AN ASSESSMENT OF DIMENSIONS OF CAST METAL AND METAL CERAMIC FULL COVERAGE RESTORATIONS

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ABSTRACT

Objective: To compare the dimensions of full coverage restorations that are recommended in literature with those being delivered by the laboratories at multiple tertiary care dental institutes.
Study Design: Descriptive cross sectional study.
Place and duration of study: Three tertiary care institute laboratories in Rawalpindi/Islamabad region, from October to December 2015.
Material and Methods: The thickness of functional and non-functional cusps for both complete cast and metal ceramic crowns fabricated in the dental laboratories of multiple teaching hospitals were measured using Iwanson gauge. Data was recorded in specially made pro forma and analyzed using SPSS 20.0.
Results: The thickness of functional cusps of both cast metal and metal ceramic crown were of less than ideal thickness where as non functional cusp of cast metal crown was bulbous.
Conclusion: There is a significant variance in the dimension of metal and metal ceramic crowns fabricated in the laboratories than the dimensions recommended in literature.

Keywords: Crown dimensions, Functional cusps, Iwanson guage.

INTRODUCTION

Nature has not given regenerative power to our teeth. Once a tooth has been subjected to caries, trauma or wear, permanent loss of structure results. Extensively carious teeth usually require endodontic treatment to salvage them. However, endodontic treatment renders the teeth brittle and susceptible to fracture under cyclic occlusal loading[1]. As a consequence most of the endodontically treated teeth in the posterior region require full coverage restorations to increase their longevity. Provision of full coverage crowns and bridge retainers is commonly used by the dentists to restore/protect endodontically treated teeth and/or fixed replacement of missing dentition. This treatment requires reduction of tooth structure to create adequate space for the prosthesis depending upon the material used[1,2].

An optimal tooth preparation ensures fabrication of a good prosthesis which can guarantee long term success. The principles of tooth preparation may be divided into three broad categories: biologic, mechanical and aesthetic considerations. For the best possible results, compromise between the three principles must be achieved[1-3]. An attempt should be made to perform the tooth preparation and fabrication of restorations in such a manner that the original topography of the tooth is restored and the restoration is neither over contoured nor of inadequate thickness. A bulbous crown or FDP (fixed dental prosthesis) retainer will be aesthetically unpleasant and also cause plaque accumulation and subsequent periodontal damage[1,2]. An indirect restoration with inadequate thickness and dimensions is also predisposed to deformations and fracture[4].

Fabrication of crowns and fixed dental prosthesis in accordance with the recommended biological, mechanical and aesthetic principles require a myriad of factors to be taken into account. Some of the more salient ones are the expertise and optimal use of available armamentarium by the clinician, the quality of

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communication between the dentist and the dental laboratory, and the knowledge and skill of the laboratory technician[5]. Poor tooth preparation and impressions by the dentist[6], lapse in communication with the dental laboratory and lack of skills of the technician will lead to a compromised restoration. For the best possible prosthesis, importance of the above mentioned factors can never be emphasized enough[5,7].

Numerous alloys and ceramic materials are available for the fabrication of indirect restorations and fixed prosthesis. The commonly used alloys are Type III gold alloys and base metal alloys[8]. The recommended tooth preparation requirements vary depending on the material that will be used for the indirect restoration/prosthesis, consequently the dimensions of the crowns and FDP retainers also vary with the materials employed. For instance, the ideal thickness of a complete cast crown functional cusp is 1.5 mm and non functional cusp is 1 mm,[3,9] whereas, for a metal ceramic crown, functional cusp thickness is 2.5 mm and non functional cusp thickness is 2 mm[3].

The study was undertaken to compare the dimensions of full coverage restorations that are recommended in literature with those being delivered by the laboratories at multiple tertiary care institutes.

MATERIAL AND METHODS

Ethical approval was taken from the respective institutes. The study design was cross sectional with non probability consecutive sampling technique. A total of 212 full coverage restorations were measured. Single unit crowns and retainers of FDP of both cast metal and metal ceramic restorations were included. Base metal alloys (nickel chromium alloy) were used for fabricating cast component of metal ceramic crowns.

The crowns and FDPs fabricated at the dental laboratories of three institutes in twin cities of Islamabad/Rawalpindi were measured. The instrument used was Iwanson gauge (EPISURG, ISO 9001 certified, ISO 13485). All cross infection control protocols were followed. After checking the gauge for zero error, the thickness of the functional and non functional cusps was measured. As the molars have more than one functional and non functional cusp, a mean value was recorded. The data were recorded in a specially designed performa.

The data were analyzed using SPSS 20.0. Frequencies were calculated for material of crowns and the arch involved. Means and standard deviation were calculated for measured thickness of functional and non functional cusps of both materials. Paired sample t-test was used to compare the measured values with that of ideal values. Independent sample t-test was used to compare the thickness of cusps in maxillary and mandibular arches for both materials. *p*-value less than 0.05 was considered significant. Confidence interval was 95%.

RESULTS

A total of 212 crowns were analyzed out of which 47.2% (n=100) were cast metal crowns and 52.8% (n=112) were metal ceramic crowns. The total number of functional and non-functional cusps for 212 crown measured was 424. Out of these 47.2% (n=200) were cusps of cast metal crown and 52.8% (n=224) were of metal ceramic crowns. Among n=200 cusps of all metal crown 50% (n=100) were functional and 50% (n=100) were non-functional cusps. Among n=224 cusps of metal ceramic crowns 50% (n=112) were functional and 50% (n=112) were non-functional cusps. In the cast metal crowns 48% (n=48) were mandibular crowns and 52% (n=52) were maxillary crowns. Whereas in metal ceramic crowns 48.2% (n=54) were mandibular crowns and 51.8% (n=58) were maxillary crowns.

The thickness of functional and non-functional cusps of cast metal and metal ceramic crowns are given in table-I. Paired sample t-test was used to compare the means of the dimensions of the cusps of cast metal and metal ceramic crowns with that of ideal dimensions. There was significant difference in the dimensions functional and non-functional cusps

of cast metal crowns from their ideal dimensions with *p*-values of 0.005 and <0.001 respectively. Whereas for metal ceramic crowns the *p*-value for functional cusp was significant, that is <0.001 but there was no statistically significant difference in the dimension of non-functional cusps with a *p*-value of 0.112.

The mean ± SD of functional and non-functional cusps of mandibular and maxillary cast metal and metal ceramic crowns along with *p*-values of independent sample t-test are given in table-II.

DISCUSSION

In this study a significant discrepancy in the thickness of full coverage restorations was found that were being fabricated at the selected tertiary care institute laboratories. Dimension of the functional cusps of both cast metal and metal ceramic crowns showed reduced dimensions from the recommended dimensions. This can either be attributed to a lack of optimal tooth reduction by the clinicians or a failure on part of the dental laboratories to restore the normal cuspal morphology and rather make flattened occlusal configuration or fabricating the crowns and FDP retainers in infra-occlusion. The results further showed that thickness of non-functional cusps for cast metal crowns were more than the recommended dimensions, that is 1.0 mm. The clinical fault may be due to inexperience of operator regarding accurate crown preparation principle or alignment of the teeth being prepared. The mandibular molars are usually lingually tilted while the mandibular molars are buccally tilted which may be the cause of increased thickness of the resulting crown.The laboratory related fault may be due to the fact

Table-I: Mean thickness (mm) of cusps of cast crowns fabricated in laboratory.

Cast Metal			
Cusp		**Mean (millimeters)**	**Std. deviation**
Functional	Measured	1.360	0.493
	Ideal	1.500	0.000
Non-Functional	Measured	1.696	0.693
	Ideal	1.000	0.000
Metal Ceramic			
Cusp		**Mean (millimeters)**	**Std. deviation**
Functional	Measured	1.420	0.472
	Ideal	2.500	0.000
Non-Functional	Measured	1.911	0.589
	Ideal	2.000	0.000

Table-II: Independent sample t-test for mandibular and maxillary cast metal and metal ceramic crowns.

Cusp	**Arch**	**Mean (millimeters)**	**Std. deviation**	***p*-value**
Cast Metal				
Functional	Mandible	1.388	0.483	0.595
	Maxillary	1.335	0.506	
Non-Functional	Mandible	1.708	0.688	0.865
	Maxillary	1.685	0.704	
Metal Ceramic				
Functional	Mandible	1.370	0.517	0.289
	Maxillary	1.465	0.426	
Non-Functional	Mandible	1.807	0.553	0.073
	Maxillary	2.007	0.610	

that the non-functional cusps are unopposed or do not have any contact with the opposing cusps or fossae.

The only non significant (p=0.112) difference in the dimensions was that of non functional cusps of metal ceramic crowns which may be due to multiple factors one of which is over prepared flat occlusal surface. Flat occlusal surface causes adequate or over reduction of non function cusp whereas under reduction of functional cusp. Another reason is the straightening of buccally aligned maxillary molars and lingually tilted mandibular molars as already mentioned.

Poons et al evaluated preparations for gold and metal ceramic crowns and found that the teeth were generally under prepared, that is, there was reduced overall thickness for cusps and fossa. These findings are in agreement with current study regarding the reduced thickness of the cusps[10]. Al-Moaleem et al, El-Mubarak et al, Al-Omari studied the casts of prepared tooth and found the reductions to be adequate. In that study the prepared teeth had adequate planar reduction with bevel and round angles[11-13]. There is reported variability in literature in the tooth reduction for crown preparation and it also varies significantly depending on experience of the dentists[10-13]. The technician can prepare a crown even with minimal thickness but at the cost of mechanical and aesthetic principles[14,15].

The limitations of this study were that we did not take into consideration the original tooth dimensions before tooth preparation or the dimensions of the prepared tooth, operator experience, laboratory technique and armamentarium, and laboratory technician's skill. Further research is required to explore the causes of the difference in crown dimensions. So that the reasons are identified and measures can be taken to ensure accurate fabrication of the restorations.

CONCLUSION

There is a significant difference in the dimensions of crown between those fabricated in tertiary care institute laboratories and the dimensions mentioned in the literature.

This necessitates the use of proper armamentarium by the dentist and education of the laboratory technician. This will ensure ideal tooth preparations and accurate crown fabrication.

CONFLICT OF INTEREST

This study has no conflict of interest to declare by any author.

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