration. Fabricated post systems were developed in order to simplify the restorative procedures of teeth which had received endodontic treatment.

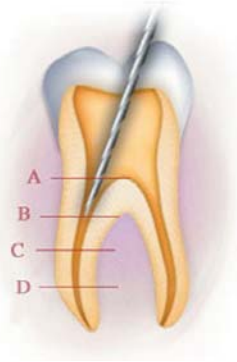
The posts may be (1) selected from a range of prefabricated designs, (2) custom-made, or (3) customized from prefabricated designs. Posts are selected by their properties of retention, stress distribution, ease of application, and cost. The characteristics determining retention and stress distribution include shape, length, diameter, surface configuration, and presence of apron. Additionally morphology, the amount of remaining tooth structure, root thickness, and occlusal forces must be considered before post space preparation.

Prefabricated posts have become more popular[1,2] because of their ease of manipulation and one visit preparation. The parallel-sided posts provide better retention per unit length and distribute stresses better than tapered posts[3], but they do not conform to the natural shape of roots and prepared root canals.[4] Using a parallel post along its entire length may carry a danger of apical root perforation.

The aim of this study was to evaluate the amount of remaining root structure and risk of perforation with the use of different sized parallel-sided drills (Parapost drills) in the distal root of first and second molar teeth, which were prepared for posts.

Materials and Methods

Forty-seven freshly extracted human mandibular first and second molar teeth were used in this study. Before the tests, the teeth were placed into 5.25% NaOCl for two hours in order to clean the periodontal tissues. Then they were stored in sterile saline solution. The teeth were then embedded into self-cure acrylic resin by using an ice-block cap and stored in an environment of 100% humidity (placed into tap water). The digital radiographs were taken with the parallel technique by using Radio Visio Grapy (RVG, Trophy 2000 for Windows, France) in a special appliance, and the focal spot-object distance was 50 centimeters. The images were exported to another computer program (Corel Draw 8 Version 8232, Corel Corp., Canada) for quantitative evaluations. Curvatures of the roots were calculated according to Schneider's technique[5], and the teeth were divided into three groups: group A (0˚-15˚), group B (16˚-25˚), and group C (>26˚).



Standard access cavities were prepared for all the teeth after the decay and old fillings were removed. Canals were enlarged using the crown-down pressureless technique.[6] The final apical size was #35, and the Gates Glidden #2 and #3 (Brassler USA, Savannah, GA) were used for the preparation of the coronal part of the root canals. The first post space was prepared with a #1 Parapost drill (Whaledent Int., New York, NY) using a slow-speed hand piece 4-5 mm over the apical constriction. Then standardized digital radiographs were taken. The same procedure was repeated with two larger Parapost Drills, #2 and #3, and then digital radiographs were taken in the same manner. The images were copied to the Corel Draw 8 software program in order to develop accuracy in measurement of the four digital images (initial and #1, #2, and #3 Parapost drills, respectively). Four horizontal lines were

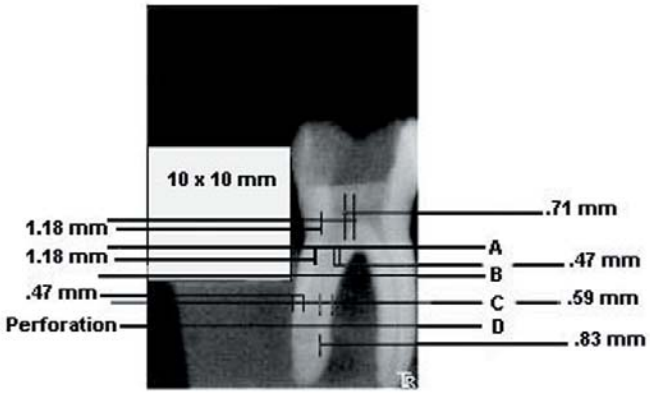


Figure 1. A roentgen graphic image analyzed with the distance-measuring tool of the Corel Draw 8 program. (A pre-measured aluminum wedge provides a 10 mm square radio opaque square image on the screen).

drawn individually for all the teeth at equal distances (2 mm each) on these images, starting from the furcal aspect (Figure 1).

Each horizontal line was given a name such as a, b, c, and d starting from the furcal line. The amount of remaining tooth structure and the possibility to produce lateral perforation were calculated on these parallel horizontal lines drawn, using the distance-measuring tool of the program. All measurements were calculated in millimeters, using a pre-measured aluminum wedge attached to the specimens.

Multiple comparison of the one-way variance analysis of ANOVA was used for statistical analysis of the remaining root thickness at the a, b, c, and d levels in different curvature groups (Groups A, B, and C). The remaining tooth structures at the different a, b, c, and d levels were also calculated by using three different Parapost drills (Groups 1, 2, and 3) without taking into account the root curvatures, and the one-way variance analysis of ANOVA was also used for this calculation.

Results

Statistical evaluation of different curvature groups is presented in Table 1 (multiple comparison test). Multiple comparisons are presented because the group sizes were not equal. There was no significant difference between the curvature groups at the a, b, c, and d levels, both for the inner side and outer side of the roots ($p>0.05$). However, there was a statistically significant difference at the "c" and "d" level on the outer side in consideration without root curvature (ANOVA; $p<0.05$) (Table 2). Thus, the results were evaluated one more time with multiple comparison of ANOVA test; statistically a significant difference was found between Group 3 and the others ($p<0.5$) (Table 3). None of the specimens showed strip perforation.

Discussion

When creating a post space, the practitioner must use great care to remove only minimal tooth structure from the root canal, by considering the minimum post diameter compatible with adequate strength and retention.[7] Additionally, the post space should be at least as long as the clinical crown.[8] A wider post provides only slightly better retention, and its use also means a thinner and weaker residual root dentin.[3,9] In this study, in the lower first and second molar teeth, perforation did not occur at the different levels of the post space by using Parapost drills #1 or #2. However, there was residual dentin at a critical level (less than 1 mm) and perforations in the most apical part of space (c and d level) in some samples when a larger drill (#3) was used. There was no correlation between root curvature degree and perforation. However, more perforations were found in short roots with larger drills (Parapost drill #3).

Scheider's technique is recognized by many endodontists as flawed in that the important parameter of toot curvature is "radius" or how sharp the curve is rather than the described "degree" or how much the tanget to the canal varies along the canal length. This study found more perforations in short roots because a short root of the same degree of curvature has, by definition, a smaller radius than a long root. It could be said smaller radius equals a sharper curve.

Table 1. Statistical evaluation of different root curvature groups (multiple comparisons).

		Mean Difference	Standard Error	Lower Bound	Upper Bound	Significant
Group A (n=18)	Group B	-0.4622	0.833	-2.6722	1.7478	0.858
	Group C	-2.7500	1.193	-5.9163	0.4163	0.096
Group B (n=19)	Group A	0.4622	0.833	-1.7478	2.6722	0.858
	Group C	-2.2877	1.208	-5.4944	0.9188	0.194
GroupC (n=10)	Group A	2.7500	1.193	-0.4163	5.9163	0.096
	Group B	2.2878	1.208	-0.9188	5.4944	0.194

Table 2. Statistical evaluation in the a, b, c, and d for both inner and outer surface of the root without taking into consideration root curvature (ANOVA).

			Between Groups	Within Groups	Total
Sum of Squares	Outer	a	17.387	79.521	96.909
		b	7.013	63.399	70.412
		c	36.800	78.657	115.457
		d	26.693	95.035	121.728
	Inner	a	17.604	62.266	79.870
		b	5.606	55.056	60.662
		c	4.590	75.795	80.385
		d	8.021	37.603	45.624
Mean Square	Outer	a	8.684	4.185	
		b	3.650	3.337	
		c	18.400	4.140	
		d	13.387	5.002	
	Inner	a	8.802	3.277	
		b	2.803	2.898	
		c	2.295	3.989	
		d	4.011	2.212	
Significance	Outer	a	0.153		
		b	0.369		
		c	0.026		
		d	0.015		
	Inner	a	0.094		
		b	0.398		
		c	0.572		
		d	0.193		

Table 3. Statistical evaluation of different Parapost drill groups 1 (#1), 2 (#2), 3 (#3) at the line "c" and "d" (multiple comparison of ANOVA).

		GROUP 1		GROUP 2		GROUP 3	
		Group 2	Group 3	Group 1	Group 3	Group 1	Group2
Mean Difference	c	0.7281	-3.2930	-0.7281	-4.0211	3.2930	4.0211
	d	1.0938	-2.3307	-1.0938	-3.4244	2.3307	3.4244
Standard Error	c	0.935	1.339	0.935	1.356	1.339	1.356
	d	1.028	1.472	1.028	1.491	1.472	1.491
Lower Bound	c	-1.7530	-6.8475	-3.2092	-7.6211	-0.2617	0.4211
	d	-1.6335	-6.2380	-3.8210	-7.3815	-1.5767	-0.5327
Upper Bound	c	3.2092	0.2617	1.7530	-0.4211	6.8477	7.6211
	d	3.8210	1.5767	1.6335	0.5327	6.2380	7.3815
Significant	c	0.742	0.073	0.742	0.027	0.073	0.027
	d	0.577	0.308	0.577	0.098	0.308	0.098

It has been recommended the post length be as long as possible with a minimum of 4 mm of undisturbed gutta percha for an apical seal.[10,11] In this study the post spaces were prepared 4-5 mm over the apical constriction. A decrease in root length must be balanced by the knowledge over preparation of the post space may cause root perforation and weaken the root by decreasing the bulk of dentin and reducing the resistance to fracture.

Root morphology may influence the choice of post design and length. Researchers[12] concluded the degree and position of root curvature and shape of the root could limit the length and diameter of the post. Furthermore, opponents argued that prefabricated parallel-sided round posts are not suitable for teeth with conical and ribbon-shaped canals. However, no correlation was found between root canal perforation and degree of root canal curvature in this study.

Gegauf et al.[13] concluded the Gates Glidden drill conformed to the original canal more consistently than the Parapost drill. In this study we first used the Gates Glidden drill and then applied the Parapost drills in the preparation of the post space.

Posterior teeth were chosen because these teeth often require root canal treatment and are broken down to the extent retention for a restoration is compromised.[14]

It is difficult to judge with accuracy how much tooth structure has been removed and what is the thickness of the remaining dentin. Digital radiographs facilitate this manipulation by taking radiographs step-by-step, producing a lower dose of radiation, and making numeric value measurements and comparisons possible on the image.

Conclusion

It was concluded the diameter of the post-space preparation should be kept to the minimum required to achieve the necessary retention of the core restoration as the incidence of perforation is proportional to the diameter of the post preparation. We may also recommend caution when using the #3 Parapost drill in the distal root of lower molar teeth. It is even more critical to use caution when restoring teeth with short roots, sharp curved roots.

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