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Research Article

DENTIN AND BONDING OF CORONO-RADICULAR RESTORATIONS

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ABSTRACT

Bonding is now an integral part of our therapeutic arsenal. It is recognized that post and core restoration has a flexibility which is close to that of dentin. This flexibility reduces the risk of root fracture. However, the management ofbondingmaterial is difficult and makes the procedureoperator dependent. Several elements can influence thebonding protocols: The canal obturation material, medicines and disinfectants used during the treatment. On the other hand, the dentin bonding is still poorly mastered. This is due to the fact that the histological structure of dentin is not adequate to the the creation of a favourablebondingenvironment. To succeedthe bonding of coronal-radicular restoration, it seems so important to look for a mechanical anchorage of the adhesive at the level of dentinal tubules, and manage all the elements that can affect the longevity of the restoration.

INTRODUCTION

Tooth bonding is no longer a trend but a daily practice in modern dentistry. Adhesion to enamel has beenmastered since a long time. However, adhesivetreatment to the dentin is far from being so. Indeed, dentin bonding still remains a challenge because of the number of factorsthat affect the optimal adhesion. Much less mineralized than the enamel and organized differently, dentindoes not create a relief on its surface when applying anacid attack. In addition, the presence of water, particularly in the cell extensions is not conducive to a good contact between the resin and dentin. The key to the dentin bonding is the possibility to penetrate the dentinal tubules by the adhesive material, hence the need to make the most of the natural presence of a tubules network to anchorthe resin in the dentin. At the root level, this mechanical anchoring is, however, made random by several elements such as the root canal obturation, medicines and disinfectants used during endodontic treatment. The aim of this paper is to review the specificity of dentin bonding in root canal restorations.

HISTOLOGICALREVIEW OF DENTIN

Composition

Dentin is a hydroxyapatite frame which is less mineralized than enamel.

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It is a heterogeneous substrate with substantial aqueous and organic phases. The organic matrix is composed of 86% to 90% collagen (mainly Type I) and 1 0% of non-collagenous proteins. Dentin is characterized by the presence of dentinal tubules containing cytoplasmic extensions. They are perpendicular to the dentino-pulparjunction. Unlike enamel, dentin is a tissue that evolves over the life of the tooth. Under the action of chemical and mechanical stress, odontoblasts (Fig 1) have the possibility to synthesize neodentin. Over time, canaliculi obliterate and the pulparvolume recesses. (Fig 2)

Root and coronal dentin: the differences

Root dentinis less mineralized and phosphorylated proteins are fewer.The diameter of the root tubules is lower and the density per mm 3 is less important.We also find more sclerotic dentin at the root level as opposed to the coronary level. Let us recall that the sclerotic dentin corresponds to a progressive obliteration of the tubules with a mineral content similar to the dense peri-tubular dentin. This causes a problem for bonding, following the reduction in diameter of tubules which leads to a lower resin penetration into them (as there is a chaotic orientation of collagen fibers at the hybrid layer).

FACTORS INFLUENCING THE SUCCESS OF DENTIN BONDING

The coronal restorations: Many factors can influence the success of dentin bonding, such as canalmedications, the operative field, the preparation of surfaces to be bonded, and/or moisture management.

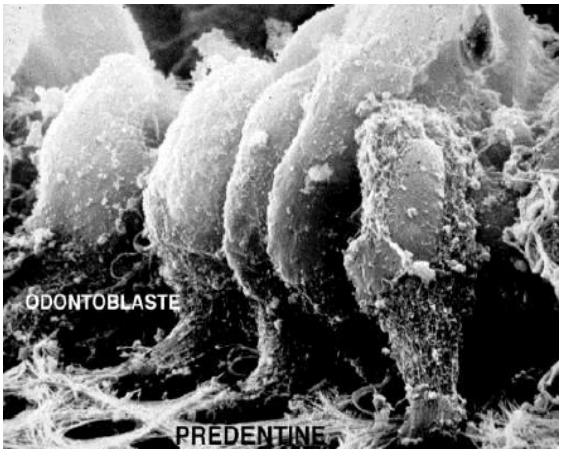

Fig 1. Odontoblast and predentine

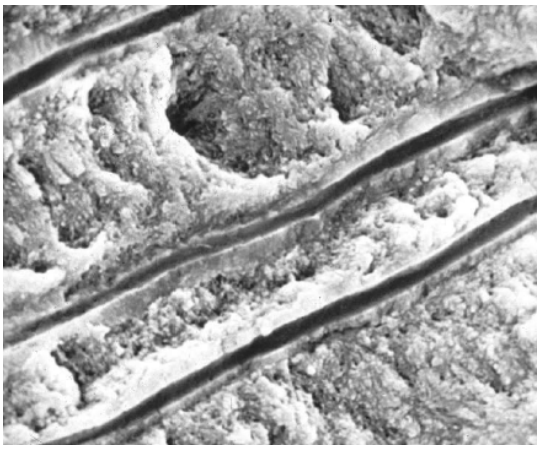

Fig 2. Canalicules

Root canal medications: They are numerous, we are not going to discuss allof them but we will try to mention the most common.

The Clona (sodium hypochlorite)

This is the most used rinse by practitioners (Fig 3). Its bactericidal power is well confirmed.It has a great power to dissolve organic tissue. In 2003, ARI and colleagues conducted a study on the influence of Clonaon bonding. The authors note a decline in adhesion for all bonding resins when there is Clona irrigation 5%. Morris et al in a comparable study also noted a decrease in adhesion in the presence of Clonairrigation. However, they proved the effectiveness of someproductsinavoiding the effect of Clonaon bonding, such as ascorbic acid.

The oxygenated water or hydrogen peroxide

It has an effervescent power that can mechanically remove debris and microorganisms.

Ali Erdemir et al [5] carried out a study of 40 teeth by comparing the effect of water and hydrogen peroxide on adhesion. They note that adherence decreases in the presence of traces of hydrogen peroxide (as for Clona).

Fig. 3. Example of commercial preparation of sodium hypochlorite

Calcium hydroxide

It is generally used in pulpotomyas a temporary dressing of endodontic treatments, apexogenesis and apexificationtechniques. Erdemir et al showed that Ca (OH) 2 has minimal accession results. Therefore, calcium hydroxide does not entail a problem in the bonding procedures.

Chloroform

It is used as a solvent in endodontic treatments.Erdemir et al in 2004 showed that adherence decreases substantially with chloroform (but much less than Clona).

The eugenol

This is an essential oil obtained from the clove. It has a local anesthetic (by inhibiting the nervous conduction), an anti-inflammatory effect, an antibacterial effect and it also affects thedentinogenesis. In 2001Ngoh et al conducted a study to see the effect of eugenol on the bonding resins. This study shows a decrease in adhesion of 30% despite etching with phosphoric acid. This same result was demonstrated again in 2006 with the studies of Alfredo et al. Tjan et al in 1992 and Scwartz et al in 1998 already found the same result. All authors agree that eugenol causes a loss of adhesion. But nowadays, it seems difficult to do without eugenol and bonding. One can ask what the means to eliminate eugenol effects on bonding are? Ethanol, phosphoric acid and chlorhexidine are very effective in this regard.

Chlorhexidine

It is highly antibacterial, but its action to dissolve tissue is extremely low. Ali Erdemir et al in 2004 compared the effect of Clona, hydrogen peroxide, the formocresol and chlorhexidine on the adhesion of resins. They note poorer adhesion in the presence of hydrogen peroxide, formocresolandClona. Conversely, they found that adherence is better with chlorhexidine.For them, the best canal irrigation is chlorhexidine since it does not cause interference with the bonding protocol (from the viewpoint of bonding and not of disinfection)

EDTA

It serves to chelate calcium ions from hydroyapatite and so dissolve the mineral component of the endodontic smear layer.EDTA allows perfect canal walls preparation for the adhesiveto penetrate the tubules. Therefore, it is good for bonding because the tubules will be released.

The operative field

When bonding, it is essential to isolate the operative field from contamination (saliva, blood, etc ...). The best protection is of course the use of the dam (Fig 4). In some cases where its installation is not possible, use a good aspiration and cotton rolls. The main problem is a good moisture management. It is difficult and harmful to completely dry the dentin because of the canalfluid. A small amount of water is necessary. This moisture prevents the collapse of the collagen fibers of the etched dentin, which allows the penetration of the resin monomers. For all these reasons, the choice of the adhesive is very important for the success of the dentin bonding.Therefore, it is better to use acetone-based adhesives because their adhesion is greater on wet dentin than water-based adhesives.

Fig. 4. Overview of the dam

Removal of canal preparation debris and conditioning of the root dentin

During the preparation of the post space, many fragments are formed (obturation paste debris, gutta-percha, dentin). The difficulty faced before bonding is the complete elimination of debris.We cannot remove them completely with an irrigation-based Clona (which is also detrimental to bonding) or chlorhexidine. Some authors therefore propose to irrigate Clona and EDTA and then again Clona.Finally, a phosphoric acid treatment is usedto finish. They find that it eliminates almost all of the debris, but they do not take into account that Clona interferes with the bonding process. Other authors found that the use of micro-brushes makethedentin surface more uniform and allows better bonding. This also avoids the extensive use of multiple canal irrigations that can interfere with the bonding effectiveness.Using these brushes is of course in combination with the traditional methods (irrigation, etching).

Conclusion

The contribution of dentin bonding in fixing root posts is very important. It makes it possible to better distribute the stresses imposed on the root and thus increase the longevity of our restorations.

However, the bonding protocol is quite complicated and very operator dependent. It must be respected under the risk of facing serious disappointments. It is also important to know all the factors that can interfere with bonding and consider the means to counter them (moisture, eugenol, Clona, etc ...). It is well accepted today it is necessary to bond avoiding moisture because the great risk is being polluted by gingival fluid or blood. For effective bonding, it is vital to be aware of the advantages and defects of each adhesive. In addition, the operator must understand how adhesion to tooth tissue occurs to be able to choose, for every situation, the best compromise. Furthermore, we must learn and pay attention to compatibility between the adhesive and the glue itself. It is also necessary to have several kinds of adhesivesto be able to face all clinical situations. It is by respecting these principles that bonding to dentin is more effective today than it was 10 years.

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