

Adhesive dentistry meets restorative dentistry and endodontics – part two

Oswaldo Zmener¹ and Cornelis H Pameijer²

Abstract

While there are many similarities with restorative dentistry, endodontics has its own particular problems and limitations with the use of adhesives. Access to the root canal affects acid treatment, rinsing and depth of cure of light curing materials. Light curing resin materials are preferred in restorative dentistry, while dual-curing resins are recommended in endodontics. As to hydrolysis, the effect of MMPs and bacterial leakage, endodontics is equally affected with the use of resins. It is important that practitioners understand the differences between the two specialties when handling these materials.

Key words: Dentine, dentine bonding, endodontics, hybrid layer, resin/dentine interface.

Adhesive dentistry meets the root canal

Much of what has been presented in 'Adhesive dentistry meets restorative dentistry and endodontics – part one' applies to endodontics.

During the last four decades, new materials have been introduced as alternatives to the most widely and traditionally used root canal filling materials (Taintor and Ross, 1978). Gutta Percha does not bond to root dentine and endodontic sealers do not bond to Gutta Percha or to root canal walls, thus allowing for fluid and bacterial leakage. Coronal and apical leakage are both contributing factors to a unfavourable prognosis of endodontic therapy. Recently, the application of adhesive dentistry in endodontics has been improved by the introduction of a new generation of hydrophilic methacrylate-based endodontic sealers and dentine adhesives with the intent to promote the formation of a hybrid layer and enabling the penetration of resin tags into smear layer-free dentinal tubules. Mounce (2007) suggested that adhesive techniques, which are currently being used in restorative dentistry, have now definitively reached the root canal system giving favourable opportunities to improve the resistance to bacterial penetration and to reinforce the root structure. However, clinicians should realise that bonding to root dentine is very different from bonding to coronal dentine. Bonding to root dentine is seriously compromised by polymerisation shrinkage stresses that occur during polymerisation (Condon and Ferracane 2000; Feilzer and Dauviller 2003). The severity of polymerisation stresses is dependent on cavity design (the so called C-factor) and the resin-based sealer thickness (Feilzer et al, 1987; Alster et al, 1997). The C-factor is the ratio of the bonded to unbonded surface area. Furthermore, as the thickness of the sealer is reduced the shrinkage stresses are also reduced (Tay et al, 2005). The use of indirect bonding methods to compensate for polymerisation stresses may be another method for optimising bond strength to the root canal dentine (Bouillaguet et al, 2007).

Effective smear layer removal and root dentine conditioning before obturation are important steps to improve the penetration of hydrophilic methacrylate-based sealers into the dentinal tubules, thus adhering to the etched and chelating with intertubular

¹ Oswaldo Zmener DDS, Dr Odont, is Head Professor, Postgraduate Program for Specialized Endodontics, School of Dentistry, University of El Salvador/AOA, Buenos Aires, Argentina. Private Practice limited to endodontics, Buenos Aires, Argentina.

² Cornelis H Pameijer DMD, MScD, DSc, PhD, Professor Emeritus, University of Connecticut School of Dental Medicine, USA.

dentine. In contrast to the coronal areas, the apical third frequently shows irregular dentine structure and fewer dentinal tubules. Some studies have demonstrated that the hybrid layer is thinner in the apical area than the coronal third (Yoshiyama et al, 1996; Ferrari et al, 2000). However, according to Bitter et al (2004) these differences are of minor importance since bonding is determined by the inherent properties of the materials used.

Moreover, although dentine of the apical and middle thirds is frequently sclerotic (Paque et al, 2006) it has also been reported that adhesion to root canal dentine is comparable to that of coronal dentine (Yoshiyama et al, 1996). However, effective bonding of adhesives in the middle and apical thirds of the root canal system is not so easy to obtain. Since effectiveness of a curing light is limited to the coronal third, dual or self-curing adhesives or adhesive sealers must be used. Self-curing resin-based sealers provide some additional advantages. They have less monomer conversion of free radicals compared to light-curing materials. This property is similar to bonding materials in restorative dentistry (Braga et al, 2002) and is responsible for the reduction of contraction stresses. However, the presence of more unreacted monomer is a disadvantage.

Endodontic irrigation solutions have a different effect on bond strength to dentine (Santos et al, 2006). Sodium hypochlorite (NaOCl) is widely used at different concentrations and is successful in dissolving soft tissues (Naenni et al, 2004; Clarkson et al, 2006), as well as having antibacterial properties (Byström and Sundqvist 1983). NaOCl is problematic when resin adhesive materials or resin-based sealers are used. NaOCl is a potent oxidising agent and the oxygen remains on the root canal walls after rinsing, causing polymerisation inhibition of resin-based materials (Ari et al, 2003). NaOCl must be totally removed before filling the root canal space with resin-based materials or resin-based sealers.

The use of 17% or 19% ethylenediaminetetraacetic acid solutions (EDTA) for one minute followed by a final copious rinsing with sterile saline has been shown to be effective for this purpose (Baumgartner and Mader, 1987). Since NaOCl only removes the organic component of the smear layer, the chelating action of EDTA helps eliminating the inorganic portion of the smear layer, which can also be contaminated with bacteria. Unfortunately, it has also been demonstrated that the action of EDTA may produce degradation of dentine (Eldeniz et al, 2005), which in turn can be a problem for effective bonding. The remaining oxygen after NaOCl treatment can also be reduced by the

action of ascorbic acid (Perdigao et al, 2000), however, more research on this subject is necessary. Finally, the use of chloroform for retreatment of Gutta Percha filled canals also constitutes an impediment for proper polymerisation of resin-based materials and subsequent bonding to dentine (Erdemir et al, 2004).

Summary and conclusions

The use of adhesives in endodontics is essentially confronted with the same advantages and disadvantages and the same problems as in restorative dentistry. One notable exception in restorative dentistry is the advantage of bonding to enamel, which presents fewer problems. Location in the root canal, apical, mid or coronal, determine the effectiveness of the bond, while age, sclerotic dentine, the role of MMPs, use of irrigation solutions and previous root canal treatment are some of the additional factors to be considered.

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