MARGINAL ADAPTATION IN COMPOSITE RESIN RESTORED DENTINE CAVITIES SHOWING GROSS MARGINAL LEAKAGE

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The aim of bonding composite resin restorations to the tooth is to ensure retention and also to prevent marginal leakage at the tooth restoration interface, a process which can lead to further caries. An in vitro marginal leakage study[1] of composite resins in combination with acid etching and dentine and enamel bonding agents highlighted the lower sealing potential of both enamel and dentine bonding agents to dentine (36%>seal) compared to enamel (79%>seal). Several studies[2-4] suggest that if the inner surface of the resin restoration appears as a well replicated negative impression of the adjacent tooth surface, bonding has been achieved. This study was undertaken to examine the appearance of the inner surface of resin restorations which showed gross marginal leakage in restored dentine cavities[1] to determine the degree of marginal adaptation between the restoration and cavity surface.

The sample was selected from 180 human premolars, in which cavities had been cut in cervical dentine. Groups of teeth were randomly assigned to combinations of bonding agents and composite resins. The enamel bonding agent studied was Heliobond^{R}(H) and the dentine bonding agents were Dentin-Adhesit^{R}(DA) and Scotchbond^{R}(S). The composite resins were light cured Heliomolar^{R}(HM) and self curing Silar^{R}(SL). The combinations studied were H/HM, DA/HM, S/HM, S/SL. In addition the S/SL and DA/HM combinations were also examined with cavities acid etched prior to restoration with Concise Enamel Bond^{R} etchant (S/SL+ae; DA/HM+ae). Seventy-two hours after insertion the restorations were polished with soflex discs and then the restored teeth were stored in distilled water and thymol for 28 days. This was followed by thermal stressing for 24 hours with a dip cycle of 30 seconds. All specimens were then immersed in 2% Rhodamine fluorescent dye for 24 hours at 20°C, sectioned and viewed in a light microscope under transmitted UV light to assess the degree of marginal leakage. The remaining portions of 5 specimens from each group which showed gross marginal leakage were decalcified in a nitric/formic acid solution at 20°C until the restoration could be easily removed from the softened dentine. After rinsing in distilled water, the restorations were dried, mounted on SEM stubs and coated with gold palladium. The walls and floor of each restoration were examined for resin tags or impressions of dentinal tubules, porosities or voids present in the restoration surface and any deposits, unevenness or detached portions of the smear layer apparent on the surface of the restoration.

The most notable feature of all the restorations were the pits and voids which were seen in varying degree on the surface opposite to the cavity wall and floor, irrespective of cavity treatment and restoration

procedure (Fig. 1). Extensive tag formation was apparent in the acid etched cavities as expected (Fig. 2). Tags were also present on only one specimen of the DA/HM and 2 specimens of the H/HM restorations. All specimens showed well replicated bur marks and grooves (Fig. 1) indicating a good adaptation between the restoration and the cavity surface during the restoration procedure. DA/HM, S/HM and S/SL+ae restorations retained what appeared to be detached tooth material on the surface.

The results suggest that good marginal adaptation occurred at the cavity surface/restoration interface during the restoration procedure. However polymerisation shrinkage contraction and/or thermocycling stresses have caused the restoration to withdraw from the cavity surface creating the marginal gap revealed by the fluorescent dye test. This gap is further compounded by the voids and porosities present in the restoration which, according to Leinfelder[5], are unavoidably generated during the manufacturing and mixing process. The marginal leakage results reveal that the bonding agents investigated are unable to maintain a completely closed cavity under these circumstances. The removal of the smear layer with the acid etch technique was also not able to improve the sealing ability of the restorations[6], despite extensive tag formation. Some form of bonding appears to have taken place as displayed by the detached tooth material adhering to one specimen each of DA/HM, S/HM and S/SL+ae.

It is concluded that although an initial good marginal adaptation occurs at the tooth/bonding agent/restoration interface, this cannot be effectively maintained by the bonding agents investigated, contrary to the claims of the manufacturers.

References

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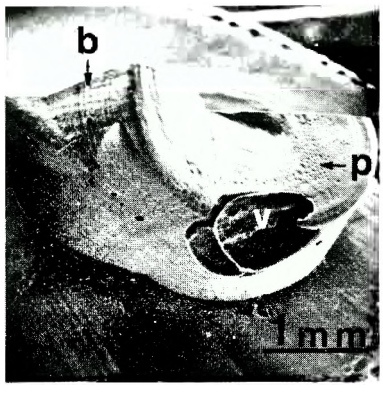

Fig. 1: Low power micrograph of the restoration - note the bur marks (b) voids (v) and porosities (p) on the surface. Fig. 2: Extensive tag formation on the surface of a DA/HM+ae specimen.