

ADHESIVE BONDING TO TEETH OF ORTHODONTIC BRACKETS AND THE LIKE

BRIEF SUMMARY OF THE INVENTION

The advantage of being able to attach devices through adhesion directly to a tooth surface have long been recognized and substantial work has been done in trying to obtain a suitable procedure for obtaining such adhesive attachment. In an article appearing in the American Journal Orthodont, 58:21-40, Jul. 1970, titled: THE DIRECT BONDING OF ORTHODONTIC ATTACHMENTS TO TEETH BY MEANS OF AN EPOXY RESIN ADHESIVE, the authors discuss various problems associated with the generally used orthodontic attachments and various attempts which had, up to that time, been made in trying to solve these problems through the use of adhesives. The authors, Retief et al., refer to earlier work by Buonocore and others in which polyacrylic acid/zinc oxide dental cements were evaluated, and work by Bowen directed to adhesion between epoxy and tooth enamel surfaces. They also described their own efforts in which they used a particular epoxy composition as the adhesive. Although their particular epoxy composition was found to be superior to the other materials they had evaluated and appeared to be better than any of the other then available adhesive compositions, the same had definite disadvantages in that one had to wait fifteen to thirty minutes after placing the orthodontic brackets on the teeth before the patient was even permitted to rinse his mouth gently with warm water. Even then the arch-wires could not be placed until after three to seven days. Despite these precautions, a failure rate of twenty-two out of one hundred and two brackets applied was noted.

Other attempts to solve this problem of adhesively adhering orthodontic brackets to tooth surfaces resulted in the design of special clamp constructions whereby the orthodontic bracket, after applying the adhesive, was clamped onto the tooth surface and so held in place until the adhesive had cured sufficiently to permit the clamp's removal. Such a clamp arrangement is described, for example, in U.S. Pat. No. 3,787,976.

It has now been discovered that orthodontic brackets and similar devices can be adhesively bonded directly to a tooth surface and held in any desired position on the tooth without the necessity of clamps and the like, and the same become securely adhered to the tooth within a matter of a few minutes. This is of substantial advantage to the orthodontist and to the patient as it permits the attachment of the brackets and the arch-wires in the same sitting. The manner of attachment by which this is accomplished is to adhere the orthodontic bracket or other such device to a prepared tooth surface by using a catalyzed thixotropic acrylic or methacrylic ester monomer mix having a viscosity within the range of 85,000 cps to 4,385,000 cps. The acrylic or methacrylic ester monomers used have two or more active acrylic ester groups and the thixotropic monomer mix as applied contains, together with the polyacrylic ester monomer fumed silica for making the monomer thixotropic, an amine activator, and a peroxide catalyst.

Due to the thixotropic nature of the adhesive, the viscosity of the adhesive decreases while it is undergoing shear. Consequently, the adhesive can be prepared

with a sufficiently high viscosity such that small amounts of the adhesive will not sag or flow under its own weight or when supporting a small light object such as an orthodontic bracket, but the adhesive will flow freely while undergoing shear such as that induced by hand mixing or by pressing an orthodontic bracket into the adhesive. When the shear is removed the adhesive returns to its highly viscous state. Thus, even though the adhesive has a sufficiently high viscosity to hold the bracket in place without sagging until the adhesive cures, the adhesive itself because of its thixotropic nature is easily mixed and applied and the tooth and bracket are readily wetted with the same.

The activated thixotropic monomer mix is prepared just prior to placing on the tooth surface or bracket by mixing together substantially equal parts of two thixotropic monomer compositions each having a viscosity within the range of 85,000 cps to 4,385,000 cps with one of the thixotropic monomer compositions containing a small amount of peroxide catalyst and the other thixotropic monomer composition containing a small amount of amine activator.

If the bracket or device to be adhered to the tooth is metal, the thixotropic monomer mix can be applied directly to the metal surface. However, if the orthodontic bracket is made of plastic, the surface of the plastic should first be treated with a mild solvent for the plastic prior to application of the thixotropic acrylic ester monomer mix. Where the plastic from which the orthodontic bracket is formed of a polycarbonate or similar resin the bracket surface to be adhered is first preferably wetted with methyl ethyl ketone or ethylene glycol dimethacrylate.

DETAILED DESCRIPTION OF INVENTION

As previously indicated, the desirability of being able to adhere an attachment such as an orthodontic bracket, directly to a tooth surface has been long recognized.

Various adhesive materials have been used and various methods of application tried. However, none of these have been fully satisfactory. Ideally, a bracket adhesive and its manner of application should be such as to give the orthodontist a maximum degree of flexibility with respect to the positioning and securing of the bracket while reducing the overall time for the adhesive to fully set so that the brackets may be firmly secured in place and the arch-wires placed all in one sitting. This not only reduces the discomfort to the patient but saves both the patient and the orthodontist substantial time.

It is necessary that the orthodontic bracket be correctly positioned on the tooth surface so as to properly direct the force of the arch-wires when applied. Should the bracket after being placed on the tooth surface tend to slide or shift in its position prior to the adhesive setting, the bracket then will not be in the precise position desired. As a result, the orthodontist is either required to hold the bracket in position until the adhesive has partially set so as to prevent the bracket from slipping or use special clamps to hold the same in place. This is both cumbersome and time consuming. Accordingly, it is highly desirable that a bracket adhesive should be of such nature that it has sufficient tack and initial internal strength that the adhesive itself will hold the bracket in the position in which it is placed without sliding or drifting but will still permit for a few minutes