Non-metal Post Systems

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Abstract: **For many years metals, whether cast or prefabricated, have been exclusively used to construct posts as foundations for indirect restorations. Developments in composite and ceramic materials have resulted in the introduction of metal-free post systems as alternatives. This article provides an overview of the systems currently available, gives guidance on their use, and discusses some of the principles underlying the clinical performance of posts.**

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Clinical Relevance: **Before introducing new post systems into clinical practice, dentists need to be able to understand the scientific principles involved in their clinical performance in order to evaluate the claimed advantages of these alternatives to established systems.**

The construction of posts (or dowels) has been used as a means of providing anchorage for restorations for over 250 years: in 1728 the French dentist Pierre Fauchard was placing metal screw posts in the roots of teeth to retain prostheses.[1] Traditionally, due to their suitable physical properties and facility for being cast or machined into precise forms, metals have been used to fabricate the post and/or core. In recent years, however, non-metal alternatives for posts have been introduced following developments in ceramics and polymers for industrial and biomaterial use. Other factors leading to their introduction into dentistry have been the desire by some patients to avoid the use of metals in the mouth, advances in adhesive materials, and improvements in the aesthetic potential of restorative materials.

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FUNCTIONS OF POSTS

Posts have been used mainly for two reasons:

1. *Reinforcement.* It was once considered that endodontically treated teeth were weak and that it was necessary to place a post into the root to strengthen it, and research appeared to support this.[2,3] However, other studies contradicted this concept,[4,5] and it is currently accepted that post placement can contribute to tooth fracture.[6] The amount of dentine remaining after endodontic treatment or caries removal may be a significant factor in determining the likelihood of tooth fracture.[7,8]
2. *Retention.* The main purpose of a post is to provide anchorage for a core upon which a restoration can be placed. The important factors determining retention of posts have been extensively investigated.[9] These are length, taper, surface configuration, surface treatment and the material used for luting.

POST FAILURE

It is acknowledged that posts can weaken roots and lead to root fracture. The important factors predisposing to root fracture are:

- inadequate thickness of dentine;[7,8]
- use of tapered posts;[10]
- use of threaded posts;[11]
- short post length;[12]
- failure to create a ferrule of adequate length and taper.[13]

Some studies have suggested that post crowns have a high failure rate;[14,15] however, Sorensen and Martinoff's study[16] of post-restored, endodontically treated teeth showed success rates of 87.3% for tapered cast posts and cores, and 100% success for parallel-sided posts when the length of the post exceeded the length of the crown. These teeth had been restored for between 1 and 25 years. Weine *et al*[17] reported on his use of cast-tapered posts, which after 10 years recorded only five failures due to root fracture or restorative causes in 138 teeth. It is likely therefore that failure is as much influenced by the skill of the operator and technician[15] as it is by design features, and this should be borne in mind when assessing the success rates for new systems.

ADVANTAGES OF METAL POST SYSTEMS

Metal post systems have a number of advantages:

History

Metal posts have a well established record of successful clinical service. High success rates have been reported from retrospective studies over periods of time that have not yet been matched by non-metal systems.[17,18]

Adaptability

Cast posts with integral cast cores can compensate for disparities between the angulation of the root and the planned crown.

Core Retention

Cast posts with cores do not have the potential for separation or breakdown that may occur between prefabricated posts and their cores. Stud attachments may more readily be joined to cast posts.

Strength

Cast metals have greater strength in thin section than the composite adjacent to fibre posts. This allows the production of ferrules, or diaphragms.

DISADVANTAGES OF METAL POST SYSTEMS

However, these systems also have their drawbacks:

Root Fracture

The incidence of root fracture may be reduced[19,20] or may occur in a more damaging manner[21,22] when fibre rather than metal posts are placed. In a retrospective 4-year clinical study comparing teeth restored using either cast metal posts and cores or a carbon-fibre system,[19] the teeth with metal posts suffered root fractures in 9% of cases whilst the fibre post group had none and overall were significantly more successful than the metal post group.

Aesthetics

A metal post alters the transmission of light through the tooth, and may show through the root.[23] This effect will be more apparent where the gingival tissues are thin. If a non-precious post has been placed, corrosion products may pass into the root, discolouring it.[24] Where all-ceramic restorations are used, a metal core will alter the optical properties of the overlying restoration.[25] A number of techniques have been described to mask the metal core, all of which involve further technical steps, and varying degrees of success.[26] However, masking the core alone will not alter root discoloration.

Post Removal

All teeth to be restored with posts should have been endodontically treated. Should the endodontic treatment fail, an orthograde approach is considered to yield a higher success rate than apicectomy and retrograde filling alone.[27] Removal of a long metal post to permit this can be difficult, if not impossible, and may result in root fracture.

Biocompatibility

Non-precious metals show corrosion within the root. Using amalgam as a core in combination with a prefabricated post may set up galvanic currents and promote further corrosion. The corrosion products can pass through the dentine of the root[28] and have also been implicated as a cause of root fracture.[29] Ceramic and carbon-fibre posts have been judged to be biocompatible;[30,31] however, this does not necessarily apply to the dentine bonding systems or resin-based luting cements.

POST TYPES

The metal-free alternatives currently available can be broadly divided into either composite materials or ceramics.

Composites

Composite materials are composed of fibres of carbon or silica surrounded by a matrix of polymer resin, usually an epoxy resin. The philosophy behind the use of these materials lies in the belief that a post should mimic the dentine of the root in its physical properties, distribute the stresses imposed on the restored tooth in a more favourable way, and thereby reduce the incidence of root fracture. In addition, if the material of the post is slightly weaker than the root containing it, then the post will fracture preferentially and the root may then be re-restored. While it may be beneficial for the post to match the flexural modulus of the dentine, it would appear to be equally important for the luting material at the interface of these materials to be able to flex harmoniously.

Carbon-Fibre Posts

A number of such posts are available currently: these are discussed below. *Composipost* (R.T.D. France: UK source Dental 21, Boreham, Essex). This system was introduced in 1990 following research undertaken by Duret and associates in France.[32] Figure 1 shows

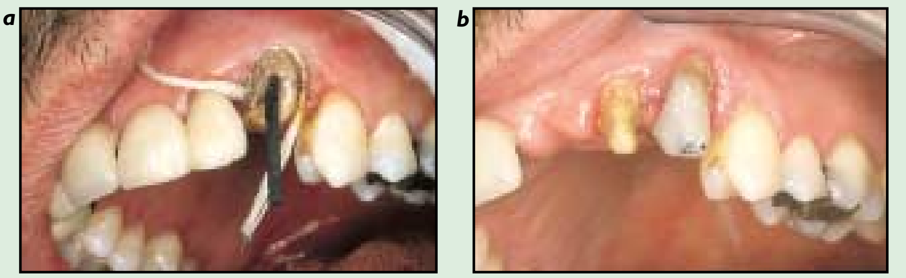

Figure 1. *An early design of Composipost, being used with a composite core.*

Figure 2. *Composipost kit with posts and drills.*

an early design of the *Composipost*, which included mechanical retention features. The current posts are smooth-sided. They are composed of 8 µm pretensed carbon fibres arranged longitudinally within an epoxy resin matrix and make up 64% by volume. The bundles are produced industrially and are then machined to the shape and dimensions shown in Figure 2. The posts were originally radiolucent, but are now advertised as being radio-opaque. An initial access instrument is supplied, together with two burs, to produce the shape of the two parallel-sided sections of the *Composipost* in the root.

For retention of core materials in narrow-diameter roots such as molars or mandibular incisors, RTD produce narrow parallel-sided cylindrical posts, *Endoposts*, available in 1 mm and 1.2 mm diameters. The manufacturer of *Composipost* is the only one who currently produces a kit of burs designed for post removal and canal reaccess. *Composipost* has been used widely in Europe and has undergone several clinical trials.

Carbonite (Harald Nordin sa, Switzerland: UK source Blackwell Supplies, Gillingham, Kent). These posts differ from the *Composipost* in that bundles of fibres, which are 6 µm in diameter, are braided together within the epoxy matrix. Fibre content is 65%. The manufacturers claim that this arrangement gives increased resistance to bending and torsion compared with a parallel fibre arrangement. The posts are parallel-sided with a 3 mm conical tip. Three diameters (1.2 mm, 1.35 mm and 1.5 mm) are produced, with a single bur for each size (Figure 3). These burs are triangular in cross-section with no cutting flutes. The post space should be pre-enlarged to the full depth before completing the preparation with the supplied burs.

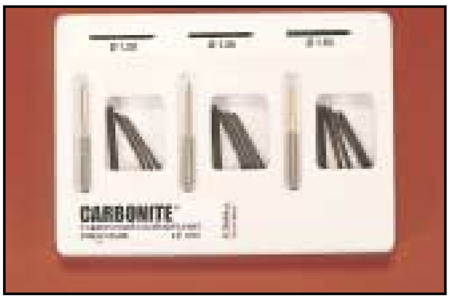

Figure 3. *Carbonite system kit.*

Mirafit Carbon (Hager Werken, Germany: UK source Glover Dental Supplies, Shrewsbury, Shropshire). This system appears identical to the *Carbonite* system in its construction, dimensions and presentation. It also is supplied with triangular cross-section burs for post space preparation.

Silica-Fibre Posts

Carbon-fibre posts are black in colour and do not lend themselves to use with all-ceramic units, where they may alter the aesthetic effect. Glass fibre has now been substituted and added to the range of prefabricated posts to overcome this limitation. The physical properties of these posts are similar to those of carbon-fibre posts and they should behave in the same way.

Aesthetipost (RTD, France). This post retains a central core of carbon-fibre bundle surrounded by quartz fibres similarly arranged longitudinally.

The next generation is the *Aesthetiplus* post, which is composed entirely of quartz fibres. More recently, this company has produced a translucent quartz fibre post designed to permit light-curing materials to be used for luting – *Lightpost*. All of these variations are produced in the same shapes and sizes as the original *Composipost* (Figure 2). RTD have most recently introduced a series of posts with a double taper.

Snowpost (Carbotech, France). Developed from research originally on carbon fibre by Professor Bois and colleagues at Lyon,[33] the *Snowpost* is composed of 60% longitudinally arranged silica zirconium glass fibres in an epoxy resin matrix. The surface is treated with silane to enhance bonding with resin cements. Its shape is cylindrical, with a 3° tapered apex. Four diameters – 1 mm, 1.2 mm, 1.4 mm and 1.6 mm – are contained in the complete kit, together with matching burs. The tapered end is 4–6 mm long (Figure 4).

Figure 4. *Snowpost silica-fibre post system.*

ParaPost Fiber White (Coltene/Whaledent, Burgess Hill, West Sussex). Designed to complement and extend the existing successful *ParaPost* system, *Fiber White* has longitudinally arranged glass fibres. The post is essentially parallel with small steps to aid mechanical retention of the cement lute. Unlike the other fibre posts, the head of the *Fiber White* post has two rounded sections, again to aid retention of the core material. It is compatible with the existing *ParaPost* system in shape and is available in diameters of 1.14 mm, 1.25 mm, 1.4 mm and 1.5 mm. Each post has a removable colour-coded ring around the head for identification (Figure 5).

Glassix (Harald Nordin sa, Switzerland). Like its carbon-fibre stablemate, the *Glassix* posts have a braided fibre arrangement, and are presented in the

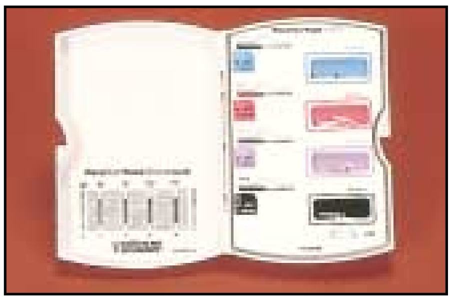

Figure 5. *ParaPost Fiber White kit.*

Figure 6. *Glassix glass-fibre system.*

same dimensions (Figure 6).

Mirafit White (Hager Werken, Germany). This is the glass-fibre version of *Mirafit Carbon*.

Luscent Anchors (Dentatus, Sweden). A tapered shape has been adopted for the *Luscent Anchors*. They are formed from translucent longitudinal glass fibres within a resin matrix. Three diameters, measured at the coronal end, of 1.4 mm, 1.6 mm and 1.8 mm, are available with matching burs.

FibreKor (Jeneric/Pentron, USA). Unlike the other systems here, *FibreKor* posts contain a filled composite as the matrix which surrounds the fibres. The fibres are glass, arranged longitudinally and comprise 42% by weight. The composite resin and filler both make up 29% by weight, respectively. These posts bear similarities to the *Fiber White* posts in their stepped parallel shape, but have no separate shaping of their heads and are supplied with a useful pair of tweezers and matching burs in three sizes (1 mm, 1.25 mm and 1.5 mm). Intermediate sizes (1.125 mm and 1.375 mm) are also available (Figure 7).

Style-post (Metalor Technologies, London). At the time of writing, the Metalor company has just introduced a parallel-sided, tapered-end quartz fibre post system. This is compatible with its metal prefabricated M-P post system and is produced in four widths.

Light-transmitting Posts

The setting reaction of self-curing cements begins rapidly after mixing and this can cause difficulty in fully seating posts.[34] Ensuring complete cleaning and then coating of the sides of the post space is difficult, and can result in reduced retention or increased microleakage.[35] Translucent posts (*Lightpost* and *Luscent Anchors*; Figure 8) have been introduced in order to allow the use of light-cured luting agents. This can facilitate cement placement and evaluation of post seating prior to setting.

The original purpose of light-transmitting posts was to provide a means of reconstituting roots with overly flared canals caused by caries or excessive endodontic preparation,[36] the aim being to achieve union between the remaining dentine and a light-cured composite, thereby restoring the lost bulk and original strength of the root.

The technique involves inserting a translucent plastic post into a light-curing composite placed within the canal. The composite is then cured by light transmitted down and through the post. Once the composite is cured, the post is withdrawn and a matching metal post luted with resin cement. The light-transmitting properties of translucent glass-fibre posts allows them to be luted in a similar fashion with light-cure cements as a definitive post, with or without additional composite resin root reinforcement. The plastic posts require a diameter greater than 1.5 mm to achieve complete curing to a depth of over 7 mm.[37] The relative ability of the glass-fibre versions to transmit light has not yet been reported.

Ribbon-fibre Materials

Several manufacturers produce woven fibre ribbons to be used as a matrix for the construction of direct etch-retained composite splints. Ribbond Inc. (Seattle, USA) suggest that their woven polyethylene fibre can also be used to construct a directly placed composite post and core.

Figure 7. *FibreKor composite and glass-fibre post system.*

Figure 8. *Luscent Anchor posts, drills and core matrix.*

Removal of the obturation material and a minimal amount of dentine to facilitate insertion of the ribbon is the only preparation required. One or more lengths are coated with light-cure resin, folded into a V-shape around an instrument and then carried into the canal space to be cured.[38] Additional increments are then added to complete the core build up.

For this technique to work well there must be sufficient light reaching the depths of the post space. Tests on this system have produced conflicting results as to the resulting strength of the restoration[39] and its ability to reinforce the root.[40]

Ceramic Posts

The proven ability of ceramic materials to mimic the appearance of tooth structure has been combined with improvements in strength and durability to permit the use of all-ceramic restorations in situations where only metal-reinforced restorations would previously have been placed. The use of ceramic to provide a core and post retention continues the idea of using a tough but aesthetic material to support all ceramic units without affecting their optical properties. If it is possible to bond this tough material to the root permanently, it is hoped to restore the original strength of the root.

Castable glass posts and cores,[41] glass-infiltrated aluminous porcelain posts and cores produced conventionally[42] or machined from blocks by computer-linked systems

Figure 9. *Cosmopost ceramic post system from Ivoclar.*

have been developed. All of these methods required a prolonged and technically exacting procedure for their construction, and the strengths of the materials produced was such that their use was suggested only in situations where a wide post could be placed.

The introduction of zirconium oxide ceramics has provided a material with over twice the flexural strength of aluminous ceramic systems,[43,44] which is therefore able to be used to construct posts of realistic diameters. Implants composed of zirconia have been produced since the 1980s and its use to construct endodontic posts was described in 1994.[45] When heated, zirconia ceramics undergo structural changes: the crystals change from monoclinic to tetragonal to cubic, with accompanying volume changes and resultant stress on the material. By adding yttrium oxide, a partially stabilized tetragonal phase is achieved. When a crack is initiated in the ceramic, a change in phase from tetragonal to larger monoclinic crystals occurs. The enlargement of the lattice around the crack prevents it from propagating and this behaviour contributes to the material's enhanced toughness.

Zirconia ceramics have been shown to be biocompatible.[30] Building a core of ceramic directly onto the zirconia posts has not been possible owing to the different coefficients of thermal expansion of the core and post materials, which would result in fracture of the core. Ceramic cores have thus to be constructed indirectly and then luted around the protruding end of the post. However, the manufacturers of the *Cosmopost* have produced a core material with a coefficient of thermal expansion very similar to that of the post, which can be heat pressed onto the zirconia post via a lost wax stage. The resulting core therefore has great strength and demonstrates superior retention to the post.[46]

Cosmopost

Cylindrically shaped with a conical tip, the *Cosmopost* (Ivoclar/Vivadent, Leicester) is available in two relatively wide diameters (1.4 mm and 1.7 mm) (Figure 9). The posts, as manufactured, have a relatively smooth surface and are subsequently treated to roughen the surface, which increases the bond strength between the post and core, whether heat pressed or luted. Although principally intended to be used with a ceramic core, the manufacturers suggest that a composite core is suitable if one-third of the coronal tooth structure remains.

TECHNIQUES

The techniques for insertion of these posts are essentially the same as those for metal prefabricated systems. An accurate radiograph of the tooth should be assessed to help select the appropriate post. The following features should be considered:

- curvature of root;
- taper of root;
- width of root;
- cross-sectional shape;
- available length of canal;

(failure to relate these parameters to the post dimensions may lead to perforation or weakening of the root. The actual width of the centre of the root may be much less than the apparent width seen on the radiograph.)

- quality of endodontic seal and apical condition;
- periodontal bone levels for support of the tooth.

As with the restoration of any tooth, consideration must also be given to the presence of caries, active periodontal disease and oral hygiene, the probable functional occlusal loads and the importance of the tooth in the patient's overall treatment.

A post can then be selected with a diameter which will suit the strength requirements of the tooth's functional load, while limiting the amount of further dentine removal necessary to prepare a post space (Figure 10). Having decided the appropriate length of the post hole, the root filling material can be removed with heated instruments or Gates-Glidden drills. Pre-enlargement can then be sequentially accomplished to full depth using matched post drills of progressively larger diameters (where available) or by using small diameter Gates drills. This should be carried out with a light touch, allowing the drill to follow the path of least resistance, the root canal. It is essential for the operator to be relatively passive and therefore avoid driving the drill, which may create an aberrant channel or perforation. The final stage should involve using the drill corresponding to the selected post size to complete the shaping. Having gone through a series of steps, the final drill should need to be placed only briefly. This will help prevent unnecessary removal of dentine laterally, and maintain the cutting efficiency of the drill.

The canal is then cleared of debris and the post checked for fit (Figure 11). In the case of most of the composite posts, the length of the

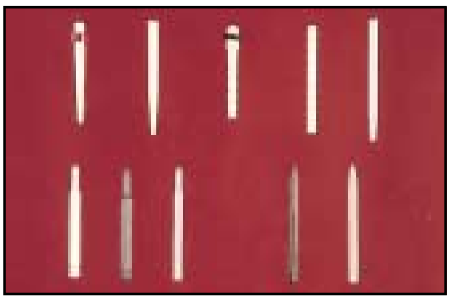

Figure 10. *Examples of currently available posts of similar diameter. Left to right, top row: Luscent Anchor, Snowpost, Fiber White, FibreKor, Cosmopost; bottom row: Aesthetipost, Composipost, Lightpost, Carbonite, Glassix.*

Figure 11. *Preparation of the post space and trial of a glass-fibre post.*

post is adjusted by using a diamond disc to remove the excess from the coronal end. The *Fiber White* posts (see above), being completely parallel and having a shaped head, are adjusted from the apical end before insertion.

It is intended that all of the non-metal posts be luted with an adhesive resin. The dentine sides of the post space are therefore etched and washed, and excess moisture removed consistent with the aims of the wet-bonding technique. A self-curing bonding material is placed into the canal, followed by the self-curing luting cement. Some cement is placed around the post itself, which is then inserted, and excess cement removed. Once the post cement is cured a core material, usually resin composite, can then be built up around the post. For a ceramic post the ceramic core may be fabricated indirectly, heat-pressed onto the post or fabricated separately and then cemented. A direct core of composite is also suggested as a suitable alternative technique.

Realizing the potential of resin composites requires very careful technique and several stages are involved, at any one of which problems may occur.

- The post space needs to be clear of debris. The presence of a eugenol-containing root canal sealer can inhibit curing, leading to reduced retention and increased coronal leakage. Acid etching and the additional use of ethanol will prevent this.[47]
- Etching of the whole of the canal needs to be ensured, as does the correct duration of etching. A small-diameter spiral interdental brush will effectively place etching gel throughout the prepared post space (Figure 12).
- All of the etchant must be washed out and the canal dried correctly. To achieve this requires a careful technique, and simply using an air/water syringe may be ineffective, reducing the potential for successful cementation.[35] Endodontic irrigation needles are useful for improving the removal of etchant (Figure 13). Some luting resin systems do not require a separate etching stage and may therefore be easier to use.
- The luting cement must be placed carefully to coat the entire canal wall, and the post inserted quickly to ensure full seating before curing commences.[34] Refrigerating the luting composite will extend the working time.

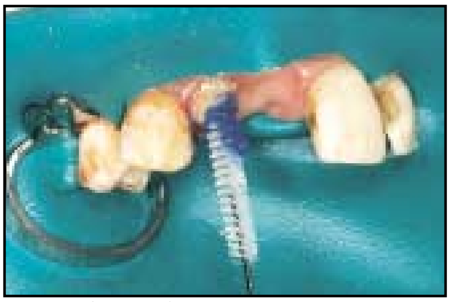

Figure 12. *Use of an interdental brush to etch the walls of the canal fully.*

A light-curing restorative composite can then be built up to form a core (Figures 14 and 15). Composite is usually envisaged as the direct core material to be used in conjunction with these prefabricated posts. The physical properties and behaviour of resin composite, however, are not ideal for this purpose:

- it has adequate but not great strength;
- its co-efficient of thermal expansion is substantially higher than that of tooth structure; and
- its tendency to absorb water makes it dimensionally unstable.[48]

The flexural modulus of composite is different from that of the fibre posts, and this mismatch may cause stresses between core and post. The stresses caused by micromovement of the post can lead to problems of microleakage. It is suggested, however, that composite is a good choice as a core material where there is substantial coronal tooth structure remaining.[49]

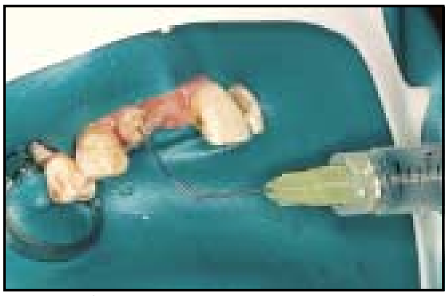

Figure 13. *An endodontic irrigation syringe and needle used to improve removal of etchant and debris.*

ADVANTAGES OF NON-METAL POST SYSTEMS

A major advantage of fibre posts is that the technique for removing them (with rotary instruments) in the event of fracture or need for endodontic retreatment is much simpler than that

Figure 14. *Core build-up with light-curing composite.*

Figure 15. *Completed core preparation.*

needed to remove metal posts.[50] With glass-fibre posts there is also an aesthetic advantage. *Zirconia* ceramic posts also have good aesthetics but may prove difficult – or impossible – to remove.

In comparison with non-precious posts, non-metal systems undergo no corrosion and are more biocompatible.

A possible goal of using dentine-bonding agents to cement a post would be to unite the encircling dentine with the post and thereby reinforce the root. This would be particularly advantageous where no dentine remains supragingivally around which to place a conventional ferrule. Two *in vitro* studies suggest that this can occur;[40,51] however, fracture studies[21] suggest that adhesively cemented posts fail at lower loads than unrestored teeth, and it is not known for how long such a union might last *in vivo*. If non-metal posts can be reliably retained by resin adhesives, traditional mechanical retentive features would be less important and shorter, tapered posts could be employed.

RESEARCH

A wealth of research papers is currently being produced in an attempt to elucidate how well recently introduced post systems perform and thereby aid the clinician in making valid treatment choices. As stated above, it is suggested that fibre posts will succeed by having flexibility comparable with that of dentine in order that they may function in harmony with the tooth;[32] other investigators, however, report that the stiffness of carbon-fibre posts is similar to that of metal posts.[31,52] *Zirconia* posts, on the other hand, are designed to succeed by being more rigid than and stronger than most metal posts.[52]

A popular means of evaluating posts is to load them at an angle progressively until failure occurs, which is often by fracture of the root. In these tests, fibre posts often fail at lower loads than steel or cast gold posts,[21] although the loads at failure exceed those that would normally occur clinically, and the mode of failure is usually less disastrous. As this type of test does not mimic the pattern of loading occurring *in vivo*, a number of investigators have used fatigue testing, in which the post systems are subjected to intermittent loading at lower levels. Such studies found fewer failures with carbon-fibre posts[53,20] than with metal or zirconium posts.

A number of clinical studies show promising results for both fibre posts[54] and ceramic posts.[46] These are short-term results, however, and the success of a post-retained restoration depends on a number of factors, which were not recorded in these studies. It must also be recalled that high success rates were reported with earlier post systems. Therefore, while these studies are encouraging, more information is needed to enable firm conclusions to be drawn, and to establish whether the advantages of non-metal posts are accompanied by high rates of success.

SUMMARY

The introduction of non-metal post systems has initiated a mass of research activity. Results from this research and from clinical data suggest that these systems can be safely introduced into clinical practice. However, the interpretation of this, sometimes conflicting, information is not easy and requires caution. Further research is required to establish whether rigid or resilient posts function better. It is also essential to consider that the post-crown restoration is a system which, as described by Smith *et al*.,[55] consists of the post, the core material and the luting cement. To this should be added the overlying crown, and the functional occlusal load. All of these elements influence the success of the whole restoration, and focusing attention on only one is inappropriate and misleading.

Clinicians would be well advised to continue to follow existing recommendations as to post selection, core fabrication and crown design: reliance on as-yet unproven attributes of new post systems will not compensate for poor technique. There are many and varied combinations of resins and reinforcements being developed industrially and it is likely that the non-metal posts introduced to dentistry so far will continue to be modified and evolve alongside their industrial counterparts.

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BOOK REVIEW

Secrets of Success in Dental Practice – 99 Things They Didn't Tell You in Dental School. By Philip R. Greene. (Available from Dept DEU Quayside Dental Centre, 2 Chester Road, Manchester M15 4WX. Tel. 0161 835 1777; email: dentalbooklets@aol.com) Price: £45 plus sae.

This slim booklet introduces itself as a guide for practitioners who wish to enjoy themselves within their practice environment, working in a happy and friendly place where everyone helps each other. It would be difficult to argue with such aims in any workplace.

Changes in the undergraduate dental curriculum in many dental schools have resulted in an increase in the teaching of Behavioural Sciences within the curriculum and it is to be hoped that, despite the title of the booklet, many of Mr Greene's 99 points have been touched upon within such courses, particularly with regard to developing rapport and friendship with patients. It is also expected that undergraduate schools stress the need for organization when treating patients. Unfortunately, for many undergraduates, mastering the practical and academic content of the BDS course, especially the need to pass examinations, can lead to a lack of appreciation of the importance of their behaviour and organization when they finally progress to general practice.

The booklet contains many helpful hints on organization of reception and appointment systems and also in-surgery behaviour for the dental team. Perhaps one of the most important sections is dealing with conflict with patients and, although in any such publication one would not agree with all the methods and suggestions contained therein, this small, slim volume does contain a wealth of thought-provoking material. It is not appropriate as an undergraduate text, but would be a most useful reminder for those in their early years in practice and particularly those in their vocational training year.

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