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Prevalence of Dentine Hypersensitivity in Vital Abutment Teeth being prepared for Fixed Partial Dentures or Crowns

Maria Komil Ghuuman, Miral Shad, Ammara Sharafat, Maira Afzal, Rida Anjum, Saira Ibrahim

ABSTRACT

Objective: To determine the prevalence of dentine hypersensitivity during the preparation of vital abutment teeth for Fixed Partial Dentures or Crowns and its association with patient's gender, age, and location of tooth.

Study Design & Setting: This is a descriptive cross-sectional study of patients with 150 abutments of either crown or fixed partial dentures, carried out in the department of Prosthodontics at Armed Forces Institute of Dentistry (AFID) Rawalpindi from June to December 2021.

Methodology: The Dentine Hypersensitivity was recorded on a VAS (Visual Analogue Scale) of 0-10 after the patient reported pain during exposure to thermal stimulus i.e. cold water from a 5cc syringe at 1cm distance during or just after the tooth preparation.

Results: In this study, the prevalence of Dentine Hypersensitivity was 13.3% with a mean dentine hypersensitivity score (VAS) for cold water test (Mean ± SD) of 0.61±1.756. Independent samples t-tests were used to determine the difference in hypersensitivity between genders, two age groups, and type of tooth (anterior/ posterior). It showed significant results with p-values of 0.002, 0.002, and 0.003 respectively.

Conclusion: Within the limitations of this study, it was highlighted that the preparation of vital teeth for conventional porcelain fused to metal (PFM) crown or fixed dental prosthesis results in dentine hypersensitivity in a considerable number of cases, with a higher incidence in women, younger patients, and vital anterior abutments.

Keywords: Crown, Dentine Hypersensitivity, Fixed Partial Dentures, Vital abutment.

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Maria Komil Ghuuman
Assistant Professor, HOD Department of Prosthodontics
Nishtar Institute of Dentistry, Multan
Email: dr.mariaghumman@gmail.com

Miral Shad
Senior Registrar, Department of Prosthodontics
Frontier Medical College, Abbottabad
Email: miraal.shaad@gmail.com

Ammara Sharafat
Assistant Professor, Department of Prosthodontics
CMH Institute of Medical Sciences, Multan
Email: ammara1390@gmail.com

Maira Afzal
Senior Registrar, Department of Prosthodontics
CMH Institute of Medical Sciences, Multan
Email: mairaafzal45@yahoo.com

Rida Anjum
Assistant Professor, Department of Prosthodontics
University College of Medicine and Dentistry, University of Lahore
Email: dr.ridaanjum5@gmail.com

Saira Ibrahim
Assistant Professor, Department of Prosthodontics
IOD CMH Lahore Medical College
Email: i_saira@hotmail.com

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INTRODUCTION:

Sensitivity is a quite common yet complex condition that continues to challenge dental professionals and affect patients' quality of life. It is a complicated variable and has many controversies existing around the ideal or correct terminology. A few such terms are 'dentine sensitivity', 'dental sensitivity' and 'hypersensitivity'. However, there is no evidence that the dentine labelled as hypersensitive will histologically differ from a normal dentine and not all exposed dentine causes sensitivity. The pulpal response of a hypersensitive tooth does not differ from a normal one.[1] Among pulpal responses, sharp pain for a short duration elicited due to dentine exposure is described as dentine hypersensitivity. This pain, although transitory, can surely impact the quality of daily life. Dentine sensitivity can adversely affect the simple day to day activities by making it difficult to eat, drink, speak, or perform oral hygiene measures which might trigger sensitivity.[2] Various factors, directly or indirectly, may affect its occurrence like age, gender, type, and position of tooth. When replacing missing tooth structure in younger individuals, the abutments are mostly vital.[3] Interestingly, dentine hypersensitivity is not a widely studied condition, especially in the context of tooth preparation for crowns and FPDs. Research on this subject remains limited despite

its importance, given that vital abutment teeth are often preferred for prosthetic rehabilitation. Few studies have focused on the incidence of dentine hypersensitivity after tooth preparation. Gumus HO found the total incidence of pulpal exposure to be 0.66% (80 teeth with pulp exposure out of 11993 preparations).[4]

Evaluation of pulpal health is of paramount importance before any restoration-involving crown or bridges.[5] Replacement by fixed dental prosthesis is a favorable choice due to numerous advantages like quick fabrication, the familiarity to both the dentist and the patient, satisfactory mechanical properties, comparable natural contour, comfort, function, aesthetics, speech, and health. However, if the preparation goes in too deep there could be several adverse effects like sensitivity, pulp necrosis, caries, periodontitis, and root fractures. It is postulated that the fixed dental prosthesis with vital abutments can comparatively have a higher survival rate and mean life span as well. The reason behind this fact may be that endodontic failure, which is the leading cause of failure of non-vital abutments, is not among the causes of failure in vital abutment teeth being prepared for the same restoration[1,5].

Despite following recommended protocols for tooth preparation, sensitivity can still occur, particularly in cases involving vital abutment teeth. The decision to proceed with elective endodontic treatment or to preserve tooth vitality is a critical one that must be made by weighing the risks and benefits. Many prosthodontists elect to perform root canal treatments before preparing teeth for crowns or FPDs, especially when achieving parallelism and proper alignment is challenging. However, it is not always necessary to devitalize teeth that are not severely mal-positioned or supra-erupted, as doing so can increase the risk of hypersensitivity and compromise the strength of the abutment. Dentin sensitivity has remained an ongoing clinical challenge that significantly impacts both the quality of life for patients and the practice of clinicians.[6]

The rationale of this study is to identify the predisposing factors associated with dentine hypersensitivity in the Pakistani population, specifically in patients undergoing tooth preparation for crowns or FPDs. By understanding these factors, clinicians can make more informed decisions about whether to preserve the vitality of abutment teeth or proceed with elective endodontic treatment before preparing it for a crown or bridge. The findings of this study are expected to contribute to the existing body of knowledge on dentine hypersensitivity and help guide clinical practice in managing this very common but challenging condition.

METHODOLOGY:

This is a cross-sectional study conducted in department of Prosthodontics at Armed Forces Institute of Dentistry over a period of 6 months from June to December 2021. After obtaining ethical approval from the Ethical Board Committee and written consent from the participants the data was collected using nonprobability consecutive sampling technique. Participating patients of both genders, within age range of 21-50 years and having vital abutment teeth (both anteriors and posteriors) undergoing rehabilitation by fixed partial dentures (FPDs) or single crowns were included in the study. Patients with endodontically treated, periodontally compromised, malposed, tilted, supra erupted, attritioned, previously carious, heavily restored abutment teeth or teeth with short clinical crowns were excluded from the study. Patients with neuromuscular diseases like Parkinsonism and dental phobia were also not included.

The sample size (n) of 150 was calculated using World Health Organization sample size calculator with the absolute precision of 0.1, confidence level of 95%, mean 3.36 and standard deviation of 1.26.[3] And a total of 80 abutments of male and 70 abutments of female patients were included in the study following the exclusion and inclusion criteria.

The vital teeth selected as abutments for single crowns or primary abutments for fixed partial dentures were prepared following the standard protocols for tooth preparation for PFM crown or FPD.[7] Teeth were prepared by a single operator using diamond burs with a high-speed hand piece under an air and water coolant. Occlusal reduction of approximately 1.5 mm for non-functional cusp and 2.0 mm for functional cusp, followed by a buccal subgingival shoulder margin of 1.5 mm and lingual supra gingival margin with chamfer of 0.5mm.

Sensitivity was recorded on exposure to cold water from a 5cc syringe for 5 seconds at a distance of 1 cm by the same operator immediately after the tooth preparation for fixed partial dentures or single crowns. The pain was recorded on VAS from 0- 10 0= no pain, 4-7 moderate pain, 8-10= severe pain. VAS is a dependable measure because the amount of pain in one patient can be measured by the operator multiple times (at least twice) and outcomes of each test for that individual will correlate well. [3]

RESULTS:

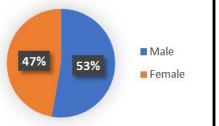
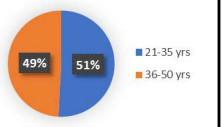
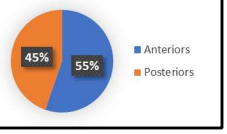
The data was compiled for a descriptive statistical analysis using SPSS (version 23.0). Qualitative variables like gender, frequency, percentage and quantitative variables like age, dentine sensitivity (on VAS) was calculated. Effect modifiers like age and gender were controlled through stratification. Age of the patients was stratified into two groups: 21-35 years of age and 36-50 years of age. Stratification on type of tooth included anterior teeth (Incisors and canines) and posterior tooth (premolars and molars). Independent Sample T-test was used post stratification, for calculating dentine hypersensitivity with respect to considered variables. P-value of = 0.05 was considered significant.

The frequency of distribution of patients according to considered variables for this study are shown in Table-1 Mean ± SD Hypersensitivity as VAS score for cold water

test performed during the tooth preparation phase is stated in Table-2.

Independent samples t-test was used to determine the difference in hypersensitivity (VAS score) between the considered variables are shown in Table-3, 4 and 5 respectively. Our study clearly shows that women, anterior teeth and younger age group reported significantly higher sensitivity.

Percentage Distribution of Patients with Dentine Hypersensitivity

Considered variables	Distribution (n= 150)	
Gender Male Female	 80 (53.3 %) 70 (47.7 %)	
Age Group 21-35 years 36-50 years	 74 (49.3 %) 76 (50.7 %)	
Type of Tooth Anterior Posterior	 83 (55.3 %) 67 (44.7 %)	

Mean Hypersensitivity		
VAS Score	Mean	Standard Deviation
10	0 . 6 1	1.756

Following figure shows the prevalence of sensitivity in our sample size

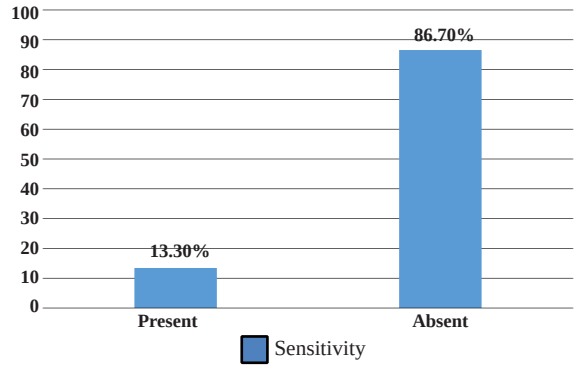


Figure: Prevalence of Sensitivity in study subjects

Table 3: Hypersensitivity (VAS score) in relation to gender

Gender	Cold Water Test (VAS Score) (mean ± SD)	Independent Sample T-test p- value
Male	0.18 ± 0.725	0.002
Female	1.11 ± 2.362	

Table 4: Hypersensitivity (VAS score) in relation to patient age groups.

Age Group	Cold Water Test (VAS Score) (mean ± SD)	Independent Sample T-test p- value
21- 35 years	1.07 ± 2.241	0.002
36- 50 years	0.17 ± 0.915	

Table 5: Hypersensitivity (VAS score) in relation to teeth.

Type of Tooth	Cold Water Test (VAS Score) (mean ± SD)	Independent Sample T-test p- value
Anterior Tooth	1.07 ± 2.241	0.002
Posterior Tooth	0.17 ± 0.915	

DISCUSSION:

Dentine hypersensitivity has been documented to have anincidence in the range of 4 to 74%. This wide variation is due to differencesin the target population, selection criteria, and the method of assessment or diagnosis.[8] A different study supports this wide range of prevalence, showing results between 3-98%.[9] Yet again a novel study anticipates the prevalence of dentine sensitivity spread over a spectrum between 4.8% and 62.3%.[10]

Dentine hypersensitivity is more commonly reported in women than in men. The reason behind this was found to be thefact that women have lower pain threshold, and they have less tolerance to noxious stimuli. Dentine hypersensitivity was most commonly found in age 20- 40 but predominantly during the third decade owing to increased dentinal thickness in old age due to continued formation of secondary dentine and sclerosed pulp chambers leading to decreased dentine permeability.[3,4,11] It has also been reported that anterior teeth, having less enamel thickness, have higher dentine hypersensitivity than posterior teeth.[4, 8, 11, 12, 13, 14]

In this prosthesis, porcelain is veneered to a cast metalsubstructure which perfectly fits over prepared tooth. A minimal reduction of 1.5mm is usuallyindicated (0.3 - 0.5mm for metal and 1.0 - 1.2mm for porcelain). The adequate thickness of porcelain is necessary to create asense of colour depth and translucency and to hide the metalsubstructure and this thickness of metal framework isnecessary for adequate mechanical strength and durability of FDPs.[7] However, there is no possible means of clinically checking the residual dentine thickness during tooth preparation.[1]

Extensive studies have been undertaken to elucidate the causes of dentine sensitivity. Direct Innervation Theory and Odontoblastic Transducer Theory have been widely rejected.[15] and the Hydrodynamic theory better explains the physiology behind dentine sensitivity.[2] First proposed by Gysi and later reinforced by Bra¨nnstro¨m, this theory suggestswhen exposed dentine surface is subjected to a stimulus, whether

thermal, chemical, tactile or evaporative, there is a change in the dentinal fluid flow of dentine tubules. This movement of dentine fluid inside the tubules leads to apressure change, exciting the pressure sensitive nerve receptors across the dentine.[16] During a full crown preparation approximately 1-2million tubules are exposed, and it is found that dentine sensitivity is strongly associated with the number and diameter of exposed dentinal tubules and on the type and duration ofthe stimulus. [17] Most commonly used methods to check for sensitivity are the use of air jet from an air water syringe or using cold water from a 5cc syringe for cold stimulus.It is found that a cold sensation is the most common stimulus in triggering hypersensitivity in patents [9, 16, 18]. A few precautions during tooth preparation, like cooling to counter the heat generation with anair water syringe, keeping dentine wet to prevent desiccation, maintaining thickness of dentine can be applied to reduce this incidence. Two different studies by Davis GR and Stanley and Swerdlow concluded that residual thickness of dentine of more than 2mm aftertooth preparation is required for maintaining vitality of tooth and the remaining thickness of dentine is inversely proportional to pulpal response.[1,7]

Crowns or FPDs are considered as one the most reliable, dependable, convenient and sought-after treatment options in prosthodontics whereas vital teeth have long been considered as preferable abutments because of their intact proprioception. Significantly, there is considerable tooth structure loss during the tooth preparation. In clinical situations like these, the dentist has to make a critical decision, by weighing the risks against benefits of keeping the tooth's vitality intact or carrying out elective endodontic treatment. Many prosthodontists elect to undertake the latter option to ensure that principles of parallelism and correct alignment are achieved before fabricating crowns and FPDs. However, it is not necessary to devitalize intact teeth that are neither supra-erupted nor tilted, as such intervention may increase the chances of sensitivity and compromise the strength of the abutment. [19, 20] A group of clinicians have evaluated incidence of possible endodontic complications during and immediately after tooth preparation phase for PFM fixed dental prosthesis to be around 3-38%.[21] The tooth preparation for porcelain fused to metal FPDs requires a considerable amount of removal of tooth structure, a minimum of 1.5 mm (0.3-0.5mm for the metal substructure and 1.0-1.2 mm for the porcelain layer) has been recommended. And the pulp vitality can be maintained in abutments if principles of tooth preparation are strictly adhered to. Maintenance of vitality of the dentine and minimal pulpal damage are the most important biological considerations in tooth preparation.[7] Despite following the guidelines for tooth preparation like minimal tooth preparation, preservation of biological width, minimizing thermal and mechanical trauma, some complexities may be faced during the preparation of vital abutment teeth. Tooth preparation leaves dentine tubules open, exposing them to noxious stimuli like bacteria, desiccation, cold and heat. Heat is also generated as a result of contact of cutting instruments on tooth structure. [7,22]

Additionally, removal of surface moisture from prepared vital tooth surface due to exposure to air i.e., desiccation can result in extreme sensitivity. Regardless of following the ideal guidelines, there is always a threat to the integrity of vital pulp during the preparation of abutment teeth as all the steps involved have a potential for irritating the vital pulp. [21] The pulpal response to these different procedures is however cumulative.

This study reported a prevalence of sensitivity of 13.3% based on the selected sample size of 150, with a mean ±SD of VAS of 0.61±1.756. A previously documented study showed that there is a wide range (4-74%) in prevalence of dentine hypersensitivity, due to extensive variation in the target population, selection criteria, and the method of assessment or diagnosis. [23] The incidence of any postoperative complication after the tooth preparation is usually undervalued by most dentists. In our study, a higher incidence of sensitivity in a younger age group (age 21-35 years) was observed, as compared to the older age group (36-50 years), P-value=0.002. These results were reinforced by another study by Blaizot et al. reporting highest occurrence of dentine hypersensitivity in the third decade. [11, 23] The reason was attributed to the continued formation of secondary dentine and sclerosed pulp chambers in old age, leading to a decreased dentine permeability and subsequently decreased dentine hypersensitivity. [7, 16] This is further underscored by an in-vitro study by Davis et al who used microtomography and calculated the amount of residual dentin thickness after tooth preparation and found a significant increase in sclerosed pulp chambers in older individuals. [1]

The study revealed a meaningfully higher incidence of sensitivity in female patients with a *p* value=0.002. Therefore, this study reinforces the results of other studies reporting the same.[3, 4] Epidemiological studies have shown that women and men experience and cope with pain and sensitivity differently due to hormonal variation, puberty, reproductive status, and menstrual cycle affecting their pain threshold and perception.[5]

Furthermore, it was reported that anterior teeth, including incisors and canine, showed a significantly higher incidence than posterior teeth, including premolars and molars (P value= 0.003). This has been observed even after strictly following the guiding principles of tooth preparation, maintaining the vitality in anterior teeth was challenging when compared to posterior teeth. Another study conducted by Hammad on the Pakistani population reinforces this statement.[24] It was established that the vitality of most of the posterior teeth being prepared for fixed prosthesis can be preserved without requiring endodontic treatment, if proper guidelines are followed. The results are attributed

to the fact that anterior teeth are smaller in size, having an overall thin layer of enamel and dentine as compared to the posterior teeth. It was affirmed by some studies that the teeth most prone to Dentine Hypersensitivity are canines and premolars. [7, 20] Cheung et al signified further that molars can better tolerate pulpal trauma during tooth preparation than premolars. [25]

Nowadays there is a growing trend towards using minimally invasive preparation methods like air abrasion and laser and fabricating minimum preparation prosthesis thereby decreasing the incidence of dentine hypersensitivity. Also the adoption of digital dentistry tools, such as CAD/CAM systems, is on the rise enhancing the accuracy of crown preparations, potentially reducing the risk of hypersensitivity by ensuring more precise tooth reductions and a better fit for crowns.[7]

The findings of our study, however, cannot be applied to the general Pakistani population, owing to the limited sample size and a certain number of people having access to treatment in this institute. It is felt that further studies in this field are necessary to ascertain the exact prevalence of sensitivity in the Pakistani population keeping in view the significance of the considered variables.

CONCLUSION:

Within the limitations of this study it was concluded that the preparation of vital teeth for conventional porcelain fused to metal crown and fixed dental prosthesis can result in sharp, transient pain known as dentinal hypersensitivity. In our study a prevalence of 13.3% was calculated in a sample size (N) of 150. It was further observed that women, patients of younger age group or patients with prepared anterior teeth reported more dentine hypersensitivity than men, patients of older age group or patients with prepared posterior teeth just after tooth preparation. Needless to say, the low prevalence of hypersensitivity suggests that operators can perform tooth preparation without elective endodontic treatment in most of the cases. Multiple factors, individually and collectively, play a role in the phenomenon of dentine hypersensitivity, which needs further exploration.

Authors Contribution:
Maria Komil Ghumman: Conception and Design of Study, Drafting of Manuscript, Acquisition of Data
Miral Shad: Drafting of Manuscript, Acquisition of Data
Ammara: Analysis and Interpretation of Data
Maira Afzal: Analysis and Interpretation of Data
Rida Anjum: Critical Review of Manuscript
Saira Ibrahim: Critical Review of Manuscript

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