Effectiveness of Immediate Dentin Sealing to Reduce Postoperative Sensitivity in Dental Inlays

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ABSTRACT
Post - operative sensitivity is a common problem in dental offices, so it has been suggested the use of immediate dentin sealing as soon as the dentin is finished cutting in the preparation of inlays. The objective of the investigation is to determine the reduction of post - operative sensitivity in dental organs by means of immediate dentin sealant for the evaluation of its efficacy in the placement of dental inlays. Materials and Methods: The research is based on an analytical and descriptive approach of scientific articles. A bibliographic review was carried out mostly from the year 2018 to 2022, obtaining 49 articles of which 38 were chosen that accomplished the focus of this research. Results: It was established that immediate dentin sealing is effective in reducing post - operative sensitivity, while there is no significant difference after a period of 6 months or more since sensitivity is transient but produces discomfort in patients. Conclusions: The bibliographic evidence found supports the effective use of immediate dentin sealing, since it decreases dentin permeability, becoming a barrier for invasive microorganisms.
Keywords: Dentin; sensitivity; inlays; adhesion; immediate dentin sealant.

1. Introduction

In a population where the life expectancy of patients has risen, the longevity of preserving their dental organs is extremely important [1] so dentistry has evolved enormously thanks to various research and technological developments, thus achieving less aggressive with dental tissues, that is, the therapeutic philosophy is currently based on minimally invasive biomimetic principles (LMIC). [2] Therefore, restorative dentistry aims to recreate oral health, uniting two fundamental aspects such as: function and aesthetics, thus achieving harmony in the oral cavity. [3]

With the improvement of adhesive materials, and alternatives for the conservation of dental tissue, optimal rehabilitation can be carried out, one option is inlays since they allow to reduce the difficulties that arise when performing direct restorations,4 obtaining a minimum intervention, since the consolidation of the adhesive protocol and its greater predictability gives the clinician the option to be more conservative when returning aesthetics. [5] To date, a fairly favorable clinical success has been achieved for inlaid restorations since aesthetic restoration is one of the fervent desires of each of the patients, in addition to having an acceptable operating technique. [6]

However, it has been shown that vital teeth when exposed to dental preparation (carving), generate postoperative sensitivity, since in most cases the wear is not limited only to enamel, but also to dentin, leaving the dentinal tubules exposed, becoming one of the most frequent problems in diagnosis and therapeutic clinical events, Where a standard treatment has not been established, however, day by day, new methods appear to reduce this complication. [7]

Therefore, dentin hypersensitivity is defined as a rapid but very acute pain, which is presented by aggression to dentin in response to stimuli that can be chemical, evaporative, thermal, osmotic or tactile and that cannot be attributed to another dental disease, [8] the same that can be associated with different factors including overheating of the dental structure, Desiccation during dental carving, bacterial infiltration and movement of fluids through the dentinal tubules. [9]

In general, the interaction between adhesive and dentin is considered the Achilles heel of any indirect adhesive restoration, therefore postoperative sensitivity and microfiltration remain a concern, however, some ingredients in desensitizing materials can affect the sealing and bonding properties to cementing agents, one of the most commonly used materials to treat sensitivity. Postoperative is based on glutaraldehyde, however, its effect on the

doi.org/10.31838/hiv23.03.261 Received: 24.11.22, Revised: 15.12.22, Accepted: 28.01.23.

adhesion technique remains the subject of debate. [10] In view of this condition, a technique called Immediate Dentin Sealing (SDI) or for its acronym in English (IDS) was developed around the 90s. [11] This technique consists of the application of an adhesive agent immediately after the preparation of the tooth (dental carving) and before the impression, in this way a barrier is provided for the dentin and pulp before microorganisms present in the environment, forming a hybrid layer guaranteeing the prognosis of dental incrustations. [12]

In recent years, with the advancement of dentistry and adhesive technologies, it is recommended that at the end of dental preparations for fixed prostheses (inlays, crowns, veneers), perform an Immediate Dentinal Sealing, in order to protect the pulp from bacteria, since the main failure of adhesive restorations is microfiltration that leads to postoperative sensitivity. [13]

Over the years, the technique of Immediate Dentin Sealing has been studied and perfected in such a way that Pascal Magne, in 2005, states that the main objective is to generate a resin film adhered to the newly exposed dentin, using available adhesive systems, (the use of fourth generation adhesive systems was proposed) in order to obtain a hybrid layer intimately adhered to the dentin from the moment in which the carving It exposes the dentinal tubules. [14]

Numerous studies show that the contamination of the dentinopulpar complex with provisional fixation systems or saliva, reduce the longevity of the final restoration, so that the newly exposed dentin is the ideal medium for SDI, since the characteristics that the literature attributes to it, is not only to reduce postoperative sensitivity but to achieve greater resistance to adhesion, prevalence of wet organic interface of dentin and consequently decrease in bacterial contamination. [14]

On the other hand, Pashley in 1992, states that the SDI is a technique that improves adhesion and adaptation, marginalizes the dentin producing less postoperative sensitivity compared to the Delayed Dentin Sealing (DDS),[15] so it is important to keep in mind that without good handling of the materials and protocols foreseen, the expected results in indirect restorations will not be obtained. Therefore, postoperative sensitivity is a problem that requires critical analysis, being of great importance to assess the effectiveness of Immediate Dentin Sealing in incrustations in order to achieve indirect restorative treatments free of postoperative sensitivity and at the same time biocompatible, satisfactory, effective and lasting in the oral cavity of patients. [16]

2. Materials And Methods

The present research is based on an analytical and descriptive approach of scientific articles about the efficacy of immediate dentin sealing to reduce postoperative sensitivity in dental inlays.

The types of research to be used in this article are:

Research under the Approach

Qualitative: Since it allowed to establish everything related to postoperative sensitivity in relation to immediate dentin sealing, the benefit presented in minimally invasive dentistry.

Purpose-based research

Applied: The present research was developed without the need to use some kind of experimentation.

Scope-based research

Descriptive: Since its purpose is to determine the reduction of postoperative sensitivity in dental organs through immediate dentinal sealing for the assessment of its effectiveness in the placement of dental inlays.

Population

The population consisted of 49 articles through different search platforms such as Google Scholar, scientific journals of Medical Sciences, and databases such as Scielo, Medline, PubMed, Dialnet.

Sample

We selected 38 articles using inclusion and exclusion criteria including: 1 meta-analysis 23 review articles, 10 clinical trials 4 in vitro studies

Methods to be used

The article, being a bibliography review, will be applied document analysis taking into account the following inclusion and exclusion criteria.

Inclusion criteria

1. Of the 49 articles analyzed, 38 were included since dental studies with a population over 18 years of age were taken into account, where their content is clear and relevant to the research among other criteria that will be described below:
2. Systemic analyses, meta-analyses, in vitro studies and case reports.
3. Most articles published in the last 5 years.
4. Articles with information regarding immediate dentin sealing and postoperative sensitivity.
5. High impact journal articles in English, Portuguese and Spanish.
6. Studies performed on human permanent teeth.
7. In the search for the articles, the keywords included were: immediate dentinal sealing, postoperative hypersensitivity, incrustations, adhesive systems.
8. We included case studies that have applied the immediate dentinal sealing technique.

Exclusion criteria

Of the total articles analyzed, 11 were excluded because they were not related to the topic or because they contemplated another technique that was not immediately sealed dentinary, among other criteria explained below:

1. Articles with a different approach to immediate dentinal sealing and postoperative sensitivity.
2. Articles whose source is unreliable, and that lack the necessary information for the contribution of this research.
3. Articles that are not indexed.
4. Experiments performed on animals.

3. Results

After exclusion of irrelevant articles, those that met the inclusion criteria were selected. For a better understanding and segmentation of the literature found, the articles were divided by categories: bibliographic reviews, meta-analyses, in vitro studies and clinical studies. Each section of this manuscript responds to the needs of the research, supporting it bibliographically in an effective and correct way.

Of the total articles focused on bibliographic reviews, 89% state that immediate dentin sealing reduces hypersensitivity after cementation of the incrustation, since it decreases the permeability of the dentin, that is, the entrance of the dentinal tubules is obliterated so it stops bacterial infiltration, in this way the filtration of external agents to the dentinal tubules that endanger the longevity of the treatment. [17,4, 18, 19, 20, 21, 14, 22]

It was observed that 11% of the literature review articles indicate that multiple layers of adhesive on freshly cut dentin do not prevent or decrease postoperative sensitivity and may also affect the binding strength between the organ and dental inlay. [23]

The different articles analyzed focused on bibliographic reviews corresponding to 55% mentioned that Immediate Dentin Sealing is much more effective than Delayed Dentinal Sealing, finding a significant difference between the first week and the first month after cementation, however after 6 months until the year no relevant difference was found[17,4,19,20, 21] The remaining 4 literature reviews do not mention such a comparison.

Selecting the adhesive system can positively or negatively affect the immediate dentinal sealing technique, so 77.8% of the literature review articles are inclined to the three-step adhesive (fourth generation) since the postoperative sensitivity was not affected and also radically increases the binding strength between 25.00 to 29.99 Mpa (megapascal, unit to measure strength), 4, 18, [19, 21, 14], 22 while the remaining 22.2% is inclined to the self-etching or universal adhesive system since the acid is more subtle with dentin, however the binding force is between (10.0 – 18, 0 Mpa). [20, 23]

Table 1: Adhesive systems and their characteristics

Generation	Feature	Bonding Strength
First to third generation	Since the first generation the third generation is discontinued since there were limitations in the strength of union and postoperative sensitivity.	Decreased
Fourth Generation	It is characterized by being a hybridization process (replacement of hydroxyapatite and water on the surface of dentin): three steps: 1 recorder, 2 primer, 3 bonding	29,99Mpa
Fifth Generation	Revolutionized, does not mix, reduces the chances of error: one step: 1 recorder, primer and bonding in one jar	16,95Mpa
Sixth Generation	The engraving is only on the enamel, however it has caused confusion producing more errors: usually 2 steps: 1 engraver, 2 primer and bonding	20,17 Mpa
Seventh Generation	Little or no postoperative sensitivity, not sensitive to the amount of residual moisture of the dentin: a single step recorder: 1 primer and bonding in a single bottle	11,00Mpa

Author: Own elaboration

Source: Arquiñejo K. Dentin-resin adhesive resistance Rev. Odontol. Sanmarquina. [Internet] 2019; [cited May, 2022]. Available in: https://docs.bvsalud.org/biblioref/2019/08/1010007/16221-texto-del-articulo-56647-1-10-20190530.pdf

One of the factors for postoperative sensitivity in the patient is bacterial contamination of dentin, so 89% of the review articles state that through immediate dentin sealing a barrier is created between the dentin and the external environment and in this way the filtration of external agents such as microorganisms to the dentin is prevented. [17,4,18, 19, 20, 21, 14, 22]

Regarding the article focused on meta-analysis, it states that there is limited information regarding immediate dentin sealing and its efficacy with postoperative hypersensitivity, I did not observe significant evidence between immediate dentin sealing and delayed dentin sealing either at the beginning of treatment or after 2 years. [24]

The bibliographic material in relation to clinical trials in 80% ie 8 of 10, show that immediate dentin sealing provides a significant difference in dentin hypersensitivity preventing it from being generated after dentin carving and thus protects from the colonization of bacteria in the dentinal tubules. [25, 26, 27, 28, 29, 30, 31, 32]

Delayed dentin sealing is another technique to protect the dentinopulp complex from aggressive agents, therefore the literature tells us in 20% (2 out of 10) that the case studies do not find a significant difference between immediate dentin sealing and delayed dentin sealing in relation to the reduction of postoperative sensitivity, Obtaining irrelevant results between the two techniques, however, these systems help prevent postoperative dentin hypersensitivity with an efficiency of 96%. [33, 34]

90% of the articles focused on case studies reflected as results that the reduction of postoperative

hypersensitivity with SDI is significant from the first week to the first month, however from 6 months to the year there are no relevant changes between the SDI and the absence of the same since this sensitivity disappears in most cases at 24 months. [25, 26, 27, 29, 30, 31, 32, 33, 34]

Table 2: Types of pain scales		
Type Of Scale	Characteristics	Interpretation
Visual analogue scale (VAS)	It allows to measure the pain with maximum reproduction among the observers, it is a horizontal line of 10cm, at the ends the extreme expressions of a symptom are placed, the patient points to the point that indicates the intensity of his pain and is measured.	Mild pain: 1 to 3mm Moderate pain: 4 to 7 mm Severe pain: 8 to 10mm
Numerical scale (EN)	It is a numerical scale from 1 to 10, being 0 absence of pain and 10 the worst pain, ease of use has become one of the most used tools	0: painless 1-3: mild pain 4-6: moderate pain 7-9: severe pain 10: maximum pain
Categorical scale	It serves in case patients cannot quantify their pain, expresses the intensity in simpler outcome categories. A relationship is established between the quantitative and qualitative.	0: (nothing) 4: (little) 6: (quite) 10: (A lot)
Enhancement analogue visual scale	Horizontal line of 10cm where the left end is not improved and right total improvement, not widely used.	0: No improvement 1-5: Something Improves 5-9:Acceptable improvement 10: Total improvement

Author: Own elaboration

Source: Herrero V. Assessment of pain. Rev. Scielo [Internet] 2018; [cited May, 2022] Available in: https://scielo.isciii.es/scielo.php?script=sci_arttext&pid=S1134-80462018000400228

Being a purely traumatic rehabilitation technique, in vitro studies 75% (3 of 4) of the articles show that dentinal sealing reduces the permeability of the dentinal tubules causing a closure of the same in order to avoid the filtration of external elements[35,36,37] however one of them did not show any change in the dentinal tubules but in the strength of union demonstrating the increase of the same. [38]

90% of the studies reviewed consider that the most effective target seal is SDI (immediate dentinal sealing) and should be performed with a three-step adhesive system (fourth generation) since it decreases postoperative sensitivity and greatly increases the binding strength,4,18,19,21,25 however the other 10% consider that there is no difference between immediate dentinal sealing (SDI) and delayed dentinal sealing () despite the adhesive system of your choice is a single step (seventh generation) since it decreases the probability of errors that may occur. [14,4,24,38]

4. Discussion

The technique of immediate dentinal sealing to avoid dentin hypersensitivity, shows prosperous results in both literature reviews, case studies and in vitro studies compared to other techniques.

Pascal[22] in 2005 introduced the term immediate dentinal sealing, where he recommends the use of this in indirect restorations, obtaining as a result that the SDI helps the formation of a hybrid layer and thus waterproofs the dentinal tubules, reducing bacterial infiltration in the dentin and thus avoiding dentin hypersensitivity.

Qanungo et al.20 in 2016 selected more than 40 articles that report on the technique, obtaining as a result that hypersensitivity after cementation is a symptom characterized by acute but short pain, which usually disappears after 24 months, however it is annoying for the patient, so different products have been created as desensitizers based on potassium nitrate, fluoride, amorphous calcium phosphate, and adhesive systems called immediate dentinal sealing being a new approach to seal exposed dentin experienced patients greater comfort during provisionalization, limited need for anesthetic during insertion of definitive restorations.

Kumar et al.28 in their article published in 2015 evaluated a total of 50 patients in a range of 21 to 40 years, where group one was a study and immediate dentinal sealing was performed with Dentin Bonding Agent immediately after dental preparation and group two was control. At the same time that the technique was not performed, obtaining significant results in the first week and first month where the control group represented a sensitivity between 40 to 64%, while the study group obtained a sensitivity of 0 to 24%, however no significant differences were found at 6 months, concluding that the SDI is an effective technique to reduce postoperative sensitivity in the early stages.

On the other hand, in 2020 Breemer at el,27 carried out a prospective clinical evaluation of a total of 765 restorations between 2008 and 2018, performed the immediate dentinal sealing (SDI) and subsequently cement with a photopolymerizable resin (HFO), observed for 53.3 months, obtaining as a result an excellent prognosis in the medium term, considering a highly reliable treatment, on the other hand, it

expresses that the exposed vital dentin is susceptible to bacterial infiltration where the SDI seals the entry of microorganisms and prevents postoperative sensitivity.

Late dentin sealing (DDS) and immediate dentinal sealing (SDI) are two techniques that create a barrier between dentin and indirect restoration in order to avoid postoperative sensitivity, however the difference is that immediate dentin sealing is done after cutting the dentin and before dental impressions, while late dentinal sealing is done before cementation. So in 2019, Van den Breemer at [el,34] conducted a prospective randomized clinical study comparing the two techniques on hypersensitivity efficacy, with a total of 30 patients, performed the technique of immediate dentinal sealing (SDI) in one dental organ and the late dentinal sealing technique (DDS) in the other dental organ of the same patients, in the two cases used first and adhesive Clearft Majesty Flow, Kuraray and cementation was with IPS-E, max press, Ivocar Viva dent, obtaining as a result that none of the patients reported failures and discomforts, reports of tooth sensitivity showed no significant difference between IDS and DDS.

Calatrava[19] in 2018 based on a literature review, states that the ideal technique for immediate dentin sealing is to place 37% phosphoric acid immediately after carving between 5 to 10 seconds, extending it to the peripheral enamel, washing twice as long and drying without drying. Then the adhesive system should be placed where it suggests three-step Obtibond because its binding strength is much better than other adhesive systems, immediately after polymerization excess glycerin is placed throughout the dental surface to remove the inhibited oxygen layer and thus complement the polymerization.

However, Nikaido et [al.4] in the same year, stated that it is necessary to complement the immediate dentinal sealing with a layer of resin in indirect restorations, since it reinforces the binding forces between the cement and the dental structure, this technique consists of applying a thin layer of fluid resin after SDI.

Elfatah E & Khalil R[10] in 2021, conducted an in vitro study comparing two adhesives iBond (single step) and GLUMA Bond Universal (single step) and the effectiveness in immediate dentinal sealing; as for the permeability of dentin was performed under a stereoscopic microscope and a fluid filtration system obtaining as a result that the two universal adhesive systems decrease the permeability of dentin, however, in terms of bonding strength, the GLUMA Bond Universal adhesive had a significant difference compared to the other adhesive, so it was concluded that using a self-etching adhesive is effective in reducing dentin permeability[39-42].

5. Conclusions

The bibliographic evidence found in the research supports mostly the use of immediate dentin sealing to reduce postoperative sensitivity in incrustations, based on the reduction of dentin permeability, which induces the early reduction of postoperative hypersensitivity after placing the restoration.

IDS is justified, since freshly cut or carved dentin is the ideal substrate for proper adhesion, pre-polymerizing leads to improved strength, preventing bacterial microfiltration and postoperative sensitivity.

Within the limitations of the research, more research is required, however there is currently no reason to distrust the efficacy of immediate dentin sealing in clinical practice.

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