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# Scanning Electron Microscopic Investigation of the Surface of Fiber Posts After Cutting

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**This study evaluated the surface of different types of fiber posts after cutting and investigated whether different cutting procedures can affect the integrity of the posts. Six types of fiber posts were selected for this study (Carbon Fiber Posts, Quartz Fiber Posts, Aesthetic Posts, Aesthetic Plus Posts, Translucent Posts, Dentatus, FRC Postec Posts). Fifteen posts of each type were studied. All posts had a diameter of 1.2 to 1.4 mm and were between 14 and 16 mm long. Each group was divided into three subgroups ($n = 5$) according to cutting method: diamond bur, carborundum disk, or scissors. The samples were then processed for scanning electron microscopic investigation. At low magnifications, no microscopic differences were found among the samples of groups 1–4 and 6. Surfaces from group 5 were more irregular, but only when cut using rotating instruments. All groups showed differences between surfaces cut with scissors and those cut with either diamond bur or carborundum disk. Posts displayed regular surfaces after cutting with a diamond bur. Cutting with a carborundum disk produced a mostly regular surface but sometimes produced irregularities close to the surface borders. The surfaces cut with scissors showed two plane and convergent flanges, and because of the formation of fracture lines these posts lost their integrity not only at the cutting surface but also along their length. The results of this study indicated that fiber posts can be cut using a diamond bur mounted in a handpiece under copious water coolant. Although the carborundum disk cutting procedure showed a less regular post surface, it can be speculated that it might be clinically acceptable. The cutting procedure using scissors should be avoided.**

At the beginning of 1990 carbon fiber posts were proposed as an alternative to metallic posts (1). In the last 10 yr, different types of posts have been proposed to improve mechanical and esthetic properties of fiber posts (2–4). Initially hybrid posts were proposed; almost simultaneously white quartz posts were proposed (5,6). More recently, translucent posts became available. As the development of fiber posts was very fast, all these types of posts are still on the market and are routinely used by practitioners. Recently, clinical efficacy and performance of three different types of fiber posts was documented (2–6). All types of fiber posts have similar strength and stiffness (7). The stiffness (or modulus of elasticity) of the posts is similar to that of dentin and, therefore, the risk of root fracture is much lower than that noted when metallic posts are used (4). In addition, bonding between different types of posts and resin cements has been demonstrated (8–10).

Fiber posts are made with a standardized length to ensure that they adapt to the length of different roots. Before being luted, the post must be tried and then cut to the length that prevents exposure of the post along the surface of the abutment. Exposure of the post to the oral environment might result in degradation of the resin with a consequent loss of the post's mechanical properties during clinical service. However, to have sufficient rigidity of the abutment at the coronal level, the post must keep its integrity and mechanical properties after being cut.

In clinical practice, three different methods for cutting fiber posts are available: diamond bur mounted in a turbine handpiece, carborundum disk mounted in a handpiece, and scissors.

The aims of this study were to evaluate if and how three cutting methods can affect the integrity of fiber posts and to test the null hypothesis that the type of cutting procedure used does not affect differentially the integrity of a post's surface.

## MATERIALS AND METHODS

Among types of fiber posts available to dentists, six were selected for this study: Carbon Fiber Posts (RTD, St Egreve, France) as control group 1, Quartz Fiber Posts (RTD) as group 2, Aesthetic Posts (RTD) as group 3, Aesthetic Plus Posts (RTD) as group 4, Translucent Posts (Dentatus, Zurich, Switzerland) as group 5, and FRC Postec Posts (Ivoclar-Vivadent, Schaan, Liechtenstein) as group 6. Fifteen posts of each type were used. A total of 90 posts were evaluated.

All fiber posts had a diameter between 1.2 and 1.4 mm and a standardized length (between 14–16 mm). Each group was divided into three subgroups according to the cutting method used: diamond bur, carborundum disk, or scissors.

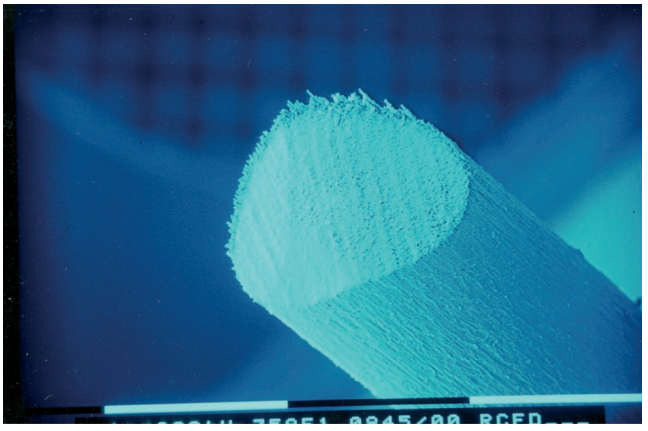

FIG 1. Cutting procedure with diamond bur often created a flat and regular surface (×36).

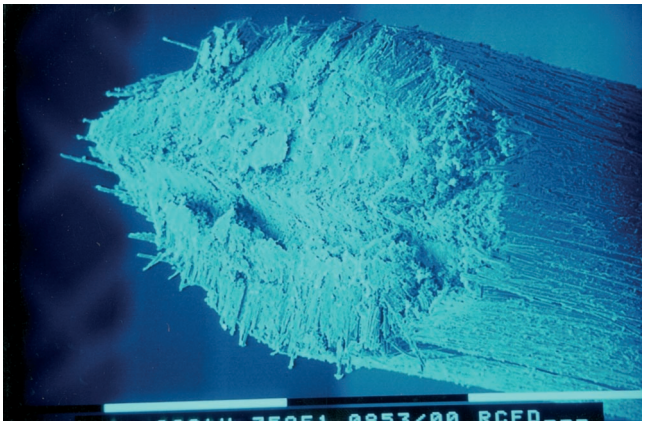

FIG 2. Cutting procedure with scissors. Two planes and convergent flanges are visible (×36). Loss of integrity and morphology of the post is clearly noted.

### Subgroup A—Diamond Bur

Five samples from each group were cut between the middle and coronal third using a diamond bur (2979, Komet, Zurich, Switzerland) mounted in a turbine handpiece under water spray. Both sections of each sample were mounted in a metallic stub to observe the cut surfaces. Then the samples were gold-coated (Edwards Co, London, UK) and evaluated using a scanning electron microscope (Philips 515, Amsterdam, The Netherlands), and microphotographs were taken at different magnifications (×36, ×200, ×500, ×1010).

### Subgroup B—Carborundum Disk

Again, five samples from each group were used. The posts were cut using a carborundum disk mounted in a handpiece (L.I.M.A., Torino, Italy). Then the samples were processed as described in subgroup A.

### Subgroup C—Scissors

The last five samples from each group were cut using scissors (Dentronix Inc., New York, NY). Then both halves of each post were processed as described in subgroup A.

## RESULTS

Analysis of the fiber posts after being cut showed different features, mainly attributable to the cutting procedures. Uniform results were found according to the type of cutting procedure.

At low magnifications, no microscopic differences were found among the samples from groups 1–4 and 6. Surfaces from group 5 (translucent posts) were more irregular after being cut with the two procedures using rotary instruments (subgroups A and B).

All groups showed evident differences between the cut surface of subgroup C samples and those of groups A and B.

In subgroup A, all types of posts showed regular surfaces after cutting with a diamond bur (Fig. 1). Cutting with a carborundum disk (subgroup B) brought a mostly regular surface, but sometimes "burns" were seen close to the surface borders.

In subgroup C, in which all types of posts were cut using scissors, the cut surfaces of all samples showed two plane and convergent flanges (Fig. 2). Also, because of formation of fracture lines these posts lost their integrity not only at the cutting surface but also along their length.

At higher magnifications, the structure of all type of posts, based on fibers embedded in a resin matrix, was observed. Also, in samples from subgroups A and B, the cutting procedure produced a smear layer that mainly covered the cut post surface.

## DISCUSSION

Cutting a fiber post is commonly done before luting and/or during build-up and final preparation of the abutment. During this clinical step, good adaptation of the post at the coronal third of the root canal preparation and proper adhesion to the resin cement and composite material (used for build-up of the tooth at the coronal level) is desirable.

The findings of this study revealed significant differences in post surfaces after cutting, similar to those already described for gutta-percha cones (11).

The loss of integrity of the posts noted after having been cut with scissors might negatively affect the adaptation of the post to the apical and middle thirds of the root preparation and to the resin composite used for the coronal build-up. Also, the loss of integrity of the posts after cutting using scissors will probably reduce their mechanical properties.

In subgroup A, samples of groups 1–4 and group 6 showed mainly smooth cut surfaces. The cut using a diamond bur created shear stress in the cross-section of the post, but the speed of the handpiece reduced the plastic deformation of the post. Therefore the stress tensions induced by the diamond bur allowed the development of an almost plane cut surface, which is perpendicular to the direction of displacement of the cutting instrument. In subgroup B, posts of groups 1–4 and group 6 also showed regular cut surfaces. The tips of the posts were irregular and some burs were observed close to the surface boarders. These probably occurred because the posts were not cut against a surface, which would create a mechanical resistance load opposed to the cut direction. In group 5, a less regular cut surface was noted for the two procedures using high-speed cutting (subgroups A and B). This could be attributable to the differing stiffness of the posts and their fiber disposition. As a matter of fact, in group 5 samples the density of the fibers might have been less uniform than that of the other

groups, and this fact could cause a different plasticity of the post resulting in the irregular cut. When subgroups A and B were compared, a more regular cut surface was observed in subgroup A. This difference might be a result of the higher speed of this cutting procedure or of the fact that water cooling was only used in combination with the turbine handpiece. In subgroup C, in which the posts were cut using scissors, the cut surfaces of the samples of all groups showed two planes and convergent flanges. The magnitude of the post deformation after cutting depends on both scissors shape and post plasticity. Also, the posts showed an area of cut surfaces where fibers were irregularly cut at different lengths, and a detachment between fibers and resin matrix was evident along their length.

However, every time a fiber post is cut, the cut of the post occurs by the application of shear stress on the transverse section of the post. The cutting procedure induces an elastic compression/deformation of the material. Close to the cut surface, post fibers bend in a direction that is similar to the movement applied by the cutting instrument. When the applied pressure overcomes the elastic resistance of the material, the fiber post is separated.

As cutting with a carborundum disk (subgroup B) might be associated with irregularities in the cut post surface, a second cut might be desirable to repair any defects. Thus, the first cut allows the calibration of the post and the second cut regularizes the post surface.

It is likely that the speed of the bur or disk mounted on the handpiece, along with the stiffness of the posts, could affect the surface cut. The posts of groups 1–4 are made by the same company following the same procedure. Therefore, the similarity in behavior during cutting might be related to their structure and stiffness. Posts from group 6 display a similar stiffness (modulus of elasticity) to that of RTD posts (groups 1–4). Because of this, they might show a similar cut surface. In addition, when different posts exhibit a similar stiffness, the speed of the bur or disk probably plays a key role in the improved results of subgroups A and B.

Cutting procedures used can have clinical implications. After the coronal build-up, the abutment is prepared to receive a crown or to refine the anatomy of the coronal portion of the tooth. For these clinical steps, the quality of bonding between the post and the resin composite used for build-up is critical. It must be without discontinuity between the two portions, and the length of the post at the coronal level must be sufficient to withstand occlusal stress. If the post contains both external and internal loss of integrity because of the cutting procedure, the bonding between the post and the resin composite will be less uniform, discontinuity might be easily present in between, and the possibility of a fracture of the abutment might be increased.

The cutting procedure using scissors should be avoided. Cutting of the post is usually performed after try-in in the root canal space and before luting. If the cutting procedure is performed at this clinical step, the rotary cutting procedure tested in subgroups A and B might be used. If the cutting procedure is performed after luting the post, it is strongly suggested that the length of the post be reduced with a diamond bur (as tested in subgroup A) after build-up of the abutment and during final preparation.

The results of this study indicated that post surface morphology was related to the type of cutting procedure utilized. It was shown that fiber posts can be cut to a regular surface using a diamond bur mounted in a handpiece, with copious water cooling. Although a carborundum disk cutting procedure (subgroup B) exhibited a less regular post surface, it is speculated that this might be clinically acceptable. The results of this study might be extrapolated to other fiber posts with similar properties available on the market.

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