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Review Article

Immediate Dentin Sealing for Indirect Restoration: Why and How?

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Abstract

Dental preparations in order to receive indirect adhesive partial restorations result in the removal of the layer of email, thus generating a significant exposure of the dentinal tubules. This dentine exposed immediately after the preparation of the cavity, makes the tooth susceptible to bacterial infiltration through the passage of microorganisms through the dentinal tubules, and can also be the cause of postoperative sensitivity.

In order to overcome these drawbacks, dentin sealing techniques using numerous amelo-adhesive systems have been described. Immediate hybridization techniques, performed just after the preparation of the dental tissues, and before the impression is strongly recommended. This step will aim the formation of a hybrid layer at the dentinal surface, thus allowing the preservation of the pulpal parenchyma, the decrease of the bacterial infiltrations, and a strengthening of the adhesion force.

In our paper we will describe the protocol of immediate dentin sealing, as well as the adhesive systems used, while reviewing the various advantages that this technique offers in the prevention of pulpal integration, the limitation of recurrence of caries and decreased postoperative sensitivity.

Keywords: Bonding Systems; Immediate Dentin Sealing; Resin Coating Technique; Hybridization; Hybrid Layer, Bond Strengths; Post-Cementation Sensitivity

Abbreviations

IDS: Immediate Dentin Sealing; DDS: Delayed Dentin Sealing; DBA: Dentin-Bonding Agent; OIL: Oxygen-Inhibition Layer; VPS: Vinyl Polysiloxane.

Introduction

The preparation of abutment teeth for indirect restorations such as inlay/onlay, veneer, and crown preparations, leads inevitably to a large exposed dentin area and thus to an indirect pulp exposure through the opened tubules. An application of an adhesive system is highly recommended, to reduce post-cementation hypersensitivity, bacterial infiltration and microleakage.

Actually, two different procedures of dentin sealing are described: the traditional delayed dentin sealing (DDS) performed right before the cementation of the final restorations, and the modern immediate dentin sealing (IDS) that is performed right after the tooth preparation. The IDS is then a technique that's allows the formation of a hybrid layer on vital abutment teeth immediately after the exposition of the dentin tissue. The hybrid layer designates a polymerized resin intermingled with collagen fibers by the application of an adhesive system that can be either a total-etch system (etch-and-rinse) or a self-etching system.

Why recourse to IDS?

The rationale behind IDS could be explained by at least four solid clinical arguments:

The freshly cut dentin is the ideal substrate for dentin bonding

Various studies have shown that the potential of dentin-bonding significantly decreases when the dentin is contaminated by the provisional cements compared to when a freshly cut dentin is used [1,2]. It is added to that, some other contamination sources such as the saliva and the bacterial leakage that effects the bonding.

On daily practice, a freshly cut dentin is only available at the time of tooth preparation, before any impression or provisional cementation.

The pre-polymerization of the dentin-bonding agent (DBA) leads to improved bond strength

The polymerization of the bonding agent before placing the final restoration have shown better bond values compared to when the DBA is cured at the luting moment [2,3]. This can be explained by the collapse of the unpolymerized dentin–resin hybrid layer due to pressure during the placement of the restoration [4-6].

The DBA precuring is highly compatible with the direct composite restorations; but concerns are raised when the DBA is applied during the luting of indirect bonded restorations: the thickness of the film formed varies from 0 to 500 µm depending on both the type of DBA and the topography of the tooth preparation [5,7], which could interfere with the complete seating of the restoration. It was therefore recommended and more acceptable for practitioners; to keep the DBA unpolymerized until the restoration is fully seated. But this might cause two problems [3].

- At the restoration placement, the outwardly directed flow of dentinal fluid dilutes the bonding agent and blocks mi cro-porosities in which the DBA otherwise would have penetrated.
- The exercised pressure during the seating of the restora tion can lead to a collapse of demineralized dentin and thus affect adhesion.

Both these issues can be resolved if the exposed dentin is sealed with a DBA applied and cured directly after the preparation.

A study conducted by Gresnigt on 2016 and that aimed to compare the effect of IDS and DDS on the durability of $Li_2Si_2O_5$ laminate veneers, has shown that the application of an immediate dentin sealing improves the adhesion and thereby the fracture strength of veneers. While in the contrary the DDS leads to higher fracture rates [8].

Immediate dentin sealing allows stress-free dentin bond development [2,3]

The dentin bond development occurs progressively over time, due to the completion of the co-polymerization process. In direct restorations, the new and still weak hybrid layer is immediately challenged by the overlaying composite shrinkage and the occlusal forces. To the contrary, when the IDS is applied, the dentin bond can develop without stress because of the delayed placement of the restoration and thus the postponed occlusal loading, thereby generating an improved restoration adaptation.

Immediate dentin sealing prevents bacterial leakage and sensitivity during provisionalization, by ensuring an immediate sealing of the opened dentinal tubules. This is particularly more useful when it comes to partial restorations (veeners, inlay.) where sealed and stable Provisionals could be quite difficult to obtain [2,3]. The technique permits also to limit the use of anesthesia during the various clinical steps.

Several researches have focused on studying the effect IDS on preventing post-cementation sensitivity. Among them the study carried by Hu., *et al*. [9] in 2010 and by Kumar in 2015 [10], that have both showed that a statistically significant diminution of the sensitivity is noted when the IDS is used compared with when the DDS is.

The immediate dentin sealing technique [3,11,12]

Dentin Identification

The adhesive system must be selectively applied on the dentin tissue; therefore, the identification of the exposed dentin surfaces is mandatory. For this aim, a simple but efficient method has been described and consists on a short etching (2 - 3s) followed by thorough drying of the prepared surfaces.

Dentin can easily be differentiated by its glossy appearance whereas the enamel is frosty. A slight roughening with a diamond bur is recommended after this step, in order to expose a fresh layer of dentin.

Preparation depth control

The preparation of the tooth should manage an enough space for both the restoration and the thickness of the DBA. And thus, the IDS might not be indicated for very superficial dentin exposures. When margins are ended in dentin, a marked chamfer (0.7 mm to 0.8 mm) is recommended to provide enough space for the adhesive and overlaying restoration (Figure 1)

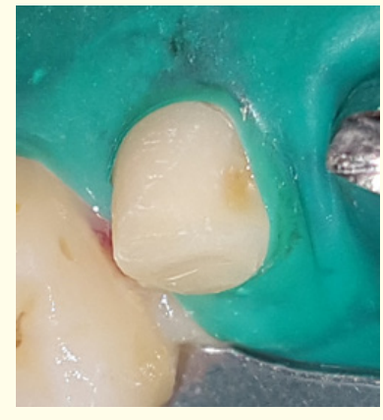

Figure 1: Freshly cut exposed dentin after preparation with a diamond bur.

The adhesive technique itself

When the technique was firstly described by Magne, 3 steps "etch and rinse" adhesive system was used and was defended by this author as being more reliable in the long term. However, there are no data, suggesting that IDS cannot be applied successfully in conjunction with other adhesive systems.

In fact, many studies have been conducted to compare between the different adhesive systems, and in 2009, Duarte showed that IDS resulted in high bond strengths for total-etch as well as self-etch dentin bonding agents [13]; Albaladejo in 2010, showed that formed hybrid layers with the two-step self-etch adhesive systems and both etch-and-rinse bonding agents were continuous and uniform in thickness [14]. In 2012, Sahin compared the ability of blocking the permeability of the etch-and-rinse and self-etch bonding agents and showed that only the one-step self-etches, and the two-step self-etch bonding agents were more efficient at sealing the dentin than original smear layer [15].

The technique is going to be described using a two-step etch and rinse agent (with self-priming resin):

- Etching of freshly cut dentin with phosphoric acid (Figure 2). The time may vary from 10 seconds for normal dentin to 20 seconds for sclerotic dentin.
- Rinsing a d removal of excess water (Figure 3). Precautions should be taken to avoid both excessive drying and excessive wetting. Ideally air drying should be avoided and excess moisture can be removed by a suction drying.
- Application of the adhesive agent with a slight brushing movement, followed by a light polymerization on regular mode for 20 seconds (Figure 4 and 5).

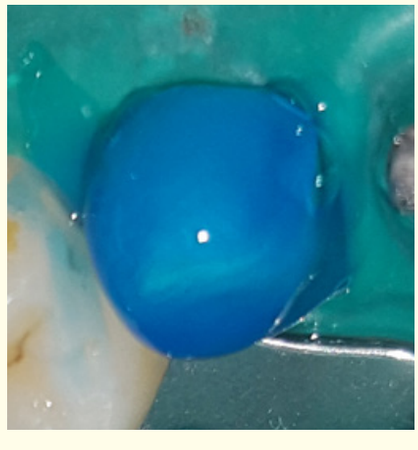

Figure 2: Etching the freshly cut dentin with H_3PO_4.

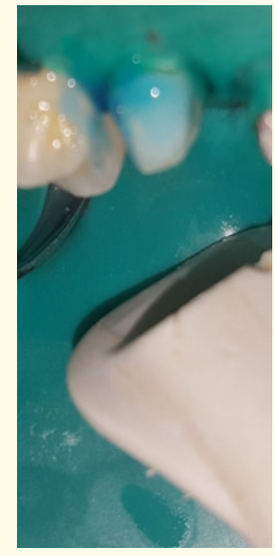

Figure 3: Rinsing and removal of water excess.

Figure 4: Applying thick layer of adhesive resin.

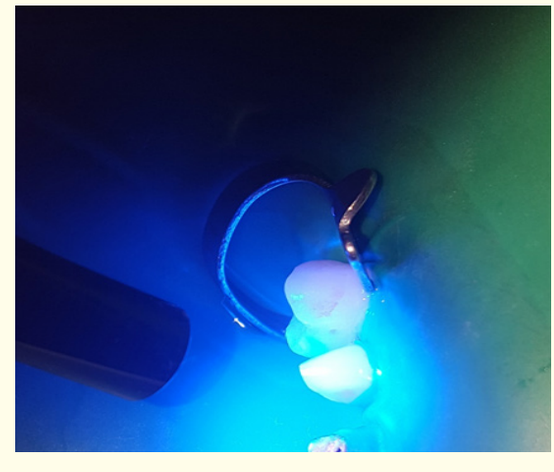

Figure 5: Polymerization of the adhesive agent for 20 seconds.

Practical Cautions

While taking the impression

When using the IDS techniques, the impression is taken after the application of the resin agent on the tooth surface. This step is particularly challenging since the DBA when light polymerized, show a superficial oxygen-inhibition layer (OIL) [16,17]. This latest interacts with impression materials and may inhibit their polymerization, especially when vinyl polysiloxane (VPS) impression materials are used [4].

To this issue, many solutions have been proposed and aims to reduce the thickness of the OIL and therefore limit its interactions. First described technique consists on adding an additional step of "air blocking" by applying glycerin jelly to the sealed surface followed by an additional 10 seconds of light curing [2,18,19]. Magne and Nielsen in 2009, demonstrated that with the air blocking successful VPS impressions can be obtained, in contrast to the polyether, air blocking/pumicing results in impression defects and is therefore contra-indicated with the IDS [20].

Another technique to face this OIL has been introduced and is based on the use of a cotton pellet soaked in alcohol. In 2014 Ghiggi., *et al.* [21] compared the interactions existing between two impression materials (Vinyl polysiloxane and polyether) and the sealed surfaces when the two techniques to eliminate the OIL are used: additional polymerization with glycerin jelly and cotton pellet soaked in alcohol. Results have proved that the alcohol was as effective as the glycerin when it comes to preventing interactions with the VPS. As for the polyether, the polymerized material remained joined to the resin surface in both cases, which confirms its contraindication with the IDS technique.

While provisionalization

It has been proved that most provisional restorative materials are incompatible with IDS, which can be explained by the potential that sealed dentin surfaces have to bond with the resin-based materials [22]. And therefore, the retrieval and removal of provisional restorations can be extremely difficult [2,3].

Magne suggests that the sealed tooth should be rigorously isolated (jelly) during direct fabrication of the provisional restoration [2]. Currently isolation materials specific to the IDS technique are marketed (Pro-V Coat by BISCO) and are used to lubricate the surface and are gently air-dried from a distance of 8 - 10 cm from the preparation for 10 - 15s to evaporate the solvent [3].

While final placement of restoration

Knowing that the techniques described above to prevent the formation of the OIL only permit its reduction and not its elimination, it is recommended, before the luting procedures, to roughen the sealed surface using a coarse diamond bur at low speed or by micro-sandblasting [2,3].

As for luting materials, resin cement would be the material of choice given that they will bond chemically to the IDS treated substrate. In this case, the dentin surface being already etched and sealed, an etching of the enamel only in necessary before the bonding.

Conclusion

Through our paper, we come to conclude that the IDS is a simple, quick and efficient method to reduce bacterial contamination and post-cementation sensitivity, and also to improve the final bond strength of the restoration.

In the absence of a well-defined protocol, further studies should be carried be to develop a standardized IDS procedure and proper materials to the technique allowing a maximum strength and protection of the dental subtract.

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