

THE FIT OF TWO FIBER POSTS INTO THE ROOT CANAL SPACE ENLARGED WITH ROTARY NiTi FILES AT FOUR DIFFERENT LEVELS

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Abstract:

Objectives: this research was performed to test the fitting at different radicular levels of two posts (DT) #0.5 and #1 in root canals enlarged with a rotary NiTi files system. **Methods and Materials:** twenty-four human lower single root canal premolars were selected for this study. Endodontic and post space preparations were performed using rotary Ni Ti files. No other burs or drills were used. Fiber posts were luted using resinous cement. The thickness of the cement layer at different levels of the root canal was observed using a SEM and measured with a specific software. The area was scored expressing it as a percentage of the entire canal section. The fitting of both posts was analysed at different depths, and the fitting of a new #0.5 DT post compared to a #1 DT post. Descriptive analysis and statistical tests were performed with SPSS software. **Results:** statistical analysis showed a significant difference between the cement thickness at different depths for each post. However, the data did not show any statistical significant difference with regard to the adaptation of these two fiber posts at any levels. **Conclusions and Clinical Significance:** results suggest that discrepancy increases at coronal level and decreases towards the apical sections of each post. Statistic analysis does not show significant differences among discrepancies reported with #0.5 DT and #1 DT at the same level. Therefore, clinical use of a smaller post (#0.5 DT) can be supported.

Short Title:

Adapting of fiber posts into canals

Keywords:

Fiber Posts, NiTi files, Post Space, Discrepancy, SEM, Fitting

Introduction:

The use of fiber posts for the restoration of root-treated teeth has been largely appreciated and investigated since their introduction in 1980^{1, 2, 3}. The restoration of endodontically treated teeth with fiber posts and direct resin composites is a treatment option that, in the short term, preserves remaining tooth structure and results in good patient compliance. This procedure is routinely performed in clinical practice with a choice of therapeutic options, with many factors being considered to provide optimal mechanical properties, aesthetics and longevity^{4, 5, 6}.

The prognosis of root-treated teeth depends not only on the success of the endodontic treatment, but also on the type of the restoration. These considerations include the decision to select the appropriate post or posts for dimension, shape and material especially if root are thin and /or curved. Stainless steel and ceramic posts show a higher risk of fracture than fiber posts, while post length is always limited by the necessary apical seal of 4 mm to 6 mm. In that case, adhesive procedures are preferred⁵.

The recent diffusion use of rotary Nickel Titanium instruments among endodontists has resulted in less enlargement and therefore in canals with small diameters especially at the coronal level^{9, 10}. This minimal intervention reduces the risk of root fracture⁹. Many authors agreed on the risk of perforation when the post space is enlarged with large drills^{10, 11}. A recent study report showed that a Gates-Glidden drill #4 caused strip perforations into the distal canal of mandibular molars, with the authors recommending that

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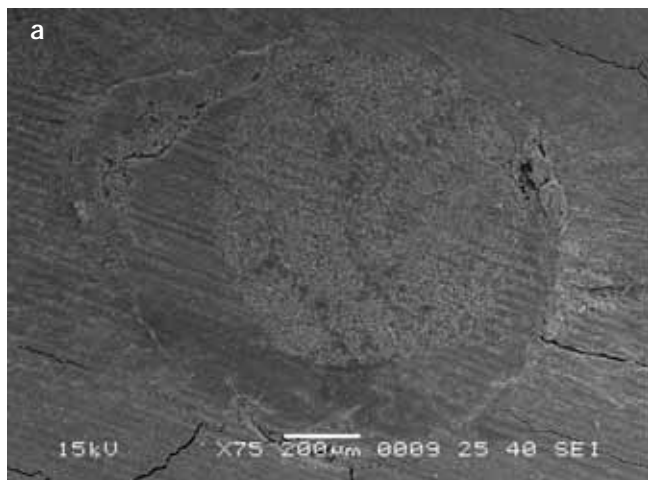


Figure 1: Coronal sections files
a: Section in the coronal portion of post space (first layer) with a DT #0.5 fiber post.

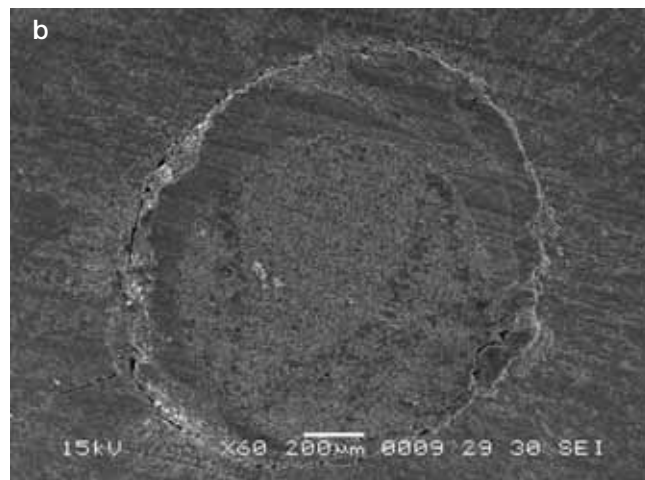


Figure 1b: Section in the coronal portion of post space (first layer) with a DT #1 fiber post.

Gates-Glidden drills larger than a #3 should therefore not be used in these roots¹².

These considerations have led the clinician to choose smaller or anatomic posts in most canals, but this requires more time and is more expensive. Recently, a new fiber post (#0.5 DT Light Post, RTD) was designed to adapt to these shapes and has an apical tip diameter of 0.8 mm and .02/.04 taper for 6 mm and 8 mm respectively. On account of this design it can be easily placed in narrow canals. However, a good post fit can be achieved when the cement has a thin and uniform layer on all canal walls¹³⁻¹⁴.

Variations in the cement film thickness along the fiber post may result in a non-homogeneous stress through the root that might increase the failure rate of the post in the long-term¹². Moreover, clinical studies have shown that the most common cause of failure for fiber posts is not root fracture, but debonding¹⁵. This is especially more likely to happen in the absence of the "ferrule effect"¹⁶ or in the presence of a large amount of cement, particularly at the coronal level¹⁴.

The aim of this study was to compare the fitting of this new #0.5 DT fiber post to a traditional #1 DT post at different sections in the root canal and to evaluate the variation of cement thickness at different levels in relation with the post section. The null hypothesis test was that there are no differences on the fitting of these two posts. Moreover it was tested also the hypothesis of no differences in cement layers among the four depths levels into root canals with the use of a post of the same size.

Methods and Materials:

Twenty-four human lower premolars extracted for periodontal or orthodontic reasons were randomly selected for this

research from a group of 40 premolars with single root canal and similar length dimension (from 21mm to 23mm). Decayed teeth were discharged to avoid pulp calcifications and very thin canals. All the teeth were stored in a bottle with 0.9% saline solution at a temperature of 37°C until they were used.

Canal morphology was analysed with standardized radiographs (70 kV and 0.08 s). The pulp space of each tooth was largely opened with a bur (Intensiv #206). Canal length was determined using a size #10 K-file (Dentsply Maillefer, Tulsa, OK, USA) into the root canal until its tip was visible from the apical foramen and then 0.5 mm deducted to establish the operative working length. The root canals were instrumented using rotary Ni-Ti instruments (Flex-Master, VDW, Munich, Germany) and a stainless steel K-file #10 to check patency. All canals were prepared to ISO size #30 and .06 taper at 1mm short of the apical foramina. The instrumentation was performed strictly according to the manufacturer's instruction. A protocol for NiTi files (blue, red or yellow) was chosen as described by manufacturers with torque and speed as set in the ENDO IT motor (VDW, Munich, Germany). The file "Intro-file" was never used. The Flex-Master NiTi file #30 .06 was used at the end of every sequence in all canals.

To prepare the post space, two accessory NiTi files #35 .08 and #40 .10 (VDW, Munich, Germany) were inserted into the canals at a speed of 400 rpm – 500 rpm and torque of 300 g/cm – 400 g/cm respectively, taking into account the anatomic shape of each tooth in order to result in a post space preparation into the canal from a minimum of 6mm to a maximum of 8mm depth from its orifice. Each set of Flex-Master was discarded after preparing five canals. The root canals were irrigated during instrumentation with 5.25% sodium hypochlorite at 37°C and 10% ethylene diamine tetra-

Table I.				
Discrepancy for DT 0.5 (% of entire canal section area)	A Layer	B Layer	C Layer	D Layer
Mean	38,5	32,1	25,3	12,2
SD	16,2	13,8	10,7	6
Discrepancy for DT 1 (% of entire canal section area)	A Layer	B Layer	C Layer	D Layer
Mean	49,7	42,1	23,7	14,3
SD	15	15,4	10,8	7,4
Layers: A: coronal section B: middle coronal section C: middle apical section D: apical section				
Discrepancy: is measured in percent with the formula: (root canal section area - fiber post area)/root canal section area*100				

acetic acid solution alternatively. All the teeth were obturated with gutta-percha, using non standardized Fine-Medium or Medium size points and the warm vertical condensation technique (System B, SybronEndo, USA), with a heater plugger Fine-Medium and an endodontic sealer (Pulp Canal Sealer, Kerr, Orange, CA, USA).

Gutta-percha was removed by System B plugger with a stop in order to leave from 4mm to 6mm of obturation material in the apical portion. No drills or burs were inserted into canals to avoid any further enlargement, neither post space calibrated burs. The teeth were divided into two groups, based on the diameter of the post space, in order to use translucent glass DT fiber posts #0.5 or #1. The #0.5 fiber post has an apical tip diameter of 0.8mm and .02/.04 taper for 6mm and 8mm respectively, while the #1 post has an apical tip diameter of 0.9 and .02/.06 for 6mm and 8mm respectively (DT Light Post, RTD, St. Egeve, France). All type of posts were tried into the root canal and cut at adequate length with a diamond bur. The

posts were cemented into post space following the entire procedure for the Calibra System (Calibra, Dentsply Caulk). Then, all the teeth were cut at the canal orifice and, from this point, every 1mm till the end of the post space preparation with a diamond blade at low speed (Isomet, USA) in order to obtain four sections at different levels for each root. These specimens were decalcified with 32% phosphoric acid for 30 seconds, then washed and gently air dried and deproteinized (immersion in a 2% sodium hypochlorite solution for 120 seconds) to clean the surface from debris. The sections were dehydrated with alcohol and sputter coated with gold (Edwards, London, UK), then observed under a scanning electron microscope (Philips, Netherlands) at different magnifications. SEM photographs were taken on the upper surface of each section at the four depth levels of the tooth.

A computer analysis of the images was performed with software Adobe Photoshop CS (Adobe Systems, USA) and ImageJ 1.34s (Wayne Rasband, NIH, USA). Each section was

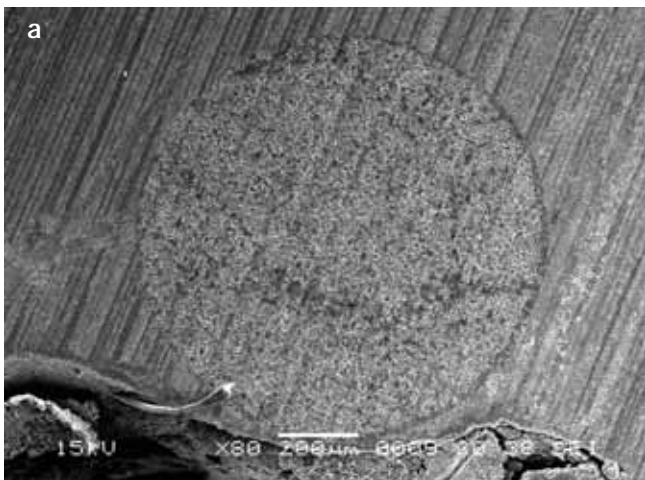


Figure 2: Apical section file
a: Section in the apical portion of post space (fourth layer) with a DT #0.5 fiber post.

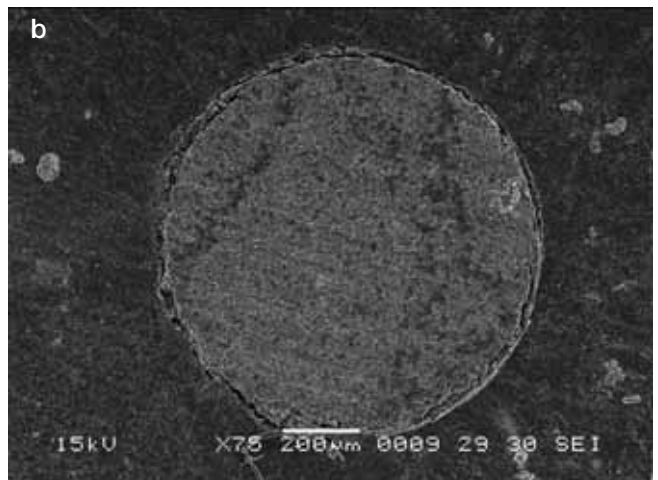


Figure 2b: Section in the apical portion of post space (fourth layer) with a DT #1 fiber post.

Table III. Discrepancy at four different levels for DT #1 (ANOVA Oneway)

	Sum of Squares	df	Mean Square	F	Significance
Between Groups	8777.455	3	2925.818	18.438	P<0.001
Within Groups	6347.455	40	158.686		
Total	15124.909	43			

Post Hoc Test: Multiple Comparisons (Bonferroni test) between layers

Layer DT 1	Layer DT 1	Significance
A	B	N.S.
A	C*	0.000
A	D*	0.000
B	C*	0.009
B	D*	0.000
C	D	N.S.

Layers:
 A: coronal section B: middle coronal section
 C: middle apical section D: apical section

The mean difference is significant at the .05 level.
 Levels marked with * are statistically different for discrepancy.

strategies to reduce cement thickness are important to avoid future failures of our restoration¹⁵. Rotary large NiTi files used for post space preparation let to insert post without calibrated drills and burs. This procedure could be very useful to save time and, moreover, to avoid complications due to erroneous use of drills or burs in post space preparation. However, it is advisable to plan further studies on endodontic finishing files and their use for post space preparation in order to reduce enlargement, to simplify the procedure and to draw the guidelines in post space preparation and fiber post rebuilding. Further studies have to be planned also to test the possibility of using more than one post in a root canal to minimize discrepancy, if this approach could show similar physical properties.

It is currently unclear which is the most preferable and acceptable enlargement for each kind of root and further clinical investigations are advisable to confirm the results of this study and to test more different types of teeth.

Conclusions:

This study reported no differences in post space discrepancy between a fiber post DT #1 and a fiber post DT #0.5 in human premolars. Statistical analysis showed a significant difference between the cement thickness of each layer for both posts with the best fitting at apical levels and the worse at coronal levels. These results suggest that the use of a smaller post such as the #0.5 can be supported as the use of a common 1.0

post. Further studies are recommended to test different kinds of teeth and different shapes of posts.

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