The use of composite resins in combination with anchorage posts as core material in endodontically treated teeth: Clinical aspects of the technique

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In vitro tests and a clinical examination of 51 patients who were treated over a period of 12 years have demonstrated that a composite resin core that is surrounded by a gold crown may provide the same function and strength as a conventional gold core. However, the method demands a thorough knowledge of the materials and a careful and detailed technique. The importance of an initially effective dentinal bond to the chosen hybrid composite resin is stressed. Zinc phosphate cements and the technique of cementing are also discussed. In most cases, a damaged root will have to be reinforced with a post, and the author recommends the use of a threaded titanium post that fits well and is bound to the root with a so-called passive cementation technique. The author has also had positive experiences with composite resin crowns, which can be expected to have a functional life of at least 10 years.

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Introduction

Some composite resins have proved sufficiently strong in oral environments to be used for restoring severely damaged endodontically treated teeth. The main reason that the technique has long been condemned as unacceptable is that the volumetric changes in composite resin materials that result from repeated temperature changes (thermal stress) would be too great to allow permanent retention of the cement.

According to the author’s experience, this assumption has proved unfounded. However, it must be emphasized that successful restorations and durable results are dependent on both a good understanding of the materials and a sound, systematic operating technique. The method developed by the author over the last 20 years for making composite resin cores will be described in the following report. The discussion will be introduced by a case report that illustrates the reliability of the method and indicates a more versatile use of some restorative composite resin materials.

Case report

A 48-year-old woman was recently treated by a colleague, who made a mandibular gold fixed partial denture for her. The end abutment, tooth 47, had been supplied, in 1971, with a separate gold crown superimposed on a composite resin core with a threaded post. (The case is listed as No. 44 in a previous article.)

When the gold crown was removed, it was observed that the underlying composite resin core was intact. It could be used in this state as an end abutment in the planned prosthesis (Figs 1 and 2). This incident showed that the clinical functioning time for the composite resin core could be as long as 17 years and that the core could have an extended life as an abutment. The excellent bond between the Adaptic low-x-ray-contrasting composite resin (Johnson & Johnson Dental) and the dentin is worthy of note, because the technique of dentinal bonding was not available at the time the core was made.

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Clinical Communication

Fig 1  Radiograph of tooth 45 after the gold crown (cemented in 1971) has been removed, 17 years later.

Fig 2  (right) Composite resin post in tooth 45.

Improvements in the method

More than 20 years have passed since the author made his first restorations containing composite resin cores. Since then, the technique of dentinal bonding has been introduced, composite resin materials have been improved, and new reinforcing endodontic posts have been introduced. It has thus been possible to improve the method. At the same time, the earlier type of threaded endodontic posts (Screw-Posts, Dentatus) continue to be used because the manufacturer was the first to produce noncorrosive titanium posts that are inexpensive and suitably shaped.

Reconstruction of the crown

Dentinal bonding

The modern technique of dentinal bonding has considerably increased the opportunities for the dentist to make strong joints between damaged tooth surfaces and specific reparative materials. However, the author’s documented experience relates only to composite resin materials. The use of glass-ionomer cements has also been introduced for building up artificial cores, but as yet they lack the documentation of clinical longevity necessary to allow them to be considered durable.

Among the different dentin–composite resin bonding systems that have been introduced, Gluma (Bayer Dental) was chosen by the author at an early stage. A large number of scientific articles, as well as the author’s own clinical experience and documentation, subsequently provided convincing evidence of the usefulness of the system. It is questionable whether durable bonding is achieved to young and vital dentin, but for both nonvital and aged but vital dentin the chances of achieving a lasting bond are good (Figs 3 and 4).

Because the surfaces dealt with in these cases are always “dense” (secondary dentin or nonvital root dentin without fluid flow) both the dentinal and the enamel surfaces have to be etched: i.e., it is necessary to diverge from the manufacturer’s directions for use. It is also important that the surfaces be carefully rinsed with water and properly dried before they are impregnated with the bonding liquid of Gluma Primer. This intermediate layer should be as thin as possible and uniform in its contact with the resin. After the primer is applied and dried, a film of resin should be applied carefully and air blown so that any excess can be removed from the surfaces; this allows the bulk to be light hardened immediately. Thus the thin primer resin layer will be fixed. The composite resin layer should then be applied and hardened in the usual way.

Choice of composite resin

A suitable composite resin for this use is a hybrid type that has both great strength and can be sufficiently...
Fig 3 Palatal surfaces of teeth 14 to 24 in a 54-year-old woman. Enamel remains only incisally. The cause of the erosion is unexplained.

Fig 4 Efficient rebuilding of the damaged palatal surfaces is made possible by dentinal bonding to secondary dentin. The restorations have been in clinical function for 4.5 years.

finished. For the last few years the author's choice has been Pekafil (Bayer Dental), a light-hardening hybrid composite resin of suitable plasticity. For certain cases it is advisable to use a chemical-hardening composite resin (see below). The primer-resin layer in such cases cannot be hardened separately, but should be forced into a thin coat (by air blowing) before it comes into contact with the composite resin, which is applied to the surfaces with a syringe.

**Rebuilding of the root**

The restored root must be made as strong as possible. The remaining tooth substance, the restorative materials, and the reinforcing root post must achieve optimal cooperation to form a completely tight structure. The technique of dentinal bonding described above is an important factor in this bond.

**Choice of composite resin**

The plasticity of the composite resin material should allow an easy flow from the tip of a syringe and rapid contact with the treated dentinal surfaces. Access to some areas of dentin may be difficult. Materials that are so viscous that they demand a "condensation" technique are therefore less suitable because they may result in incomplete obturation. Such defects are unacceptable, at least at the periphery. On the other hand, a few small porosities in the center of a restoration will probably have no effect on the structural strength.

Sometimes the tooth to be restored has such large and deeply damaged areas that the use of light-hardening resin would entail the risk of areas of uncompleted hardening and thus inferior strength. For these cases a chemical-hardening composite resin should be used, at least for the apical portion. Two-paste systems require manual mixing, but the prespatulated paste must first be placed in a syringe and then injected into very close contact with the root dentin and the cemented post. For these cases the author has also chosen a hybrid composite resin (Miradapt, Johnson & Johnson Dental) which can be combined with the earlier mentioned light-hardening composite resin Pekafil, which is also based on Bowen's resin.

**Deeply damaged roots**

Several teeth treated in the clinical investigation were so deeply damaged by caries that the only alternative to the chosen composite resin therapy would have been extraction of one or more roots. When a careful but complete excavation of caries was completed, sometimes only very thin dentinal walls, level with the bone and under the marginal gingiva, remained (Figs 5 and 6).

A special method was used in those cases, because any attempt to place a tight-fitting matrix around such a root is doomed to failure: damage to the soft tissue and/or fracture of the dentinal walls would let blood and exudate from the pocket penetrate the matrix border. Therefore the root must be restored in two stages.
Fig 5 Case 4 of the clinical investigation. Tooth 23 is part of a total maxillary prosthesis with an observation time of 2 years 3 months. The composite resin restoration has been in clinical function for 11 years.

Fig 6 Tooth 23 before composite resin rebuilding. A threaded titanium post, No. 6 extra long, has been cemented. At this stage any attempt to place a tightening matrix band around the root periphery is doomed to failure.

Restoration step I

In the first phase one has to work "by hand," utilizing efficient moisture control in the area of the root. The root dentin must be carefully cleaned, impregnated, and airblown. In the author's experience, most of these troublesome cases can then be handled so that a dense root obturation can be built up (through injection of composite resin) on a level with—and in the center even higher than—the root periphery.

Any bleeding or contamination by exudate will halt the treatment, because a totally clean and dry operatory field is absolutely necessary. If that cannot be achieved, treatment must be delayed, a provisional restoration must be placed, or, if the case seems impossible, the tooth must be extracted.

Restoration step II

A suitable steel matrix is used. It is not advisable to use plastic strips because of their elasticity and because their transparency makes it difficult to maintain a dry field. The matrix is fastened facially or lingually, according to where the matrix clip can achieve the best hold. Usually this is on the facial side. The necessary tight hold may peripherally damage the gingiva, but at this stage bleeding can be kept away from the operatory field. The unavoidable opening toward the root where the shanks of the matrix holder run together (Fig 7) is no impediment to maintaining a dry operatory field, in the author's experience. On the other hand, some extra work is often needed when the matrix holder is to be removed together with the excess hardened composite resin, especially when the remainder of the root is small where it grasps the matrix holder (Fig 8).

A buccal matrix band, turned lingually, will facilitate the contouring of lingual and palatal surfaces (Fig 9).

Reinforcement of roots

Root posts

The weaker a root is, the more important a cemented root post is to strengthen the root and to anchor the restorative materials. A weakened root may also fracture, however, if the technique used to place the post is incorrect or if the post is too short or of an unsuitable shape (Figs 10 and 11).

The author has seen no reason to abandon use of the classic threaded root post ("screw post") to reinforce endodontically treated teeth, because the shape of these posts accords well with the root anatomy, and, with Dentatus reamers (Dentatus), it is easy to achieve the exact fit that is a prerequisite for effective retention. Titanium threaded root posts should always be used for permanent restorations (Fig 12).

Threaded root posts that are too short and/or too thin must not be used for permanent restorations. Many root fractures and retention failures can undoubtedly be explained by such inappropriate choices. No dimension smaller than a Dentatus No. 4 long should normally be used, even if the tooth is a fragile mandibular incisor. The reaming should always be started with reamer No. 1. With a loose grasp around the
Fig 7 A matrix steel band is placed tightly around the buccal aspect of the root except for the opening between the shanks. The gap can be tightened with a small compressed cotton pellet, which is pressed apically to the preparation border. The matrix steel band will be contoured into good proximal contact with the adjacent teeth (here the distal contact is missing).

Fig 8 Sometimes the excess hardened composite resin locks in the matrix band holder, which must then be ground loose with a flame-shaped diamond. The composite resin mass will then be transformed into a crown or a post.

Fig 9 The buccal steel matrix band provides a good view and facilitates the direct contouring of a palatal surface into its anatomic shape.

Fig 10 Para-Post (Whaledent) is part of the construction for a premolar in the maxilla.

Fig 11 Same restoration as in Fig 10, 1 year later. An axial root fracture is suspected of being connected with the core.

Fig 12 Dentatus threaded titanium posts with reamers and keys. The stand for the reamers may also be used to check that a chosen post has the right thickness.
handpiece and with short cuts so that no frictional heat will damage the root, the operator should allow the reamer to be guided into the root canal to an adequate depth. The enlargement of the canal is best made if all sizes of the reamer are used in succession, with sufficient cooling intervals, up to at least thickness No. 4.

The majority of the author's restorations have been built up to post dimensions Nos. 5 or 6, long or extra long (11.5 and 14 mm, respectively). Recently the manufacturer has also expanded the line with a 17.0-mm super-long post, in thickness Nos. 3 to 6.

**Cementing technique**

An investigation of the threaded root post as an aid to anchoring demonstrated the great value of a passive cementing technique. Optimal retention is achieved by the threaded post without the built-in tensions that even a moderate fastening by screwing may cause. Therefore the term screw post is inappropriate; threaded post is a better choice of name. The screw form is not only a help during insertion; during cementing the viscous surplus of cement will be able to flow away through the screw threads, if the screw is cautiously rotated to the bottom. Moreover, the screw form is helpful if an old root anchoring must be removed. If the screw is kept fairly intact during removal, the post can be easily loosened and unscrewed from its earlier hold. Finally, in the author's opinion, the thread form makes the retention stronger if there is a maximal fit to the reamed canal.

**Choice of cement**

Zinc phosphate cements are the oldest and most tested of the dental cements. Properly used, they may give lifelong retention. They have a suitable reaction time, and solidified surplus cement can easily be removed. If necessary, a cemented object may be detached relatively easily.

Zinc phosphate cement also functions well with threaded posts. It is advisable to insert the cement into the reamed root canal through a cement tube, minimizing the amount of excess cement especially in narrow spaces. Unnecessary excess cement must also be avoided to allow as large a dentinal bonding surface as possible.

Zinc phosphate cements are produced by many different manufacturers, but the retention capability of

![Frequency diagram showing the distribution among different teeth of 248 teeth that received composite resin crowns.](image-url)
different brands may vary remarkably. In vitro tests showed that about double the load was required to loosen the core from its crown when Lumicon zinc phosphate cement (Bayer Dental) was used than when other cements (among them a glass-ionomer cement and a carboxylate cement) were used.

Permanent or semipermanent therapy
The 51 teeth in the clinical investigation were all provided with permanent restorations by enclosing every composite resin post in a cast gold crown. This was less costly for the patients than using gold posts would have been. Forty-three restorations were satisfactory at long-term recall. In one case, the surrounding gold crown had lost the retention to its post. In the remaining seven cases, the cement retention between post and crown was intact, but the tooth had been lost to root fractures, secondary caries, and/or insufficient core retention.

Several patients with similar root defects have thought that they could not afford permanent therapy. Instead, they asked for a composite resin crown, that is, a semipermanent restoration. During the same period as the clinical investigation was carried out (1970 to 1982), 248 teeth in 201 patients were, for economical reasons, provided with composite resin crowns. Most of the restorations (84%) were achieved with a core anchorage. Eight percent had vital roots, for which anchorage was made with parapulpal pins and/or den-
mented in detail to allow them to be included in clinical studies. Because the results of these investigations have shown a surprisingly high frequency of success in spite of complicated and widespread damage to the roots, the author is now able to maintain that certain composite resin materials may be even more favorable than gold for both simpler and more difficult cases of rebuilding posts.

References