Long-term retrospective study of the clinical performance of fiber posts

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ABSTRACT: Purpose: To retrospectively evaluate the long-term clinical performance of three types of fiber posts after a service period of 7-11 years. Methods: 985 posts were included in the study: 615 Composiposts, 160 Æsthetic Posts and 210 Æstheti Plus Posts were placed into endodontically treated teeth. Four combinations of dentin adhesives/luting materials were used. Endodontic and prostho-dontic results were recorded. Results: A 7-11% failure rate was recorded for the three types of posts. 79 failures in total were noted; 39 due to endodontic reasons, 1 root fracture, 1 fiber post fracture, 17 crown dislodgements and 21 due to post debonding. The mechanical failures were always related to the lack of coronal tooth structure. The results indicated that fiber posts in combination with bonding/luting materials may be used routinely for restoring endodontically treated teeth. Mechanical failure of restored teeth with fiber posts can be related to the amount of residual coronal structure. (Am J Dent 2007;20:287-291).

CLINICAL SIGNIFICANCE: The use of fiber posts in combination with adhesive restorative materials can provide a long term clinical success in endodontically treated teeth.

Introduction

Technological advances in fiber-reinforced materials have resulted in a continuous evolution of fiber posts, with the latest generation of these posts overcoming some of the limitations of metallic posts in terms of esthetic appearance, failure modes, and clinical performance. The mechanical properties and failure mechanisms of fiber posts were recently compared to those of metallic posts and to endodontically treated teeth that were restored without posts. The results of these studies indicated that failures were often associated with irreversible root fractures with the use of metallic posts or in the absence of post placement. Conversely, coronal failures occurred more with the use of fiber posts, so that the failed restorations were salvageable. This difference in the failure mode may, by and large, be due to the greater amount of tooth structure that must be removed for the placement of a metallic post. Moreover, when endodontic retreatment is indicated, fiber posts may be more easily removed than metallic or ceramic posts.

Since post placement and root canal treatment are regarded as major causes of root fractures, crown coverage has been routinely recommended as a protective measure. A positive association between crown placement and the survival of endodontically treated teeth was observed when the loss of tooth structure was extensive. The deflection characteristics of bonded fiber-reinforced composite posts demonstrated that they may protect remaining tooth structures.

Retrospective and prospective clinical studies on the use of fiber posts for restoring endodontically treated teeth have been encouraging. The survival rates of fiber posts ranged from 2-7.7% in retrospective studies and from 1.7%-12.8% in prospective studies, with the absence of root fractures. As these studies were all short-term studies that reported the performance of fiber posts after 2-3 years of clinical service, long-term clinical trials are required to determine if the previously reported findings are clinically significant. Thus, the objective of this study was to evaluate the clinical outcome of three different types of fiber posts luted with four combinations of bonding/luting materials that have been in service for 7-11 years. The null hypothesis tested was that there were no differences in the clinical performance of the three types of fiber posts during long-term clinical service.

Materials and Methods

Eight hundred and fifty carbon fiber posts (C-Posts), the first generation of fiber posts, were placed between January 1994 and November 1997; 215 Æstheti Posts, the second generation of fiber posts that consisted of quartz fibers instead of carbon fibers, were placed between December 1997 and April 1998; and 249 Æstheti Post Plus, the third generation of fiber posts, were placed between January 1998 and December 1998. A total of 719 subjects were treated with the 850 C-Posts, 215 subjects with the 249 Æstheti Posts and 234 subjects with the 290 Æstheti Post Plus (Table 1). The age of the subjects ranged from 20-84 years with a mean age of 53 years. Three dentists participated in the placement of these posts.

All the teeth were previously endodontically treated with cold lateral compaction of gutta-percha and eugenol-free sealer. In the molar roots, only one post was placed in the palatal root of maxillary and in the distal root of mandibular molars, with at least 5 mm of gutta-percha remaining apically. The fiber posts were bonded with different combinations of
dentin adhesives and resin cements: All Bond 2 and One-Step in combination with C&B resin cement, Scotchbond Multipurpose Plus in combination with Opal luting composite and Scotchbond 1st (Single-Bond) with Rely X resins. Core build up was performed with different resin composites. Bis-Bond, a self-curing composite, was mainly used with C-Posts and Æstheti Posts while light-curing composites were used with Æstheti Plus Posts.

The final restorations of the treated teeth at the last recall consisted of porcelain-metal restorations (56%), ceramic crowns (30%) and resin-composite restorations (14%). Of the opposite teeth still at the baseline, 38% had fixed restorations, 22% were restored with a removable denture, 34% occluded with unrestored teeth and 6% were not in occlusion. 

Recall – 80% of the subjects treated were recalled for evaluation by simple randomization with random number tables. Distribution of the three generations of fiber posts placed clinically between 1994-1998 and the frequency of the types of tooth treated. The recalled patient pool consisted of 580 subjects with 615 C-Posts, 145 subjects with 160 Æstheti Posts and 186 subjects with 210 Æstheti Post Plus.

The age of the recalled subjects ranged from 26-79 years with a mean age of 48 years. The outcome was considered successful if the post and core remained in situ, without clinical or radiographic signs of failures.

Table 2. Distribution of the three generations of fiber posts placed clinically between 1994-1998 and the frequency of the types of tooth treated.

<table>
<thead>
<tr>
<th>Post Type</th>
<th>Location</th>
<th>Tooth type</th>
<th>Pre-molar</th>
<th>Molar</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-Post</td>
<td>Maxilla</td>
<td>Central incisor</td>
<td>65</td>
<td>68</td>
<td>71</td>
</tr>
<tr>
<td></td>
<td>Mandible</td>
<td>Lateral incisor</td>
<td>53</td>
<td>38</td>
<td>70</td>
</tr>
</tbody>
</table>

Subtotal: 615

| Æstheti Post (AP) | Maxilla  | Central incisor | 16 | 12 | 22 | 83 |
|                   | Mandible | Lateral incisor | 15 |  |  | 77  |

Subtotal: 160

| Æstheti Post Plus (APP) | Maxilla  | Central incisor | 29 | 15 | 25 | 108 |
|                         | Mandible | Lateral incisor | 18 | 14 | 24 | 102 |

Subtotal: 210

Table 4. Combination between bonding system and fiber post related to failures.

<table>
<thead>
<tr>
<th>Fiber Posts</th>
<th>C-Post</th>
<th>AP</th>
<th>APP</th>
<th>Total</th>
<th>Failures</th>
</tr>
</thead>
<tbody>
<tr>
<td>AB2</td>
<td>480</td>
<td>34</td>
<td>20</td>
<td>534</td>
<td>24</td>
</tr>
<tr>
<td>SBMPP</td>
<td>41</td>
<td>12</td>
<td>6</td>
<td>59</td>
<td>17</td>
</tr>
<tr>
<td>SB1</td>
<td>50</td>
<td>52</td>
<td>99</td>
<td>201</td>
<td>18</td>
</tr>
<tr>
<td>OS</td>
<td>44</td>
<td>62</td>
<td>85</td>
<td>191</td>
<td>20</td>
</tr>
</tbody>
</table>

Total: 615 160 210 985 79 Failures: 43 13 23 79

Legend: C-Posts, AP: Æstheti Posts; APP: Æstheti Post Plus; AB2: All Bond 2; SBMPP: Scotchbond MultiPurpose Plus; SB1: Scotchbond 1; OS: One Step.

Results

Table 3. Length of clinical service of the different posts. Number of failures per type of post.

<table>
<thead>
<tr>
<th>Type of fiber posts</th>
<th>Failures (n)</th>
<th>Age interval and average (months)</th>
<th>No. of subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-Posts (n=615)</td>
<td>43 (7%)</td>
<td>(8-10aa, m=10.2)</td>
<td>580</td>
</tr>
<tr>
<td>AP (n=160)</td>
<td>13 (8%)</td>
<td>(7aa, m=7.3)</td>
<td>145</td>
</tr>
<tr>
<td>APP (n=210)</td>
<td>23 (11%)</td>
<td>(7aa, m=7.1)</td>
<td>186</td>
</tr>
</tbody>
</table>

Total: 79 (7-10aa, m= 7.9) 911

Legend: C-Posts, AP: Æstheti Posts; APP: Æstheti Post Plus; aa: years.

Table 5. Type of failures.

<table>
<thead>
<tr>
<th>Fract/root</th>
<th>Debonding</th>
<th>Dislodg/crown</th>
<th>Endo</th>
<th>Fract/post</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-Posts</td>
<td>0</td>
<td>13</td>
<td>10</td>
<td>19</td>
</tr>
<tr>
<td>APP</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>Failures</td>
<td>1*</td>
<td>5</td>
<td>6</td>
<td>11</td>
</tr>
</tbody>
</table>

Total: 1 21 17 39 1

*Abutment of a debonded bridge.

A logistic regression model was applied to the final recall data. Treatment outcome (success vs. failure) represented the dichotomous dependent variable, whereas post type, dental arch (maxillary vs. mandibular), and tooth position within the arch (anterior vs. posterior segment) were investigated as independent categorical variables in the model.

Results

Length of clinical service of the different posts is shown in Table 3. The C-Posts remained in service for 8-11 years, with mean service duration of 10.2 years. The Æstheti Posts remained in service for 7-7.9 years, with mean service duration of 7.5 years. The Æstheti Post Plus remained in service for 7-7.5 years, with mean service duration of 7.2 years. A total of 79 failures were recorded at the end of these service periods, with 43 failures occurring in the C-Post group, 13 failures in the Æstheti Post group, and 23 failures in the Æstheti Post Plus
The type of post found to be a non-significant factor for the failure event (Wald test, $P > 0.05$). Conversely, dental arch and tooth position within the dental arch were significant risk factors for failure, with upper and posterior teeth being more likely to fail than lowers and anterior teeth. Wald statistics and odds ratios with 95% confidence intervals are reported for the significant variables in Table 7. It should be pointed out that in posterior teeth failure was most commonly due to an ineffective endodontic treatment.

Only one root fracture was found. This tooth was a premolar with a very small amount of root dentin at the coronal third of the root. Fracture occurred between the coronal and medium thirds of the root. The tooth was subsequently extracted.

**Discussion**

As no significant differences were found among the three types of fiber posts luted with the four different types of adhesive/luting materials, we have to accept the null hypothesis tested. Retrospective studies on the clinical performance of fiber posts have previously been published. Thus, with the large number of restorations recalled after long-term clinical services, some useful information may be derived from a retrospective study of this nature. Unfortunately, the difference in size of each group did not allow performing statistical analysis of other variables such as different bonding systems and different types of restorations.

The results of this clinical outcome study were not completely in line with the findings of previous retrospective studies, in which survival rates of the tested posts were found to be in the range of 94-97%. In the present study, the survival rate was between 89-93%. The higher number of clinical failures may be attributed to the longer period of clinical service of the fiber posts examined.

Differences in the type of failures were also observed between the present study and a previously reported study. In the latter, failure of the fiber posts was not associated with root fractures, with the most frequently encountered causes of failure being debonding of the post and endodontic failures. Debonding mainly occurred during the removal of provisional crowns and in teeth with less than 2 mm of remaining coronal dentin and two residual walls. In two cases, partial debonding of the crown/bridge occurred. Each case was caused by extensive leakage beneath the restoration and subsequent decay of the abutment. The remaining 39 failures were due to refractory periapical lesions. Thirty-five of these endodontic failures were asymptomatic and were discovered during radiographic examination. The other four endodontic failures exhibited clinical signs and symptoms during the recall appointment. Distribution of failures per type of tooth is reported in Table 6.

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The present study also confirmed previous results that debonding of fiber post restorations after long term clinical service occurred predominantly in teeth that have little remaining coronal tooth structure. The contribution of the
ferrule effect on crown and post retention is well known, and the effect of non-uniform ferrule circumferential height on fracture resistance was highlighted in a recent study. In the present clinical study, it was noted that crown dislodgement and fiber post debonding were always associated with the presence of less than two residual walls in the coronal part of the tooth and when natural dentition was present in the opposing arch. Thus, it is crucial to preserve as much coronal residual dentin as possible during post preparation and placement. Debonding of the fiber posts along long term clinical service may also be caused by the difficulty in achieving high bond strengths to intraradicular dentin, and to the high C-factors that may be encountered when bonding is performed in long narrow cavities such as post spaces and root canals. As the bond strength to root canal dentin is considerably lower than to coronal dentin, disruption of the bonded interface may occur during occlusal loading. Propagation of these debonded sites ultimately results in the debonding of the posts and crowns when high stresses are encountered in teeth that possess inadequate ferrule height. This clinical trial was performed in endodontically treated teeth restored with fiber posts. Recently, several lab investigations stated that the placement of a post does not have much added value to the strength of a post-core restorations while other studies showed the opposite and also that in case of failure, the type of fracture is mainly repairable when a fiber post was used and catastrophic when it was not placed. However, no clinical data on endodontically treated teeth restored without posts are available and clinical trials would be desirable.

References


