A Comparison of Composite Post Buildups and Cast Gold Post-and-Core Buildups for the Restoration of Nonvital Teeth After 5 to 10 Years

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Purpose: The aim of this study was to compare the cumulative survival rates and the complication rates of established methods of indirect cast posts and cores and direct posts and composite cores over at least 5 years within a retrospective study of patients who received fixed restorations. **Materials and Methods:** The patients were questioned according to a protocol and were examined clinically and radiologically. Of the 101 patients who were recruited, 72 came for a follow-up examination. **Results:** Forty-one cast posts and cores and 31 composite cores were examined clinically and radiologically after an average observation period of 8.56 (SD 1.45) years. Four teeth were extracted during the observation period, and 2 more were extracted at the time of the examination. This resulted in cumulative survival rates of 90.2% for cast posts and cores and 93.5% for composite cores. There were 28 complications altogether, consisting of 2 (7.1%) root fractures, 8 (28.6%) teeth with increased probing depths, 3 (10.7%) with increased degrees of mobility, 4 (14.3%) with caries, 9 (32.1%) with periapical radiolucency and/or retrograde filling, and 2 (7.1%) with loss of retention. No statistically significant differences between the 2 methods could be found regarding survival and complication rates. **Conclusion:** It can be concluded that over an average observation period of 8.56 years the indirect cast post-and-core buildup and the direct composite post buildup can be considered of similar value. *Int J Prosthodont 2007;20:63–69.*

An essential task of dentistry is the restoration of tooth substance. Different procedures are adopted for the treatment of vital and nonvital teeth. Because of the usually greater loss of tooth substance in nonvital teeth, the restoration of this substance is as important as the anchoring of the restoration material. In such cases, root posts are used in the clinic to reinforce the buildup materials. These posts have been made of wood, steel, gold, titanium, zirconia, and glass fiber. Recommendations for the ideal post material can be found in the literature. It should have physical characteristics similar to those of dentin,[1] it should be biocompatible, and it should be able to adhere well to the tooth substance.[2]

Although formerly it was thought that a post strengthened nonvital teeth,[3,4] new studies have shown that posts in fact weaken nonvital teeth.[5–9] In spite of this weakening, the use of a post to anchor the buildup of a severely damaged nonvital tooth is usually indispensable. In cases of rather damaged nonvital and root-filled anterior and posterior teeth requiring a fixed restoration, post buildups are almost always necessary because of the poor mechanical resistance of the remaining tooth structure.[10]

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Frequently used materials for core buildups are amalgam, gold, glass-ionomer cement, composite, and ceramic.[11,12] The materials differ not only in their physical characteristics, biocompatibility, and esthetic qualities but also in the time and effort necessary for their application and in their treatment costs. The cast post-and-core buildup and the composite post buildup are the most widely used because of their good biocompatibility and appealing physical characteristics.

The aim of this study was to compare the cumulative survival rates (CSRs) and the complication rates of the established methods of indirect cast post-and-core buildup and direct composite post buildup over at least 5 years in function by means of a retrospective study of patients who received a fixed restoration with post buildups.

Materials and Methods

Patients

One hundred one patients who had received a cast post-and-core buildup or a composite post buildup at the Clinic for Fixed and Removable Prosthodontics at the University of Zurich between September 1991 and May 1997 were recruited for a follow-up examination between January and May 2004. If patients had received several post buildups, the tooth that was to be examined was chosen randomly early in the preclinical work.

Clinical Guidelines

All post buildups were made by saving as much tooth substance as possible. For all post buildups, tapered or cylindric-tapered CM (Cendres & Métaux) and Mooser posts (Cendres & Métaux) sizes 1 to 4 were used. For the composite buildups, titanium posts were used, and for the cast post-and-core buildups, gold posts were used. The composite buildups were fabricated with either Core-Paste (Coltène) together with the All-Bond adhesive system (Bisco) or with Tetric (Ivoclar) together with the Syntac adhesive system (Ivoclar).

The indirect cast post-and-core buildups were made in 2 steps. As a first step, polymethylmethacrylate (PMMA) (Duralay, Reliance Dental) was built up around the gold post directly in the patient's mouth. This buildup was then sent to the dental laboratory, where in a second step the PMMA was replaced by Protor 3 (Cendres & Métaux), a gold-platinum alloy containing mostly gold. The replacement was done using the standard casting technique.

Before insertion all posts were sandblasted with 50-mm Al_2O_3 at 4 bar and thereafter cemented either with zinc phosphate (Dentsply De Trey), glass ionomer (Ketac Cem, ESPE), or composite (Panavia, Kuraray).

Clinical and Radiologic Examinations

All patients were examined clinically and radiologically and questioned according to the protocol. The patients were asked whether they regularly (at least once a year) went to a dentist or a dental hygienist for a recall visit. Also, the patients were asked about their smoking behavior. Those patients who had lost the tooth that had been chosen for examination during the period of observation and were no longer being treated at the University of Zurich were asked for the names of their private dentists. This enabled the authors to document the time at which the tooth was lost.

The randomly selected teeth were examined clinically and radiologically. Clinically, probing depth, bleeding on probing, tooth mobility, the width of keratinized gingiva, and recession were measured. Furthermore, the marginal adaptation was assessed according to the modified United States Public Health Service criteria. The teeth examined were radiographed using the parallel technique (Hawe x-ray film holder, Kerrhawe). These radiographs were evaluated by 2 independent examiners, who focused on the following abnormalities and diagnoses: root fractures, periapical signs of pathology, retrograde root fillings, periodontitis, and caries. In addition, these radiographs were used to measure, to the nearest half millimeter, the post length, the crown length, and the length of any residual root canal filling.

Statistical Analysis

Means, standard deviations, and medians were calculated for all data. For statistical analysis, the chi-square test was used to show the dependency of 2 discrete criteria. When both criteria only had 2 categories, the exact Fisher test was used. A survival analysis was performed and the data were shown graphically as Kaplan-Meier curves. The CSR is the estimate of the proportion of individuals that have not experienced the event (tooth loss) from time *0* (insertion of the reconstruction) to the time of interest *t* (clinical examination). The differences between the survival curves were evaluated with log-rank tests.

The results of statistical tests with *P* values under 5% were judged as significant. The statistical analysis was carried out using Stat View version 5 (SAS Institute).

Results

Patient Characteristics

Of the 101 recruited patients, 72 could be examined clinically and radiologically. Seventeen (23.6%) of them were men and 55 (76.4%) were women. Their average

age was 54 years at the time of cementing the buildups (median 62.15 years; range, 31 to 73). Of those patients who did not show up for the examination, there were relatively more men (43.3%) than women (22.5%) and their average age was 61.35 years (SD 13.06); these patients had either died or could not be found because either their home address or their name had changed.

The average observation period of the patients who showed up for the examination was 8.56 years (SD 1.45). Forty-nine (68.1%) patients said they attended regular recall visits.

Of the 72 patients, 11 (15.3%) declared themselves to be smokers. No radiograph was obtained for one patient because she was pregnant. Five patients suffered from diabetes at the time of the examination; however, all were receiving treatment. Four patients were diagnosed with a carcinoma in the time between cementing the post and the date of the follow-up examination; however, none were situated in the jaw region. One patient suffered from Sjögren syndrome.

Tooth Characteristics

Out of the 72 teeth examined, 46 (63.9%) were in the maxilla and 26 (36.1%) were in the mandible. Altogether, 41 (56.9%) cast post-and-core buildups and 31 (43.1%) composite post buildups were examined. The distribution of the buildup types showed significantly more cast post-and-core buildups in the region of the incisors and the canines, whereas in the molar region there were significantly more composite post buildups (chi-square, $P = .0006$) (Table 1). A similar distribution regarding buildup materials and tooth position was observed for the patients who did attend the examination.

The buildups were inserted with 3 different types of cement (Table 1). The distribution of buildup types did not show any relationship to the type of cement used (chi-square, $P = .078$). The distribution of cement types also did not show any relationship to the various positions of the teeth (chi-square, $P = .2384$).

The average length of the apical part of the root canal treatment of the examined teeth was 3.6 mm (SD 1.8) for the composite post buildups and 3.8 mm (SD 1.9) for the cast post-and-core buildups. The cast post-and-core buildups had an average post length of 8.2 mm, which was approximately 1 mm longer than the 7.0 mm of the composite post buildups. The ratio of post length to crown length was very similar in both buildup types: 0.92 (SD 0.28) for cast post-and-core buildups and 0.86 (SD 0.30) for composite post buildups.

Tooth Loss and Complications

Tooth loss. In 4 of the 72 patients, the tooth chosen to be examined was no longer in situ. In 2 other patients, the teeth were so massively destroyed at the time of examination that they could no longer be restored and so were registered as lost teeth. Altogether, therefore, 6 (8.3%) teeth were lost (Table 2).

The different types of tooth (incisor, canine, premolar, molar) were combined for the statistical evaluation of the maxilla and the mandible. No significant differences were observed between these 4 groups with regard to the distribution of tooth loss (chi-square, $P = .2567$).

In addition, no statistically significant difference was detected in tooth losses between the 2 buildup types, either for the 4 teeth that had been provided with a cast

Table 1 Characteristics of the 72 Teeth Evaluated in the Study

Characteristic	Cast gold post-and-core buildups	Composite post buildups
Total no. of buildups	41	31
Location		
Incisors	9	2
Canines	10	1
Premolars	21	19
Molars	1	9
Cement type		
Glass ionomer	7	6
Composite	22	21
Zinc phosphate	9	1
Could not be evaluated	3	3
Type of restoration		
Fixed partial denture	16	13
Single crown	20	14
Splinted crown	5	4

Table 2 Characteristics of the 6 Teeth Classified as Losses

Type of tooth	Survival time (y)	Type of buildup	Type of reconstruction	Reason for extraction
Premolar (maxilla)	3.13	Cast post and core	Fixed partial denture	Periapical pathology
Incisor (maxilla)	5.42	Composite	Fixed partial denture	Periapical pathology
Incisor (maxilla)	5.53	Cast post and core	Single crown	Root fracture
Molar (mandible)	7	Cast post and core	Fixed partial denture	Periapical pathology
Canine (maxilla)	8	Composite	Splinted crown	Periapical pathology and caries
Canine (maxilla)	9.62	Cast post and core	Fixed partial denture	Root fracture

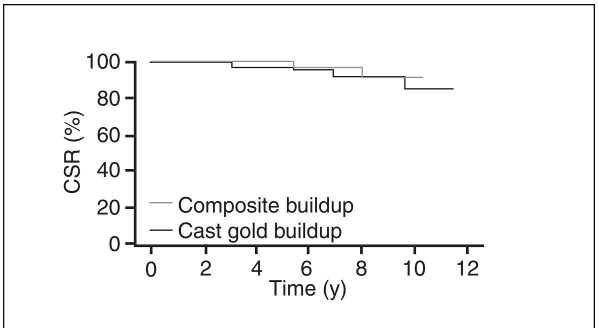
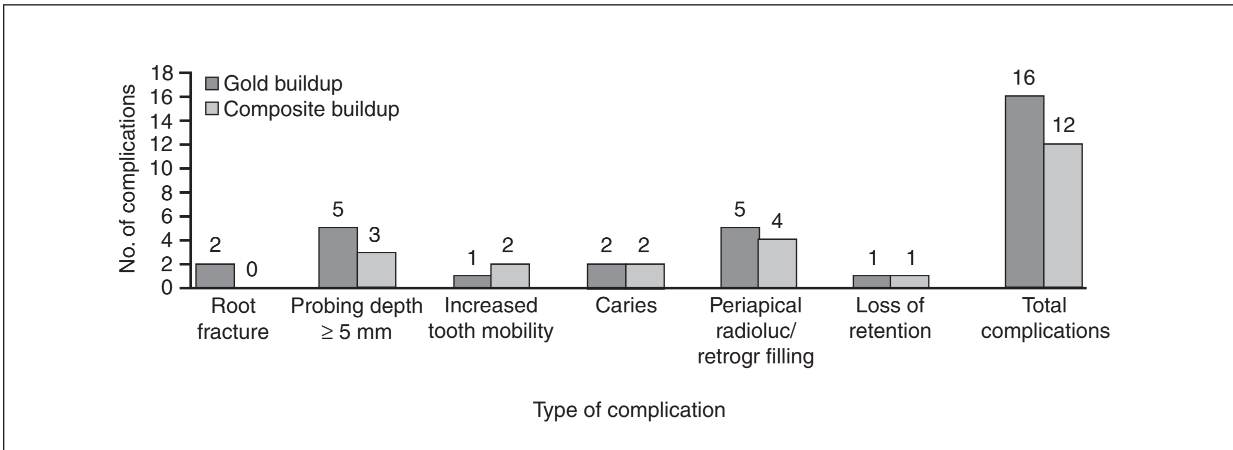


Fig 1 *(left)* CSRs of cast post-and-core buildups and composite post buildups over an average observation period of 8.56 years (Kaplan-Meier).

Fig 2 *(below)* Distribution of the total number of complications according to type of complication and type of buildup.



post-and-core buildup or for the 2 teeth with composite post buildup (chi-square, $P = .735$). From these data, a CSR of 90.2% was measured for the cast post-and-core buildups, versus a CSR of 93.5% for composite post buildups over an average observation period of 8.56 years (Fig 1).

Complications. Probing depths of ≥ 5 mm were measured for 8 of 72 teeth. Of these 8 teeth, 5 had been provided with cast post-and-core buildups and 3 received composite post buildups. Of the 72 teeth examined, 3 (1 cast post-and-core buildup, 2 composite post buildups) showed a mobility degree of 3 or 4.

Of the 4 teeth that had been diagnosed as having caries in the clinical examination, 2 had been provided with cast post-and-core buildups and 2 had received composite post buildups. The teeth of patients who did not show up regularly for recall exhibited a higher caries incidence compared to the teeth of patients who regularly showed up for recall. The 2 teeth with root fractures had been provided with cast post-and-core buildups and could no longer be treated.

At the follow-up examination, 9 teeth either showed periapical radiolucency and/or had been treated either with only an apical root resection or a simultaneous retrograde filling since cementation of the post buildups. There was no statistically significant difference between the 2 buildup types of the teeth with periapical radiolucency or retrograde fillings. In addition, no significant relationship was found in the incidence of periapical radiolucency/retrograde filling complications and the residual length of the apical root canal sealing.

By looking through the patients' histories and by questioning the patients, the authors found 2 retention losses of the examined restorations, and they were evenly distributed (1 each of the 2 buildup types). One tooth was extracted shortly after retention loss because of a root fracture, and the other was judged no longer reconstructible. Both were finally classified as tooth losses.

Thus, 28 complications were found in the entire patient sample; 16 were cast post-and-core buildups, and 12 were composite post buildups (Fig 2). Of all the teeth examined, 11 (26.8%) of the 41 teeth with cast post-and-core buildups showed at least 1 complication, as did 8 (25.8%) of the 31 teeth with a composite post buildup. However, a total of only 6 buildups ended in tooth or restoration loss. The individual teeth with complications, listed according to the type of restoration, are shown in Table 3.

Table 3 Distribution of Complications According to Type of Reconstruction

Type of complication	Single crowns		Fixed partial denture		Splinted crowns	
	Cast P&C	Composite	Cast P&C	Composite	Cast P&C	Composite
Root fracture	1	0	1	0	0	0
Pocket depths ≥ 5 mm	2	2	3	1	0	0
Tooth mobility 3 and 4	0	0	1	1	0	1
Caries	0	1	2	0	0	1
Periapical pathology	2	0	2	2	1	2
Loss of retention	1	1	0	0	0	0
Total complications	6	4	9	4	1	4

P&C = post and core.

Discussion

It was shown in this retrospective study that there were no statistically significant differences in CSRs and complication rates between indirect cast post-and-core buildups and direct composite post buildups over an average observation period of 8.56 years. In this comparative study, the indirect cast post-and-core buildups showed a CSR of 90.2%, and the direct composite post buildups showed a CSR of 93.5%. These values correspond, on average, to the survival rates described in the dental literature for diverse post buildup materials over various observation periods.[13–18] In most studies, however, the average observation period was shorter, which restricts comparability to the present study. For cast post-and-core buildups, a CSR of 90.6% was found over an average period of 6 years; caries, root fracture, and retention loss were responsible for the extractions or the provision of a new restoration.[13] Two clinical studies showed survival rates of composite post buildups over an observation period of more than 8 years. There, of a total of 67 teeth that had been checked in a follow-up examination and had been provided with composite post buildups, 7 extractions were performed, corresponding to a CSR of 89.6%.[16] In the second study, 51 teeth with mainly screws and composite post buildups were followed up over a period of 10 years. In that time, 6 teeth (12%) were lost because of caries, root fractures, and retention loss; this amounted to a survival rate of 88% over 10 years.[15] The slightly lower survival rate of the composite post buildups in these 2 studies versus the present study may possibly be explained by the increased use of screws. Similar complication rates between the post buildup types described in the study presented here agree with the findings of a review of 10 in vitro and 6 in vivo studies.[19] In these it was also shown that no evidence exists for a preference of either post buildup type.

According to the literature, the prognosis for teeth provided with post buildups is dependent on a wide range of factors. These factors were examined more or less independently using in vitro studies.[20,21] Various aspects were examined, such as post design, treatment of the apical part of the root canal, post material, post length, cement type, buildup material, and the ferrule effect.

All posts used in the present study were cylindric-tapered or tapered. The biomechanical characteristics of different post forms have been evaluated in the literature. On the one hand, the onset of a wedge effect was noted when cylindric-tapered posts were used, whereas no such onset was found when parallel and tapered posts were used.[8,22] All post buildups used in the present study were provided with a vertical stop in the form of a canal inlay, since it has been demonstrated that an inlay is able to reduce the wedge effect of tapered posts.[23] In an in vivo study that considered different post systems, screws showed the lowest survival rate and always caused massive pressure to develop in the root.[15]

Ideally, the time between root treatment and post setting should be as short as possible to minimize the risk of endodontic failure.[24,25] In addition, it was shown that, in teeth with a post buildup, significantly more periapical radiolucency was found in teeth with a post buildup that had an apical sealing of less than 3 mm.[26] The average length of the apical part of the root canal treatment of the teeth examined in the present study was 3.7 mm. In spite of the demand for at least a 3-mm-long apical portion, the apical part of the root canal treatment varied between 0 and 8.5 mm. However, no correlation between the teeth with apical radiolucencies/retrograde root fillings and the length of the apical part of the root canal treatment could be found. The frequency of nonvital teeth with apical radiolucencies/retrograde root fillings (12.5%) found in this study corresponds to that of 12.1% found in a study of fixed partial dentures with cantilevers.[27]

The buildups of both studied groups were cemented with 3 different types of cement (zinc phosphate, glass ionomer, and composite); composite was used in nearly two thirds of all buildups. Various studies showed that adhesive fixation of posts in the root canal by means of composite cement resulted in improved retention and increased pullout forces of the coronal restoration.[28,29] This fact and the fact that no fixed partial dentures with cantilevers were used could explain the small number of retention losses found in the present study.[30] Because composite cements have an elastic modulus similar to that of dentin, the fortification of a thin root wall as a result of the adhesion of the cement is also discussed.[31,32] In addition, composite cements have been shown to be superior to the zinc phosphate and glass-ionomer cements in terms of microleakage.[33] A disadvantage of the composite cements, however, is seen in their high technical sensitivity.[34,35] In addition, temporary cements that include eugenol can have a negative influence on the adhesive power of composite cements.[36,37] In spite of these many factors, it was found in the present study that, when the essential biomechanical principles in treating nonvital teeth with posts were followed, the choice of cement did not play a significant role for the prognosis of the treated tooth.

The different buildup materials have also been compared and assessed in a range of situations. Although composite clearly exhibits a lower modulus of elasticity and flexure strength than gold, no statistically significant difference was found in the fracture resistance of the 2 buildup materials in various in vitro experiments.[21,38] The difference manifested itself only in the location of the fractures. Whereas materials with a lower modulus of elasticity (composite or amalgam) showed a tendency to fail by fracture of the buildup, the cast post-and-core buildups tended more to root fractures.[21] Regarded from the clinical perspective, composite buildups offer various advantages over cast post-and-core buildups: they show a good color match with the remaining dentin, they have adhesive qualities, they require a shorter treatment period, and they cost less. Under mechanical stress and high temperatures, however, they undergo greater deformation.[39,40] Absorption of liquid also has a negative effect on the 3-dimensional stability of composite buildups,[41] leading to a tendency toward the development of microleakage, caries lesions, and endodontic failures.[42]

It has been shown that more residual dentin means that the mechanical qualities of the buildup material played less of a role.[21,43,44] The importance of retaining as much tooth substance as possible is also demonstrated in the fact that an adequate ferrule effect can only be maintained when there is enough residual tooth substance.[8,45,46] This is in broad agreement with the often repeated statement that, despite the various possibilities available to optimize treatment of the nonvital abutment, the amount of tooth substance that is retained is probably the most important prognostic factor.[9,18,47–51]

Conclusion

It can be concluded that over an average observation period of 8.56 years the indirect cast post-and-core buildup and the direct composite post buildup can be considered of similar value when taking into account the CSR and the frequency of root fractures, increased probing depths, increased tooth mobility, caries, periapical lesions, and loss of retention. However, it must be taken into consideration that in the present study, more cast post-and-core buildups were placed in the region of the incisors and the canines, whereas in the molar region there were more composite post buildups.

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