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Review Article

Post-Cementation Sensitivity in Vital Abutments of Fixed Partial Denture: A Review

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Abstract: Fixed partial denture is one of the most popular and commonly used treatment modality for replacement of missing teeth. It often involves preparation of vital abutments to support the retainers of the fixed partial denture. Full coverage restorations or retainers; involve preparation of all the tooth surfaces of the abutments. Post-cementation hypersensitivity in vital abutments is a common complaint among patients receiving fixed prosthesis. Post- cementation sensitivity rates varied widely in clinical studies ranging from a low of 3% to a high of 34 %. There are many factors considered to be associated with the occurrence of post-cementation hypersensitivity and several approaches to reduce the risk of post cementation hypersensitivity. This review discusses the measures to be considered in managing post-cementation sensitivity of vital abutments of fixed partial dentures.
Keywords: Post cementation sensitivity, fixed partial denture, vital abutment sensitivity

INTRODUCTION

Fixed prosthodontic treatment involves the replacement and restoration of teeth by artificial substitutes that are not readily removable from the mouth by the patient and serve to restore function, esthetics and comfort. When fixed partial dentures are used to replace missing single tooth especially in young patients most of the time the abutment teeth are vital.Fabrication of fixed partial denture usually requires preparation of these vital teeth.

Postoperative sensitivity after cementation of fixed prosthesis is a common complaint especially in cases where the abutments have vital pulp [1]. It has been observed that unlike anterior teeth vitality of most posterior teeth prepared for fixed prosthesis can be preserved without the need for any elective endodontic treatment, provided proper precautions are taken during and after tooth preparation procedure [2]. In spite of following a standard protocol, some patients suffer from hypersensitivity following cementation of restorations on teeth. Post cementation sensitivity rates have varied widely in clinical studies ranging from a low of 3% to a high of 34%. According to the survey by Rosenstiel and Rashid, the incidence of post-cementation hypersensitivity is about 10% [3]. However, the incidence of this post cementation complication is underestimated by most clinicians.

Definition-Dentin hypersensitivity

Dentin hypersensitivity is a "short, sharp pain arising from exposed dentin in response to stimuli typically thermal, evaporative, tactile, osmotic or chemical and which cannot be ascribed to any other form of dental defect or pathology." The first part of the definition provides a clinical description of dentin hypersensitivity, whereas the second part aids in its differential diagnosis [4].

Prevalence and Epidemiology

Dentinal hypersensitivity has an incidence ranging from 4 to 74%.A slightly higher incidence of DH is reported in females than in males. While DH can affect the patient of any age, most affected patients are in the age group of 20–50 years, with a peak between 30 and 40 years of age. Regarding the type of teeth involved, canines and premolars of both the arches are the most affected teeth. Buccal aspect of cervical area is the commonly affected site [5].

Etiopathogenesis

Several theories have been proposed over more than a century to explain the mechanism involved in dentine hypersensitivity.

Odontoblastic transduction theory

The odontoblast transducer theory proposed by Rapp *et al.;* postulated that odontoblasts act as receptor cells, and transmit impulses via synaptic junctions to the nerve terminals causing the sensation of pain from the nerve endings located in the pulpodentine border. However, evidence for the odontoblast transducer mechanism theory is deficient and unconvincing.

Neural theory

This theory advocated that thermal, or mechanical stimuli, directly affect nerve endings within the dentine tubules through direct communication with the pulpal nerve endings. Although this theory has been reinforced by the presence of unmediated nerve fibers in the outer layer of root dentine and the presence of putative neurogenic polypeptides, it is still considered theoretical with lack of solid evidences to support it.

Hydrodynamic theory

The currently accepted mechanism of dentine hypersensitivity is the hydrodynamic theory which has been proposed by Brännström in 1964. According to this theory, when the exposed dentin surface is subjected to thermal, chemical, tactile or evaporative stimuli, the fluid flow within the dentine tubules there will be increased. This fluid movement within the dentine tubules causes an alteration in pressure and excites pressure-sensitive nerve receptors across the dentine. So the response of the excited pulpal nerves, mainly in intradentine fibers, will be depended upon the intensity of stimuli in pain production [6].

Etiology of dentinal and pulpal pain and sensitivity:

It has been stated in the literature that DH develops in two phases:

1-lesion localization and

2-lesion initiation

Lesion localization occurs by loss of protective covering over the dentin, thereby exposing it to external environment. It includes loss of enamel via attrition, abrasion, erosion or abfraction. Another cause for lesion localization is gingival recession which can be due to toothbrush abrasion, pocket reduction surgery, toothing preparation for crown, excessive flossing or secondary to periodontal diseases. Advanced age and extrusion of teeth due to absence of antagonist are also reasons.

As stated earlier, not all exposed dentine is sensitive. For DH to occur, the lesion localization has to be initiated. It occurs after the protective covering of smear layer is removed, leading to exposure and opening of dentinal tubules [7].

Post cementation hypersensitivity

Number of possible causes which develops abutment sensitivity following tooth preparation and cementation has been suggested. They include:

a) Aggressive tooth preparation
b) Poor provisional restorations
c) Bacterial leakage and contamination
d) Desiccation of the preparation prior to cementation
e) Removal of protective smear layer
f) In vivo dissolution of the luting agents at the margins of the restorations
g) Hydraulic pressure in the dentinal tubules produced during cementation may enable the cement to enter the dentinal tubules especially in preparations with minimum remaining dentin thickness with increased dentine permeability [8].

The application of blasts of compressed air to dentin produced pain, presumably resulting from the activation of the low threshold myelinated nerve fibers (A fibers) that are responsible for dentinal sensitivity. A short air blast is capable of removing enough fluid from the dentinal tubules to activate capillary forces that produce a rapid outward flow of dentinal fluid. A rapid outward shift of only 2µm is known to activate intradental A fibers. Possibly the slight sensitivity to cold six weeks after final crown cementation was evidence of a fluid gap nearest the dentin somewhere under the crown or at least tubules opened to the pulp in a gap [1].

Clinical management of post cementation hypersensitivity:

a) Tooth reduction, preparation under high volume spray and quality of provisional restorations was considered to have a significant impact on the incidence of post-cementation sensitivity. Several attempts have been made to reduce postoperative sensitivity, especially in the choice of operative technique and the copious use of water cooling during tooth reduction.
b) Superficial exposure of dentin for 1 or 2 weeks will result in bacterial invasion of the dentin at least half way to the pulp. So the crown must completely cover the cervical dentin without

disturbing the periodontal tissues which is an important measure.

c) The pulp will react favourably to a more rigid provisional crown or, at the very least, a rigid cement, such as zinc phosphate or polycarboxylate cement. This could prove effective, for instance, in a molar tooth in which one root canal is infected and the others are more or less healthy, as indicated by a positive vitality test. A perfect seal may result in sensitivity and even toothache, possibly because the outward movement of fluid has been blocked. It is better that this occur during the placement of a provisional crown than after permanent cementation.

d) The occlusion should be checked prior to permanent cementation. A crown that is just a little too high in some location may result in injury to the tooth's blood and nerve supply which may cause poor cellular response, inadequate blood supply, and hypersensitivity.

e) To obtain a good mechanical bonding all of the lining must be removed from the dentin before final cementation and interlocking, and the dentin should be cleaned with a brush or rubber cup using low speed and pumice in a suitable solution. The dentin should be kept wet until the time of cementation. Brannstorm in his study has found that normal evaporation from dentin is sufficient to activate capillary forces and produce a rapid outward flow of fluid, resulting in pain that lasts for several minutes and the loss of primary odontoblasts. However, this will not create any problems for the puIp; rather it may have a positive effect, as new cells may produce irregular, reparative dentin that blocks the pulpal ends of the tubules.

f) Having the patient bite on a cotton roll or pellet while the cement is setting should not cause an inward movement of tubule contents, which may give rise to pain and other pulpal problems.

g) Luting cements are not irritating, even when placed very near the pulp. To prevent the formation of voids and air or fluid spaces nearest the dentin, the cement should be brushed on the dentin and not only to the inside of the crown. Moreover, communication to the oral cavity is not necessary to elicit microbial complications and hypersensitivity. Living bacteria may be under the surface of the dentin, and any fluid gap may lead to thermal sensitivity. The consequences of fluid spaces near the dentin are known [1].

Immediate Dentin Sealing

A clean dentin surface is mandatory for optimal seal and adhesion. Freshly cut dentin is uncontaminated and clean, thus more easily capable of resin infiltration. Immediate sealing of dentin protects it from contamination from bacterial leakage or remnants of temporary cements. Capturing the hybrid layer into the impression will eliminate the concern for gap formation and ill-fitting restorations. Immediate dentin sealing (IDS) is a new approach in which the dentin is sealed immediately after tooth preparation and prior to impression taking. When the dentin was sealed with a three-step etch-and-rinse dentin bonding agent (Optibond, Kerr) before impression taking, the continuity between the hybrid layer and dentin appeared with less gap formation under scanning electron microscopy. The results indicate that dentin treated with the IDS technique could potentially better tolerate long-term exposure to thermal and functional loads compared to delay dentin sealing. Eighteen patients treated with the IDS technique experienced improved comfort during the provisional restoration stage, limited need for anesthesia during insertion of the definitive restoration, and reduced postoperative sensitivity. Jun HU did a study to investigate the effect of Prime & Bond adhesive on preventing post cementation hypersensitivity of vital abutment teeth restored with a full-coverage restoration using the immediate dentin sealing (IDS) technique and he concluded that preventive treatment with Prime & Bond using the IDS technique can significantly reduce post cementation hypersensitivity [9].

Dentin desensitizers

An alternative approach to reduce the risk of vital abutment sensitivity is the concept of sealing exposed dentin with desensitizing agents following tooth preparation and before cementation of restoration. Clinical efficacy of desensitizing agents in reducing dentin senstivity has been reported when applied on vital abutment teeth prepared to receive full coverage restoration. Desensitizers occlude the dentinal tubules at surface and subsurface level preventing the fluid flow and hence reduce the pain sensation by counteracting the hydrodynamic mechanism of dentinal hypersensitivity. In a study Nantiya H. Yi *et al.;* concluded that the application of a polymerizable dentin desensitizer significantly enhanced crown retention values when resin cement or resin-modified glass ionomer cement was used, and use of a dentin

desensitizer when cementing with zinc phosphate significantly reduced crown retention values [10].

Effect of luting cements on post cementation hypersensitivity:

Selection of the luting cement for vital abutments is considered critical as it plays an important role in controlling post-cementation hypersensitivity and success of the final prosthesis. Type I glass ionomer cements and resin based luting cements are the two most commonly used luting agents [11].

Glass ionomer cement can displace certain amount of dentinal fluid, which may cause excessive hydrostatic pressure leading to post-cementation hypersensitivity. Glass Ionomer luting cement has a comparatively low initial setting pH at the time of placement and this has been implicated as a cause of post-cementation sensitivity when the prosthesis is being cemented on vital teeth [12]. Johnson et al in their in vitro study found that, use of a resin sealer resulted in 55% increased retention when used with glass ionomer cement. They concluded that a dentin bonding agent can be used successfully with type I glass ionomer cement [11].

Resin based luting cements exhibit lower solubility in comparison to conventional glass Ionomer cements and their pH at placement is also higher as compared to glass Ionomer cements. Rohit mohan shetty *et al.;* compared the postoperative sensitivity of abutment teeth restored with full coverage restorations retained with either conventional glass ionomer cement (GIC) or resin cement and concluded that self-adhesive resin cement can be the material of choice for luting if presence of postoperative sensitivity is of prime consideration [13]. Hassan s et al in a study concluded that there was no significant difference between the resins based luting cement and glass ionomer luting cement in terms of post cementation sensitivity in vital teeth with fixed restorations [14]. However resin based luting cements have also been reported to cause post-operative sensitivity because their main shortcoming is marginal defects and gaps caused by polymerization shrinkage during placement.

Precautions recommended:

While preparing vital abutments, the dentist may carry out elective endodontic treatment for the vital abutments or may try and preserve pulp vitality. The choice of luting agent is important, as they have been known to contribute to post cementation hypersensitivity. Brannstrom suggested certain precautions for precementation procedures to reduce the risk of an inflammatory response in the pulp:

i. The provisional crown should be well fitting, covering cervical dentin but not impinging on the periodontal tissues. The permanent crown should be cemented as soon as possible
ii. The superficial smear layer should be removed and the dentinal surface should be treated with an antibacterial solution before the provisional crown is placed
iii. To decrease dentinal permeability under the provisional crown, the dentinal surface should be covered with a liner that can be easily removed before final cementation
iv. To ensure optimal micromechanical bonding, the dentinal surface should be thoroughly cleaned, and the dentin should be kept moist until cementation; and
v. The occlusion should be carefully checked before cementation of the crown.

When these recommendations are followed, patients have seldom complained of postoperative sensitivity during and after final cementation [1].

CONCLUSION

Increased sensitivity to hot or cold stimulation is an occasional, but perplexing, unwanted consequence of a newly cemented crown or fixed partial denture. The dentist has to make the critical decision whether to carry out elective endodontic treatment for the vital abutments or to try and preserve pulp vitality. Because of sectioning of dentinal tubules, a certain degree of pulpal trauma is inevitable during tooth preparation. Completely avoiding sensitivity is impossible. Literature in regard to post-cementation sensitivity is still lacking and has not yielded any definitive answers. Better understanding of the causes and precautionary measures can help in management of post cementation hypersensitivity.

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