

CHOICE OF MATERIAL FOR FIXED DENTAL PROSTHESIS; A CROSS-SECTIONAL STUDY

¹NIDA ZEHRA BANO, ²JAFFAR HUSSAIN BUKHARI

³HASHMAT GUL, ⁴MUHAMMAD KALEEM

ABSTRACT

The objective of this study was four fold; to find out the materials of choice for fixed dental prosthesis (FDP), role of luting agent in post operative sensitivity, to find out the trend of elective root canal therapy (RCT) among the clinicians prior to provision of FDP and to record the frequency of temporary crown placement by the clinicians. A cross-sectional study was performed in two dental Institutes; Armed Forces Institute of Dentistry (AFID) and Margalla Institute of Health Sciences (MIHS) of Rawalpindi City from 24th May to 30th August 2016. Non-probability convenience sampling was done in this survey. Raosoft sample size calculator was employed to determine the sample size of 150 by keeping the level of confidence at 95%. The response rate was 87%. The collected data were analyzed and interpreted using SPSS version 21. For categorical variables frequency was calculated. Using Pearson's chi-square test the level of association between designation of the clinicians and their preferred materials of choice for FDPs as well as frequency of temporary crowns provision was also calculated. Majority of the dentists preferred all ceramic (53%) for anterior FDP and ceramic fused to metal (61%) for posterior FDP. Among luting agents, Glass-ionomer cements (GIC) (77%) was the most popular luting agent and resin cements (40%) used by acid etch technique was labeled to be the most irritant luting agent leading to post-operative sensitivity. Elective RCT was performed by 49% clinicians only if the tooth was sensitive to percussion and 70% clinicians provided temporary crowns only in case of anterior and vital teeth. The study highlighted the materials commonly used by the dentists and the differences in the choices and practices of the dentists regarding prosthodontic treatment. It also pointed out some important factors such as an increase in frequency of temporization and careful justified decision of elective RCT by the dentists.

Key Words: Choice of material, Fixed dental prosthesis, Prosthodontic treatment

INTRODUCTION

The basis for a successful treatment plan is the appropriate selection of the material. Over the past years all ceramic fixed dental prosthesis (FDP) have been established as an alternative to the ceramic fused to metal prosthesis.¹ The reason is their excellent life-like appearance and the availability of new dental ceramics providing the aesthetics and mechanical properties comparable to the ceramic fused to metal prosthesis. Increase in the cost of noble metals like gold and platinum has also contributed to the preference for all ceramic FDP.² Previously used ceramics such as feldspathic porcelain had low mechanical strength due to which it was only indicated for anterior regions of the dental arches and had survival rate significantly lower than the gold standard metal ceramic prosthesis.^{3,4}

The recently introduced dental ceramics such as leucite, lithium disilicate, lithium disilicate reinforced

glass ceramics, alumina and zirconia can be used for the fabrication of multiple unit posterior FDPs due to their better mechanical stability as compared to earlier used ceramics.⁵ A recent meta-analysis revealed that there is no statistically significant difference found between the survival rates of all ceramic FDP made up of lithium disilicate reinforced glass ceramics, alumina, zirconia or leucite base ceramic and metal ceramic FDP for both anterior and posterior regions of the dental arches. However, the usage of densely sintered zirconia as a primary treatment option for FDPs is still questionable due to technical problems like loss of retention.³

While placing FDP, even the conservative methods of the tooth preparation can threaten the pulpal integrity which questions the decision of performing elective RCT. The use of proper techniques like placement of temporary crown and proper sealing of the temporary and permanent restoration causes no permanent injury to the vital pulpal tissues, thus, not always necessitating the need of RCT in some cases.⁶ As the time of use of temporary crowns is limited only to a few weeks, the requirements for temporary crown differ only slightly from FDP.⁷ Pashley et al revealed that after a few days of crown preparation, the permeability of the cut dentin is greatly reduced, hence, enhancing the protection of the pulp against environmental insults.⁸

^{1,2,3,4} Army Medical College, National University of Medical Sciences, Rawalpindi

For Corresponding: Nida Zehra Bano, PG Trainee MPhil Dental Materials, Department of Dental Materials, Army Medical College, NUMS, Rawalpindi, Cell: 0345-5074427 Email: nidaxehra@gmail.com

Received for Publication: August 30, 2016

Revised: September 2, 2016

Approved: September 5, 2016

Luting agents used for the attachment of prosthesis to teeth include a broad range of materials. Among which GICs and zinc phosphate cements are the most widely used.⁹ Apart from the advantages offered by GICs over other luting agents, GICs exhibits difficult handling properties and potential post-operative hypersensitivity. Resin cements provide better mechanical strength than conventional cements but has other disadvantages like frequent post-operative tooth sensitivity and pulp necrosis.¹⁰

Postoperative tooth sensitivity has been related to the crown cementation since the introduction of zinc phosphate cement in 19th century.¹⁰ However, recently published studies indicate that the post-cementation sensitivity with GICs is comparable or even less than zinc phosphate cement.^{9,11} Johnson et al reported of post-operative sensitivity to cold after two weeks of crown cementation with GIC (19%) and zinc phosphate cement (34%).^{12,13}

This survey was intended to identify the popularity of different materials used for the FDP fabrication and luting among clinicians, to find out the trend of elective RCT of the tooth to be crowned or served as an abutment and the frequency of temporary crown placement. It will highlight the most commonly used materials and treatment regimens with respect to fixed dental prosthodontics.

METHODOLOGY

A cross-sectional study was performed in two Dental Institutes (AFID & MIHS) in Rawalpindi City of Pakistan from 24th to 26th May, 2016. Non-probability convenience sampling was done in this survey. Raosoft sample size calculator was employed to determine the sample size of 150 by keeping the level of confidence at 95%. The Clinicians including house officers, clinical demonstrators and consultants of the two teaching hospitals were included in the study. The clinicians who failed to respond after being repeatedly approached and those working privately i.e. other than the teaching hospitals were excluded.

Data were collected anonymously using a twelve-question survey questionnaire. Questionnaire addressed questions regarding prosthodontic treatment provided to the patients receiving FDPs. The collected data included clinician's demographics (designation, area of interest/expertise and clinical experience), number of crowns placed per month, choices of material for FDPs in anterior and posterior regions and luting agents, frequency of temporary crown provision and approach towards elective RCT of the tooth to be crowned or served as an abutment. The collected data were analyzed and interpreted using SPSS version 21. Level of association between designation of the clinician and rest of the variables was calculated using Pearson's chi-square test.

RESULTS

The sample size of the study was 150 but 131 (87%) participated in the study. Among the participants 61% were from AFID and 39% were from MIHS. The data

missed was due to no return of the questionnaire and failure to answer the questions as they were self applied on the practitioners. Among the participants 48% were house officers, 27% residents, 15% registrars and 10% consultants. Table 1 shows descriptive analysis of the data.

There was a statistically significant association between the designation and number of crowns placed per month, their choices of material for anterior and posterior crowns ($p \leq 0.05$). Only the variables that revealed statistically significant associations to the designation of the clinicians were mentioned in Table 2 which can be interpreted as that the consultants placed more crowns per month in comparison to house officers and residents ($p < 0.05$). The material of choice for anterior crown by consultants was all ceramic i.e. zirconia followed by lithium disilicate, whereas the rest of the clinicians still preferred ceramic fused to metal ($p = 0.004$). The material of choice for posterior crowns by consultants was porcelain fused to metal where as other clinicians prefer all metallic crown (base metal over noble metal alloys) ($p = 0.04$). The consultants and residents believed in more frequent use of temporary crowns as compared to rest of the clinicians.

DISCUSSION

The study was conducted to find out the most popular materials among the dental clinicians for fabrication and luting of FDP. The survey also included some important questions related to Prosthodontic treatment such as the frequency of temporary crown placement, choice regarding the need of elective RCT for FDP and the identification of most irritant luting agent leading to post-operative sensitivity. The clinicians of all designations were included (house officers, registrars, residents and consultants).

Consultants were found to place more crowns per month followed by the residents and least by the house officers. Ceramic fused to metal prosthesis has been considered as a gold standard¹⁴ and marks a success history of 50 plus years due to their predictable survival rates not only in crowns but also in long span bridges. In this survey, 47% clinicians still preferred metal-ceramic over all ceramics for the fabrication of anterior FDP. However, majority of the clinicians (53%) preferred all ceramic over ceramic fused to metal prosthesis. Apart from the obvious reason of excellent esthetic appearance, all ceramic FDP do not wear the opposing tooth structure¹⁴, are less expensive than metal-ceramic prosthesis and as per a meta-analysis shows a 5 year survival rate comparable to metal-ceramic crowns.¹⁵

As per scientific evidence, zirconia possesses the best mechanical properties at a maximum span length of 5 units among all ceramic crowns.¹⁶ In this study among all the ceramics for anterior FDP, consultants preferred zirconia followed by lithium disilicate. During the last decade zirconia has gained a lot of interest for the fabrication of FDP.¹⁷ On the other hand Glass based ceramics like Leucite reinforced glass ceramic has gained popularity among dentists for the past 20 years due to its excellent esthetics.¹⁷ The introduction of Lithium disilicate glass ceramics lead to further advancement by the development to IPS E. Max which exhibited promising results due to technical improve-

TABLE 1: NUMBER AND FREQUENCIES OF STUDIED VARIABLES IN THE SURVEY PERFORMED IN TWO TEACHING HOSPITALS OF RAWALPINDI (N = 131)

Variables	n	Percentage
1. Material of choice for anterior crowns		
Zirconia	32	24
PFM*	61	47
E. Max (lithium disilicate)	7	5
Not sure between zirconia and E. Max (lithium disilicate)	28	21
Unspecified	3	2
2. Material of choice for posterior crowns		
All metallic (base metal alloys)	38	29
All metallic (noble metal alloys)	11	8
Metal fused to ceramic	80	61
Zirconia	2	2
3. Elective RCT of a vital tooth to be crowned /abutment		
Always	36	28
Do RCT if sensitive /painful after preparation.	64	49
Use temporary crown and avoid RCT whenever possible	20	15
Unspecified	11	8
4. Preferred luting agent for the cementation of FDP		
Resin based cement	15	12
Glass ionomer cement	101	77
Zinc phosphate	8	6
Zinc polycarboxylate	1	8
5. Cements mostly responsible for post-operative sensitivity		
Resin based cement (acid etch technique)	52	40
Glass ionomer cement	16	12
Zinc phosphate	45	35
Zinc polycarboxylate	8	6
6. Frequency of temporary crowns		
Always	11	8
Only for vital teeth	46	35
Only for anterior teeth	46	35
Never	13	10
Unspecified	15	12

PFM = Porcelain fused to metal and FDP = fixed dental prosthesis

ments like high flexural strength and esthetics with a survival rate of 95 to 100% for 5 years. Still it is not recommended to be used in the fabrication of long span bridges.¹⁴ These might be the reasons that 53% of the overall clinicians in this survey preferred all ceramic over ceramic fused to metal prosthesis. Currently the change in the trend from metal-ceramic towards all ceramics FDP appears to be justified.¹⁴

This study reports that 61 % of the clinicians used ceramic fused to metal crowns for posterior fixed dental prosthesis. Another study in North America revealed an

increase in recommendations for esthetic restorations as an alternative to the traditional metal FDPs in posterior teeth.¹⁸ Recently a meta-analysis reported no significant statistical difference in survival rate of anterior and posterior single metal ceramic crowns which justifies the use of ceramic fused to metal crowns by 61% of the clinicians in this study.³

Selection of a material for FDP also accompanies the selection of a suitable luting agent. There is a wide range of luting agents available in the market including GIC, zinc phosphate cements, zinc polycarboxylate and

TABLE 2: ASSOCIATION BETWEEN DESIGNATION OF THE CLINICIANS AND VARIABLES RELATED TO THEIR PREFERENCES REGARDING MATERIAL AND TREATMENT PLANNING

Variables	Designation				P value
	House officer	Resident	Registrar	Consultant	
No. of crowns provided to patients per month					
< 10	55	21	11	5	0.00
10-25	5	12	3	5	
< 50	1	2	1	1	
50-100	0	0	1	2	
Material of choice for Anterior Crowns					
Zirconia	13	9	3	7	0.004
Porcelain fused to metal	30	16	13	2	
E. Max (lithium disilicate)	0	5	0	2	
All ceramic but not sure between	19	5	2	2	
Zirconia and E-Max					
Unspecified	2	0	1	0	
Material of choice for Posterior Crowns					
All metallic (base metal alloys)	23	11	4	0	0.04
All metallic (noble metal alloys)	4	6	1	0	
Metal fused to ceramic	36	18	14	12	
All ceramic (zirconia)	1	0	0	1	
Frequency of temporary crowns					
Always	2	3	2	4	0.001
Only for vital teeth	23	10	6	7	
Only for anterior teeth	17	19	8	7	
Never	10	1	0	0	
Unspecified	12	2	3	0	

resin cements (dual cured, auto cured and photo-polymerized resin cements). The results of this survey reported that 77% of the clinicians preferred GIC over resin cements and zinc phosphate cement for luting FDP. Zinc phosphate cement has been used for more than a century despite its certain disadvantages like low setting pH, high solubility and lack of adhesion to the tooth structure. GIC gained preference over zinc phosphate due to its ability to bond chemically to the tooth structure and its fluoride release potential. Thus, GIC is believed to minimize the occurrence of micro-leakage and secondary caries.

Usage of resin cements has increased during the past few years especially for the cementation of porcelain veneers and all ceramic crowns. However, it requires careful manipulation and is technique sensitive. In case of photo-polymerizable resin cements, the polymerization shrinkage allows micro leakage to occur leading to post-op sensitivity.¹² This might be the reason of 40% clinicians reporting the post-operative sensitivity associated with resin based cements used via acid etch technique followed by Zinc phosphate cement (35%) and GIC (12%). The post-operative sensitivity

associated with GIC and zinc phosphate cement may be attributed to their low initial setting pH. Thus, in cases of minimum dentin thickness, usage of varnishes and sealers in conjunction with GIC and zinc phosphate cement is recommended.¹⁴

A successful prosthodontic treatment requires the prepared teeth to be protected by a provisional restoration that closely resembles the definitive restoration. Tooth reduction exposes the dentinal tubules and necessitates the pulpal protection. Provisional restorations seal the pulp from bacterial, chemical and thermal insults.¹⁹ In this study, majority of the clinicians (70%) placed temporary crowns only in case of vital and anterior teeth whereas 8% never placed temporary crowns. These 8% clinicians were those who always performed RCT prior to the provision of FDP. This raised the question that whether is it justified to always perform endodontic therapy prior to crowning. The response of the clinicians regarding this important question was quite alarming and revealed that 28% of the dentists always performed RCT of the tooth to be crowned or to be used as an abutment for FDP irrespective of the condition of the tooth. Almost 50%

clinicians reported that they performed RCT only if the tooth is sensitive or painful to percussion whereas only 15% avoided unnecessary endodontic therapy and always temporized the tooth preparation. An obvious reason for the 8% clinicians who always performed endodontic therapy prior to prosthodontics treatment was to avoid any post-operative complaints by the patients. The trend needs to be changed emphasizing on the fact that use of proper techniques like the use of air-water coolant during tooth cutting, fabrication of the temporary crowns and sealing the final restorations against bacterial invasion contributes a lot in maintaining the pulpal vitality, thus, minimizing the need of unnecessary endodontic treatment.⁷

The limitation of this study was that it was conducted in only two teaching dental hospitals of Rawalpindi and hence, was not the representative of all the dental hospitals of the country. So, the results cannot be generalized to all the teaching hospitals of Pakistan.

This study highlights the materials commonly used by the dentists and the differences in the choices and practices of the dentists regarding prosthodontic treatment. It also points out some important factors such as an increase in frequency of temporization and careful and justified decision of elective RCT by the dentists.

CONCLUSIONS

Thus to conclude, within the limitations of the study; Dentists working in AFID and MIHS preferred all ceramic FDP for anterior teeth and porcelain fused to metal for posterior teeth. Glass-ionomer cements was the most popular luting agent used for FDP cementation. Resin cements used by acid etch technique was reported as the most irritant luting agent leading to post-operative sensitivity. Most of the clinicians performed elective RCT only if tooth was sensitive or painful to percussion. Majority of the clinicians used temporary crowns only in case of anterior and vital teeth.

REFERENCES

- Edelhoff D, Brix O. All-ceramic restorations in different indications: a case series. *The Journal of the American Dental Association*. 2011; 142 (2): 14-19.
- Walton TR. Making sense of complication reporting associated with fixed dental prostheses. *The International journal of prosthodontics*. 2013; 27 (2) : 114-18.
- Sailer I, Makarov NA, Thoma DS, Zwahlen M, Pjetursson BE. All-ceramic or metal-ceramic tooth-supported fixed dental prostheses (FDPs)? A systematic review of the survival and complication rates. Part I: Single crowns (SCs). *Dental Materials*. 2015; 31 (6): 603-23.
- Pjetursson BE, Sailer I, Zwahlen M, Hämmerle CH. A systematic review of the survival and complication rates of all-ceramic and metal-ceramic reconstructions after an observation period of at least 3 years. Part I: single crowns. *Clinical Oral Implants Research*. 2007; 18 (3): 73-85.
- Raigrodski AJ, Chiche GJ, Potiket N, Hochstedler J, Mohamed SE, Billiot S, et al. The efficacy of posterior three-unit zirconium-oxide-based ceramic fixed partial dental prostheses: A prospective clinical pilot study. *The Journal of prosthetic dentistry*. 2006; 96 (4): 237-44.
- Jackson CR, Skidmore A, Rice RT. Pulpal evaluation of teeth restored with fixed prostheses. *The journal of prosthetic dentistry*. 1992; 67 (3): 323-25.
- Wassell R, George GS, Ingledew R, Steele J. Crowns and other extra-coronal restorations: provisional restorations. *British dental journal*. 2002; 192 (11): 619-30.
- Pashley DH, Kepler E, Williams E, Okabe A. Progressive decrease in dentine permeability following cavity preparation. *Archives of oral biology*. 1983; 28(9): 853-58.
- Manso AP, Silva NR, Bonfante EA, Pegoraro TA, Dias RA, Carvalho RM. Cements and adhesives for all-ceramic restorations. *Dental Clinics of North America*. 2011; 55 (2): 311-32.
- Christensen GJ. Resin Cements and Post operative sensitivity. *The Journal of the American Dental Association*. 2000; 131 (8): 1197-99.
- Klausner L, Brandau H, Charbeneau G. Glass-ionomer cements in dental practice: a national survey. *Operative dentistry*. 1988; 14 (4): 170-75.
- Johnson GH, Powell L, DeRouen T. Evaluation and control of post-cementation pulpal sensitivity: zinc phosphate and glass ionomer luting cements. *The Journal of the American Dental Association*. 1993; 124 (11): 38-46.
- Kern M, Kleimeier B, Schaller H-G, Strub JR. Clinical comparison of postoperative sensitivity for a glass ionomer and a zinc phosphate luting cement. *The Journal of prosthetic dentistry*. 1996; 75 (2): 159-62.
- Christensen GJ. Is the rush to all-ceramic crowns justified? *Journal of the American Dental Association* (1939). 2014; 145 (2): 192.
- Anusavice KJ. Standardizing failure, success, and survival decisions in clinical studies of ceramic and metal-ceramic fixed dental prostheses. *Dental Materials*. 2012; 28 (1): 102-11.
- Larsson C, Vult v SP, Sunzel B, Nilner K. All-ceramic two-to five-unit implant-supported reconstructions. A randomized, prospective clinical trial. *Swedish dental journal*. 2005; 30 (2): 45-53.
- Zarone F, Russo S, Sorrentino R. From porcelain-fused-to-metal to zirconia: clinical and experimental considerations. *Dental materials*. 2011; 27 (1): 83-96.
- Lund A. In your dental practice, is dental amalgam still the restorative material of choice?: *J Am Dent Assoc*. 2002. Aug; 133 (8) 1046.
- Mathur S, Shah A, Makwana R, Shah M, Shah A, Jathal N. Provisional Restorative Materials In Fixed Prosthodontics: A Comprehensive Review. *B Bhavnagar University's Journal of Dentistry*. 2013; 3 (3) 50-57.

CONTRIBUTIONS BY AUTHORS

- | | |
|----------------------------------|------------------------------|
| 1 Nida Zehra Bano: | Writing article |
| 2 Jaffar Hussain Bukhari: | Assistant in Data collection |
| 3 Hashmat Gul: | Formatting of the text |
| 4 Muhammad Kaleem: | Supervisor |