

# The fit of two fiber posts into the root canal space enlarged with rotary NiTi files at four different levels

Pier Francesco Porciani, Simone Grandini, Federica Papacchini, Cecilia Goracci, Marco Ferrari

**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.<sup>1,2,3</sup> 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.<sup>4,5,6</sup>

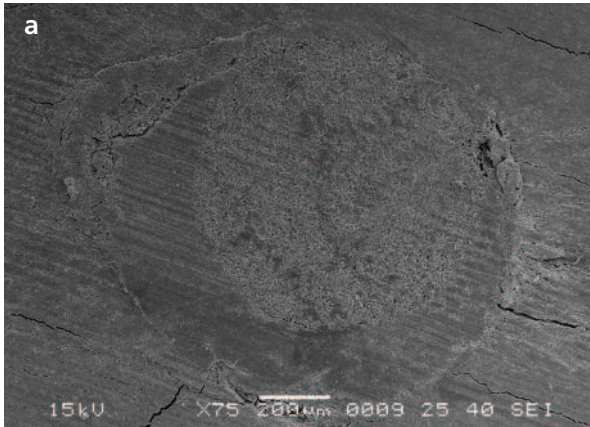
The prognosis of root-treated teeth depends not only on the success of the endodontic treatment, but also on the type of the restoration. These considerations include the decision to select the appropriate post or posts for dimension, shape and material especially if root are thin and /or curved. Stainless 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 6mm. In that case, adhesive procedures are preferred.<sup>5</sup>

The recent diffusion use of rotary Nickel Titanium instruments among endodontists has resulted in less

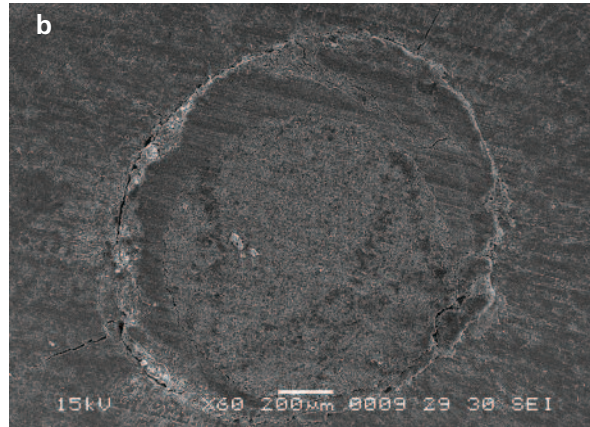
*Department of Dental Materials, Dental School, University of Siena, Siena, Italy*

### Corresponding Author:

*Pier Francesco Porciani, Piazza P. Leopoldo 8 Firenze, Italy,  
Phone: +39 055482912, Mobile: +39 3356262040,  
Fax: +39 055482861, Email piercateads@libero.it*



**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.**

enlargement and therefore in canals with small diameters especially at the coronal level.<sup>9, 10</sup> This minimal intervention reduces the risk of root fracture.<sup>9</sup> Many authors agreed on the risk of perforation when the post space is enlarged with large drills.<sup>10, 11</sup> 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 Gates-Glidden drills larger than a #3 should therefore not be used in these roots.<sup>12</sup>

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 walls.<sup>13-14</sup>

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-term.<sup>12</sup> Moreover, clinical studies have shown that the most common cause of failure for fiber posts is not root fracture, but debonding.<sup>15</sup> This is especially more likely to happen in the absence of the “ferrule effect”<sup>16</sup> or in the presence of a large amount of cement, particularly at the coronal level.<sup>14</sup>

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

**Table 1.**

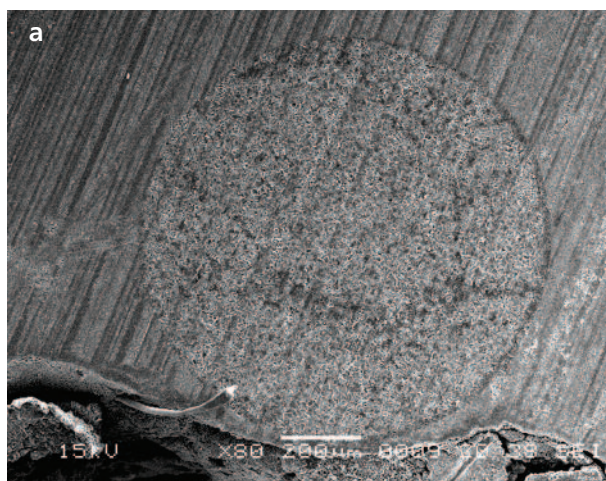
Discrepancy for DT 0.5 (% of entire canal section area)	A Layer	B Layer	C Layer	D Layer
Mean	38,5	32,1	25,3	12,2
SD	16,2	13,8	10,7	6
Discrepancy for DT 1 (% of entire canal section area)	A Layer	B Layer	C Layer	D Layer
Mean	49,7	42,1	23,7	14,3
SD	15	15,4	10,8	7,4
<b>Layers:</b> A: coronal section C: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

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.

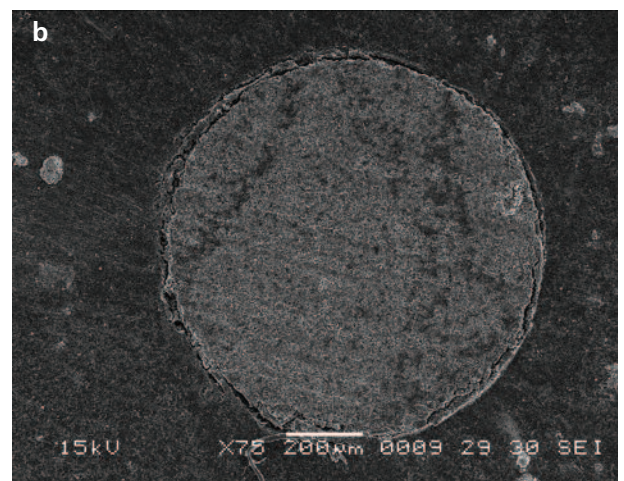
To prepare the post space, two accessory NiTi files #35 .08 and #40 .10 (VDW, Munich, Germany) were inserted into the canals at a speed of 400 rpm – 500 rpm and torque of 300 g/cm – 400 g/cm respectively, taking into account the anatomic shape of each tooth in order to result in a post space preparation 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-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



**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 2. Discrepancy at the four different levels for DT #0.5 (ANOVA Oneway)**

	Sum of Squares	df	Mean Square	F	Significance
<b>Between Groups</b>	4574.167	3	1524.722	10.113	<b>P&lt;0.001</b>
<b>Within Groups</b>	6633.833	44	150.769		
<b>Total</b>	11208.000	47			

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 recorded and the area outlined by canal walls and the area of the post were calculated. Each area was measured converting the number of pixels in square millimetres depending by the scale of the photograph. In order to compare different levels of root sections, discrepancy was calculated as a percentage of the entire canal area. Therefore discrepancy was measured with the formula: (root canal section area - fiber post area)/root canal section area. It was scored as a percentage in order to be processed as a parametric value. The T-Test for unpaired samples was used for

Post Hoc Test: Multiple Comparisons (Bonferroni test) between layers		
Layer DT 0.5	Layer DT 0.5	Significance
A	B	N.S.
A	C	N.S.
A	D*	0.000
B	C	N.S.
B	D*	0.002
C	D	N.S.
<b>Layers:</b>		
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.		

comparisons between the two kind of posts. All the groups of data were screened for normal distribution and then the one-way ANOVA test used to compare the different levels of sections and the post-hoc analysis (Bonferroni test) to suggest a statistical difference among the four depth layers.

For all the statistical tests SPSS ver.12.0 for Windows (Apache Software Foundation, USA) was used and the level of significance was set at 0.05.

**Results**

Twelve teeth were allocated to each group and only one from the DT #1 post group was rejected before SEM examination because of a vertical fracture due to the sample preparation procedure. All the groups of data from the specimens of these two different posts had a normal distribution either when they were analysed together or each group by itself. The mean of discrepancy for all sections of each tooth was 27% (SD 15.4) with DT #0.5 fiber post and 32.5% (SD 18.8) with DT #1 fiber post. No significant difference between roots filled with a #1 post and those filled with a #0.5 fiber

**Table 3. Discrepancy at four different levels for DT #1 (ANOVA Oneway)**

	Sum of Squares	df	Mean Square	F	Significance
<b>Between Groups</b>	8777.455	3	2925.818	18.438	<b>P&lt;0.001</b>
<b>Within Groups</b>	6347.455	40	158.686		
<b>Total</b>	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.

post was noted using the T-Student test - neither at every level nor for the entire post space. The null hypothesis that there are no differences on the fitting of these two posts was therefore accepted.

High levels of cement layer were scored at cervical and middle sections of each root for both the fiber posts tested and, the best fitting was therefore recorded at apical sections as shown in Figure 1 and Figure 2. The discrepancy for each post was statistically different among the layers at varying levels of the sections analysed (p<0.05). Therefore the null hypothesis of no differences in cement layers among the four depths levels into root canals with a post of the same size was rejected.

A detailed summary of the discrepancy at varying levels for both posts is reported in Table I. Statistic tests among these sections at different depth are showed in Table II for DT post #0.5 and Table III for DT post #1.

**Discussion**

Results suggested a worse adaptation for both fiber posts at the coronal level with no significant difference

between the two sizes tested at every depth. The best fitting for both posts was scored at the apical section confirming the operator's selection of the correct post for that tooth.

In this study the discrepancy between canal section and post was measured as the percentage of the area not filled with the post in order to have more consistent data less influenced by the different sizes of canal that is usually reported even in the same kind of teeth. Moreover, the introduction of a percentage allows the use of parameter statistical tests and better describes the adaptation of the post at different depths into the root canal.

Today, the market offers a large number of different sizes and tapered fiber posts which are available for the restoration of root treated teeth with insufficient coronal structure. However, it remains uncertain which brand, type and quantity are more beneficial.

Data from this study suggested an increase of the discrepancy between apical and coronal layers for both posts in the same canal with statistically significant differences among sections. Statistical analysis showed a more progressive increase of discrepancy for DT #0.5 than for DT #1 post. This observation could suggest the development of a different kind of taper or, perhaps, a higher tapered post. Furthermore, the possibility of using a shorter and thinner post as an additional accessory post has to be evaluated. The option of using an anatomic post can also be considered, but it generally takes longer operative time and is more expensive. Obviously, all strategies to reduce cement thickness are important to avoid future failures of our restoration.<sup>15</sup> 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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