AN ASSESSMENT INTO EXISTING CERAMIC PROSTHESIS IN PATIENTS REPORTING TO DENTAL CLINICS- A RETROSPECTIVE STUDY

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ABSTRACT

The use of ceramic prosthesis for the replacement of missing teeth has become abundant in recent years due to its aesthetic appearance. Certain factors that contribute to failure of the ceramic prosthesis can be broadly divided into 3 - biological factors, mechanical factors and aesthetic factors. The dental professional and dental technician should pay a great deal of attention to all these aspects in order to preserve the longevity of the prosthesis. The aim of this study is to determine the failures associated with existing ceramic prosthesis. This was a comparative, descriptive study, where the data of the patients who reported to the dental clinics in saveetha dental college, Chennai, India, was obtained from the dental information archiving software (DIAS). Data was collected and tabulated. The collected data was further analyzed, recorded in microsoft excel software and was subjected to statistical analysis using IBM SPSS statistics analyzer. The total sample size of the current study was 26 cases. In this study, the ceramic prosthesis was analysed for defects and failure associated with the ceramic prosthesis. Satisfactory results demonstrating defects and failure of the prosthesis were obtained. Most commonly reported old prosthesis were of the metal ceramic type. Ceramic fracture was the major observation of the present study following which secondary caries, marginal integrity and discoloration were observed.

INTRODUCTION

A dental prosthesis is an intra oral device used to restore or replace the hard and soft tissues of the oral cavity. The dental prosthesis is used to restore and provide comfort, function and aesthetics for the patient [1, 2]. The use of ceramic prosthesis for the replacement of missing teeth has become abundant in recent years due to its aesthetic appearance [3]. Certain factors that contribute to failure of the ceramic prosthesis can be broadly divided into 3 - biological factors [4, 5], mechanical factors [6] and aesthetic factors [7]. The dental professional and dental technician should pay a great deal of attention to all these aspects in order to preserve the longevity of the prosthesis. A good knowledge about the complications can help in the fabrication of a long lasting prosthesis [8].

Previous literature in regard to the current topic suggests that fixed dental prosthesis (FPD) failures occurred not just as a result of biological, mechanical and aesthetic factors but also due to the complexity of the diagnosis process and treatment undertaken [9]. Mild failure that occurs in the prosthesis is generally correctable while severe failure which results in the loss of tooth structure is irreplaceable [10]. If structure loss occurs due to fpd failure, other means of replacement such as removable partial denture and placement of implant must be considered [11, 12]. Periodontal parameters must also be considered as it will determine the stability of the FPD [13, 14]. Presence of any congenital defects, destructive habits and maintenance of oral hygiene must also be noted before planning FPD restoration [15, 16]. Care must be taken durings steps such as cord packing and impression taking in order to ensure proper fit of the prosthesis without any marginal discrepancies [17]. Choice of a luting agent is also very essential in order to prevent cementation failure which may lead to the failure of the entire prosthesis [18]. Very limited amount of literature exists where the assessment of dental ceramics post treatment is performed.

The main aim of this study was to determine the type of failures associated with existing ceramic prosthesis. The other objectives that were targeted to be fulfilled were to determine at which quadrant, the failures are associated with and to determine any secondary finding developed during the failure of fixed ceramic dental prosthesis.

MATERIALS AND METHODS

The research study was designed as a comparative and a descriptive study where the data of all the patients reported to

Saveetha Dental College, SIMATS, Chennai, India with pre existing ceramic prosthesis in their oral cavity were obtained from the dental information archiving software (DIAS).

This was done in a university setting and the research study was conducted in the dental clinics of saveetha dental college. This setting came with a variety of pros and cons. The pros included the presence of a versatile population and an abundant availability of data. Some of the cons included the study taking place in an unicentred setting and possessing a very limited demographic. The dependent variables in this study included the old ceramic prosthesis. The independent variables included the aesthetic, biological and mechanical failures of the old ceramic prosthesis. This was a correlation and association type of analysis. The selection of the study population was performed at random. This population was selected from the patients who visited the undergraduate and postgraduate dental clinics in saveetha dental college. The approval to undertake this research study had been approved by the ethical board of saveetha university (applied). Sample collection period was set from june 2019 to april 2020. Totally 76 case sheets were reviewed and cross verification was performed by an additional reviewer.

The minimisation of sample bias was performed by an additional reviewer, acquiring all the data from within the university and as an additional measure, simple random sampling was performed. There was a presence of high internal and external validity.

The data was then arranged in a methodical manner using microsoft excel software and was tabulated on the basis of the USPHS criteria for ceramic prosthesis. The data was validated by an additional reviewer. Any incomplete or censored data that was present in the collected data was excluded from the study.

Statistical analysis of the compiled data was performed using IBM SPSS statistical analyzer. Chi square test was done for statistical analysis **[19]**. The inclusion criteria for this study was outpatients with pre existing ceramic prosthesis that have presence of defects or have undergone failure irrespective of their age or gender. The exclusion criteria included outpatients with prosthesis other than the ones made out of ceramic without any defects or failure.

RESULTS AND DISCUSSION

The total sample size was n = 26 for patients who had the presence of pre existing ceramic prosthesis in their oral cavity. Nearly 38.5% of the was found to be under Charlie which is

the most common followed by Alpha (34.6 %) and Bravo (26.9 %) for colour match **(Figure 1)**. Nearly 69 % of the prosthesis was found to be under Alpha which is the most common followed by Bravo (31 %) for presence of secondary caries **(Figure 2)**. Nearly 38.5% of the prosthesis was found to be under both Alpha and Charlie which is the most common followed by Bravo (23.1 %) for marginal integrity **(Figure 3)**. Nearly 42.3 % of the prosthesis was found to be under Charlie which is the most common followed by Bravo (34.6 %) and Alpha (23.1 %) for surface texture **(Figure 4)**. Nearly 38.5 % of the prosthesis was found to be under Alpha which is the most common followed by Bravo (34.6 %) and Charlie (26.1 %) for marginal discoloration **(Figure 5)**. Almost 96 % of the prosthesis was found to be under Bravo which is the most common followed by Alpha (4 %) for presence or absence of any fracture in the ceramic prosthesis **(Figure 6)**. Almost 69 % of the prosthesis was found to be a metal ceramic prosthesis which is the most common followed by all ceramic (19.2 %) and ceramic facing (11.5 %) prosthesis for the type of ceramic prosthesis **(Figure 7)**. Nearly 50 % of the prosthesis defect or failure was found to be in the anterior maxillary which is the most common site followed by the

posterior mandible (26.9 %), posterior maxilla (15.4 %), and anterior mandible (7.7 %) **(Figure 8)**.

The data was collected and sorted based on the USPHS criteria for ceramic prosthesis which is mentioned in **Table 1**. The criteria is constituted by six parameters namely, color match, secondary caries, marginal integrity **[20]**, surface texture, marginal discoloration **[21]** and fracture **[22]**. Additionally in the current study, we have also analyzed the site of prosthesis defect or failure inside the oral cavity and also the type of prosthesis involved.

The distribution of color matches that was observed in pre existing ceramic prosthesis. Out of 26 cases that were analyzed, the most common finding was charlie which made up about 38.5 % of the population followed by alpha with 34.6 % and finally bravo with 26.9 %. **Figure 1** clearly describes the frequency and distribution of color match that was observed. In an earlier study it was revealed that, alpha was the most common finding with 81.8 % and also in another study, alpha was the most common finding obtained with 78 % of the study population. Overall consensus showed that the findings of the current study were not in concordance with those of literature **[23]**, **[24] (Figure 1 and Figure 9)**.

The presence of secondary caries in teeth supporting the ceramic prosthesis. The most commonly observed finding was alpha with 69.2 % followed by bravo with 30.8 %as shown in **Figure 2** clearly. A recent study conducted by Samer M *et al,* 2017, obtained alpha as their most common finding with 100 % of the study population. In another study conducted by Roggendorf *et al,* 2012, it was found that similarly alpha was the most common finding for secondary caries with 81.3 %. Overall consensus showed that the findings of the current study were in concordance with that of literature. Chi square test showed that p value < 0.05 which suggested significant results **(Figure 12)**.

The marginal integrity of the prosthesis. In these 26 cases, 38.5 % of the study population was alpha and charlie each which were the most common findings followed by bravo with 23.1 % **(Figure 3)**. Chi square test showed p value > 0.05 suggesting that the difference in distribution was not significant. Other research studies such as the ones done by Samer M *et al,* 2017 and Roggendorf *et al,* 2011 **[23, 24]** showed that the most commonly obtained value was alpha with 77.3 % and 66.1 % respectively. I The findings of the current study is in concordance with literature findings and as shown in **Figure 11**.

Surface texture of the ceramic prosthesis. Out of the study population, 42.3 % was found to be charlie which is the most common finding followed by bravo with 34.6 % and alpha with 23.1 % **(Figure 4)**. The chi square test with a p value > 0.05 suggested that there wasn't a significant difference in the distribution. Similar studies such as the one performed by Samer *et al*, 2017 **[23]** showed that alpha was the most common finding with 96.6 % and the one performed by Van Dijken *et al*, 1999 **[25]** where the most common finding was bravo with 74.4 %. The results of the current study were not in concordance with literature findings.

Marginal discoloration which occurs at the margins of the ceramic prosthesis, Alpha was the most commonly observed with 38. 5 % followed Bravo with 34.6 % and Charlie being the least common with 26.9 % as shown in **Figure 5**. Other literature studies such as the ones conducted by Van Dijken *et al,* 1999 **[25]** and by Fasbinder *et al*, 2010 **[26]** showed that the most common findings in their study was also found to be alpha with 97.4 % and 95.6 % respectively. Chi square test showed p value >0.05 suggesting difference in distribution was insignificant. The results obtained in the current study were not in concordance with literature.

Most common finding was bravo indicating ceramic chipping or fracture with almost 96.2 % of the population followed by alpha with just 3.8 % as shown in figure 6 and 10. The chi square test showed p value < 0.05 which suggests a significant difference in the distribution of fracture in ceramic prosthesis. Other studies such as the ones done by Roggendorf *et al,* 2011, **[24]** where the most common value was alpha 69.5 % and by Fasbinder *et al,* 2010 **[26]** where the most commonly assessed variable was also alpha with 97.4 %. Therefore the literature findings were not in concordance with that of our current study.

Apart from the USPHS criteria for ceramic prosthesis **(Table 1)**, we also analyzed two additional parameters in this study which were the type of ceramic prosthesis and site involved. **Figure 7** demonstrates the frequency of the type of ceramic prosthesis in which defects or failures were observed. Most common type of prosthesis that was seen in patients that was seen in patients were metal - ceramic prosthesis comprising of 69.2 % of the entire study population followed by all ceramic with 19.2 % which has been in increased demand in recent times due to its improved aesthetics **[27]** and ceramic facing prosthesis with 19.2 %. The chi square test showed p value < 0.05

suggesting significant difference in the frequency of type of ceramic prosthesis. Other studies such as the ones performed by Elagra ME *et al*, 2019, **[28]** also found that the most common type of ceramic prosthesis was metal ceramic with 74 %. The reasons of metal ceramic failure are multiple, most commonly it occurs due to the improper fusion between the metal and ceramic components with other reasons being trauma, iatrogenic causes, occlusal forces **[29, 30]**. The overall consensus showed that the study findings are in concordance with that of literature.

The most common site was found to be the anterior maxilla comprising almost 50 % of the entire study population which was followed by posterior mandible with 26.9 %. The reason for this could be due to the increased occlusal load in that region **[31]**. This was followed by posterior maxilla with 15.4 % and anterior mandible being the least with 7.7 % as shown in figure 8. The chi square test showed p value < 0.05 suggesting significant difference in distribution of site. A similar study conducted by Nayar S *et al* 2015, **[32]** also found that the most common site to be the anterior maxilla with a complete 100 % of the study population. Overall consensus of our study findings were in concordance with that of literature.

The present study's search words used in many combinations to identify the old pre-existing ceramic prosthesis. Still some data could have been missed if the key words were not matching. Multi Centered study can be planned with a yearly follow up on prosthesis to know the prosthesis survival and its impact on oral health.
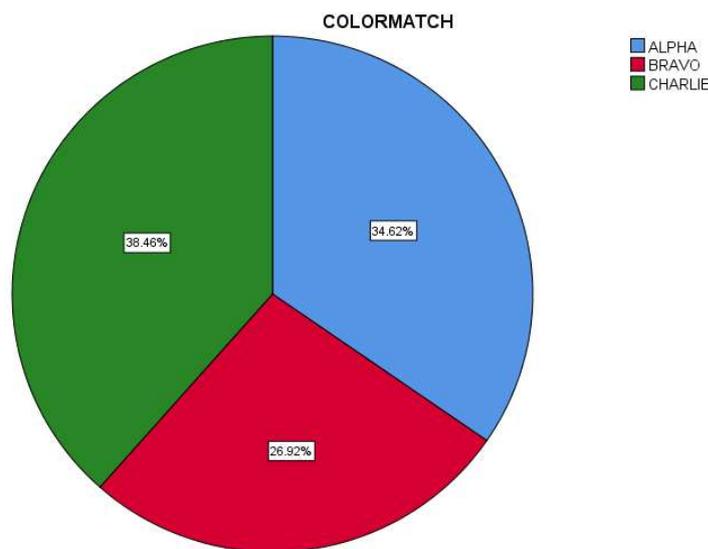
COLORMATCH

ALPHA
BRAVO
CHARLIE

34.62%
26.92%
38.46%

Figure 1: Pie chart represents the distribution of colour match among ceramic prosthesis on a scale of 1 – 100 % where blue colour denotes alpha, red colour denotes bravo and green colour denotes charlie. Nearly 38.5% of the was found to be under Charlie which is the most common followed by Alpha (34.6 %) and Bravo (26.9 %) for colour match.

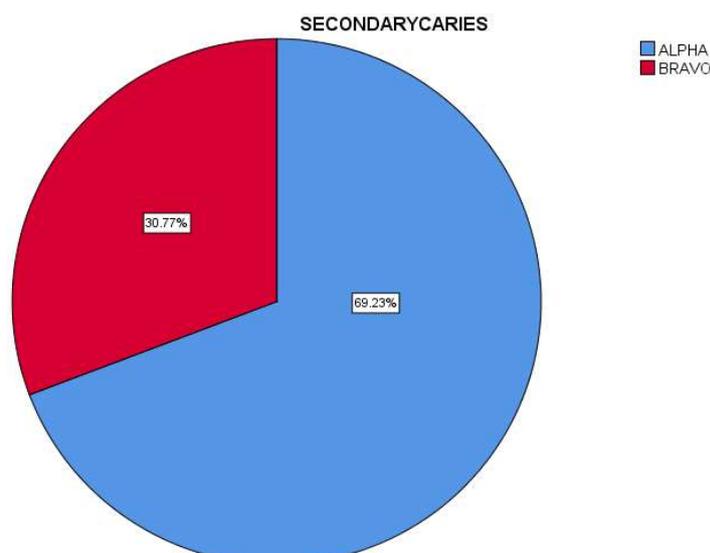**SECONDARYCARIES**

ALPHA
BRAVO

30.77%
69.23%

Figure 2: Pie chart represents the distribution of secondary caries among ceramic prosthesis on a scale of 1 – 100 % where blue colour denotes alpha and red colour denotes bravo. Nearly 69 % of the prosthesis was found to be under Alpha which is the most common followed by Bravo (31 %) for presence of secondary caries.
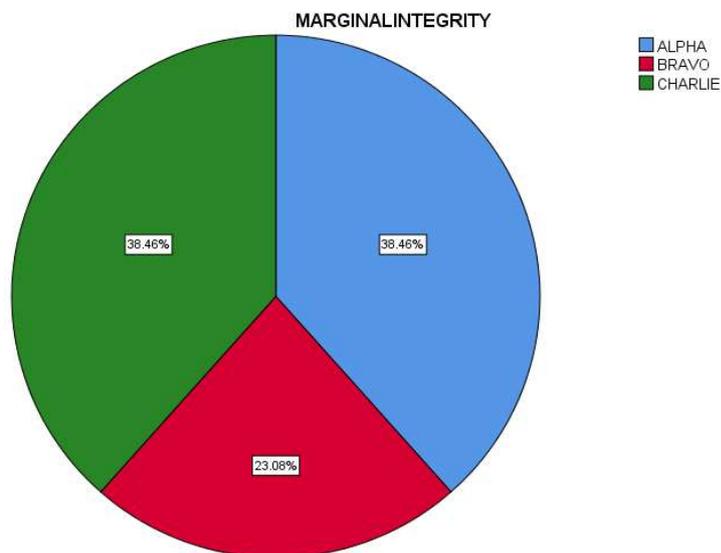
Figure 3: This pie chart represents the distribution of marginal integrity among ceramic prosthesis on a scale of 1 – 100 % where blue colour denotes alpha, red colour denotes bravo and green colour denotes charlie.Nearly 38.5% of the prosthesis was found to be under both Alpha and Charlie which is the most common followed by Bravo (23.1 %) for marginal integrity.
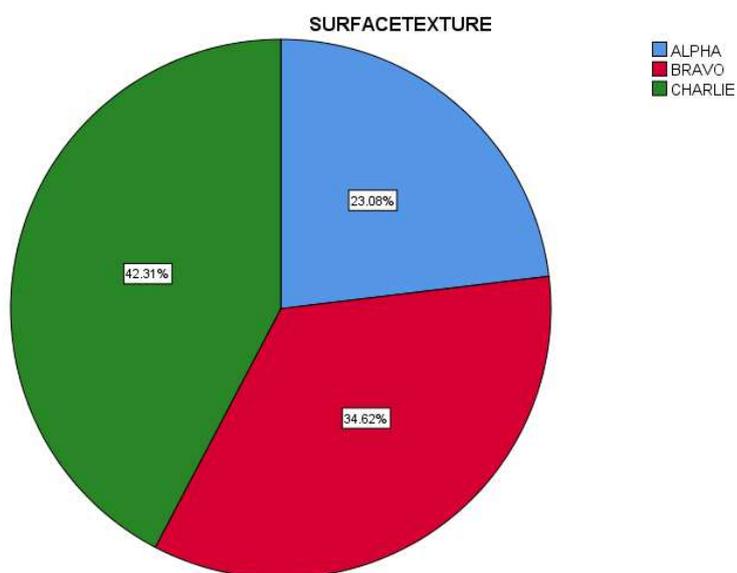

Figure 4: This pie chart represents the distribution of surface texture among ceramic prosthesis on a scale of 1 – 100 % where blue colour denotes alpha, red colour denotes bravo and green colour denotes charlie. Nearly 42.3 % of the prosthesis was found to be under Charlie which is the most common followed by Bravo (34.6 %) and Alpha (23.1 %) for surface texture.
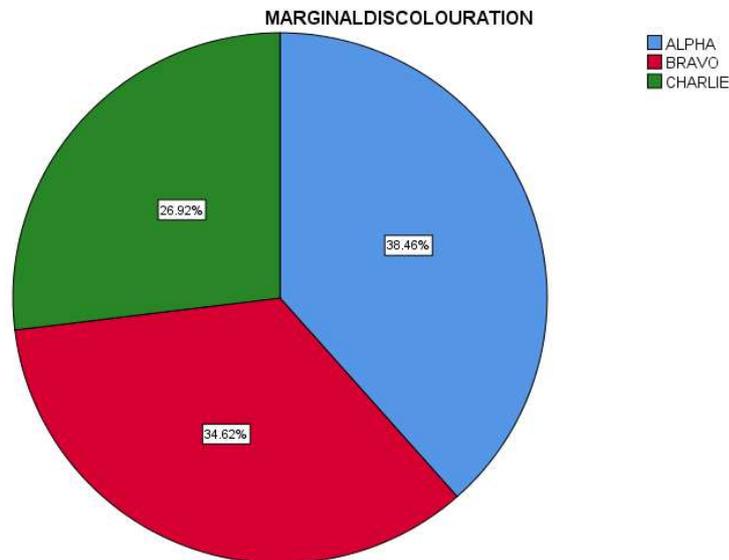
Figure 5: Pie chart represents the distribution of marginal discolouration among ceramic prosthesis on a scale of 1 – 100 % where blue colour denotes alpha, red colour denotes bravo and green colour denotes charlie. Nearly 38.5 % of the prosthesis was found to be under Alpha which is the most common followed by Bravo (34.6 %) and Charlie (26.9 %) for marginal discoloration.
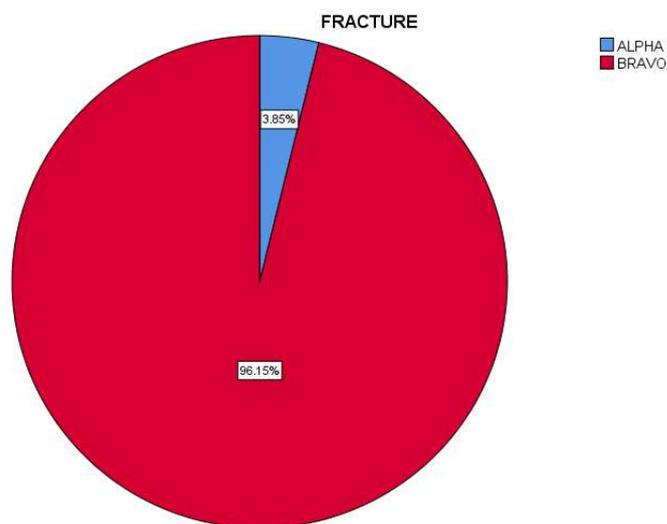

Figure 6: This pie chart represents the distribution of fracture among ceramic prosthesis on a scale of 1 – 100 % where blue colour denotes alpha and red colour denotes bravo . Almost 96 % of the prosthesis was found to be under Bravo which is the most common followed by Alpha (4%) for presence or absence of any fracture in the ceramic prosthesis.

TYPEOFCERAMICPROSTHESIS

ALL CERAMIC
CERAMIC FACING
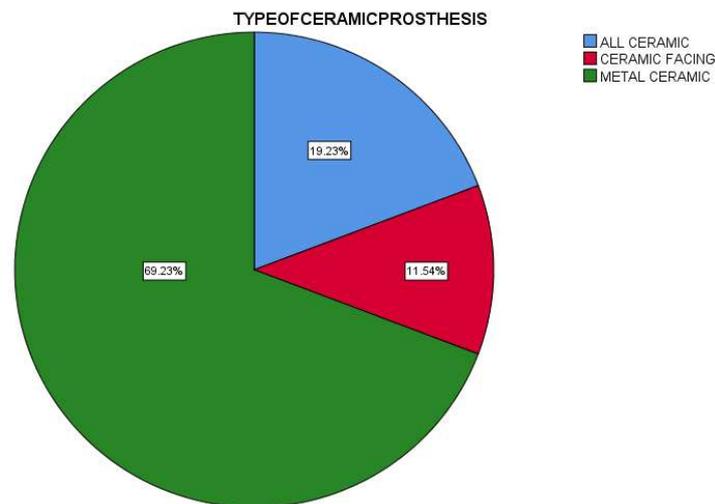METAL CERAMIC

19.23%

11.54%

69.23%

Figure 7: This pie chart represents the distribution of type of ceramic prosthesis among old ceramic prosthesis on a scale of 1 – 100 % where blue colour denotes all ceramic, red colour denotes ceramic facing and green colour denotes metal ceramic. Almost 69 % of the prosthesis was found to be a metal ceramic prosthesis which is the most common followed by all ceramic (19.2%) and ceramic facing (11.5%) prosthesis for the type of ceramic prosthesis.

SITE

ANTERIOR MAXILLA
ANTERIOR MANDIBLE
POSTERIOR MAXILLA
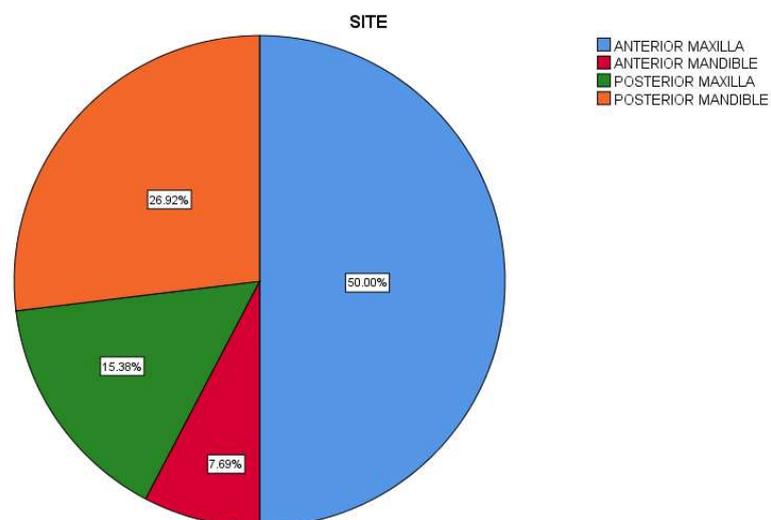POSTERIOR MANDIBLE

26.92%

50.00%

15.38%

7.69%

Figure 8: This pie chart represents the distribution of sites of ceramic prosthesis on a scale of 1 – 100 % where blue colour denotes anterior maxilla, red colour denotes anterior mandible, green colour denotes posterior maxilla and orange colour denotes posterior mandible. Nearly 50 % of the prosthesis defect or failure was found to be in the anterior maxillary which is the most common site followed by the posterior mandible (26.9 %), posterior maxilla (15.4 %), and anterior mandible (7.7 %).
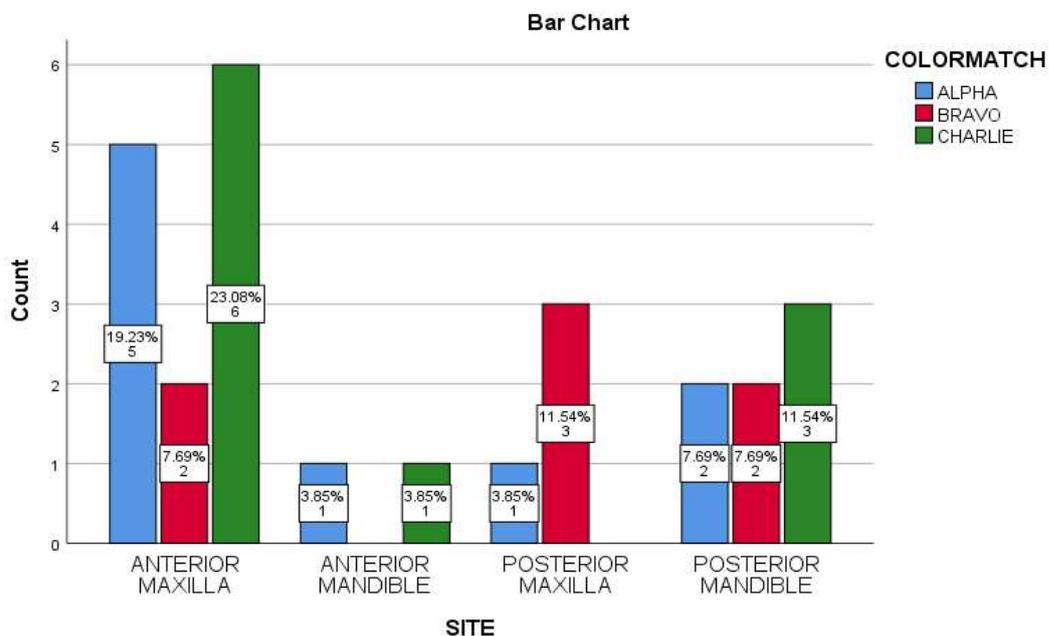
Figure 9: This bar graph represents the correlation between colour match and site of the prosthesis with site in x - axis and count of colour match in y - axis where blue colour denotes alpha, red colour denotes bravo and green colour denotes charlie. Charlie (23.08%) form of color match was more prevalent in the anterior maxillary region. Chi square test was used to analyse the association between the variables, p value was found to be 0.974, (p > 0.05). Hence it is not statistically significant.
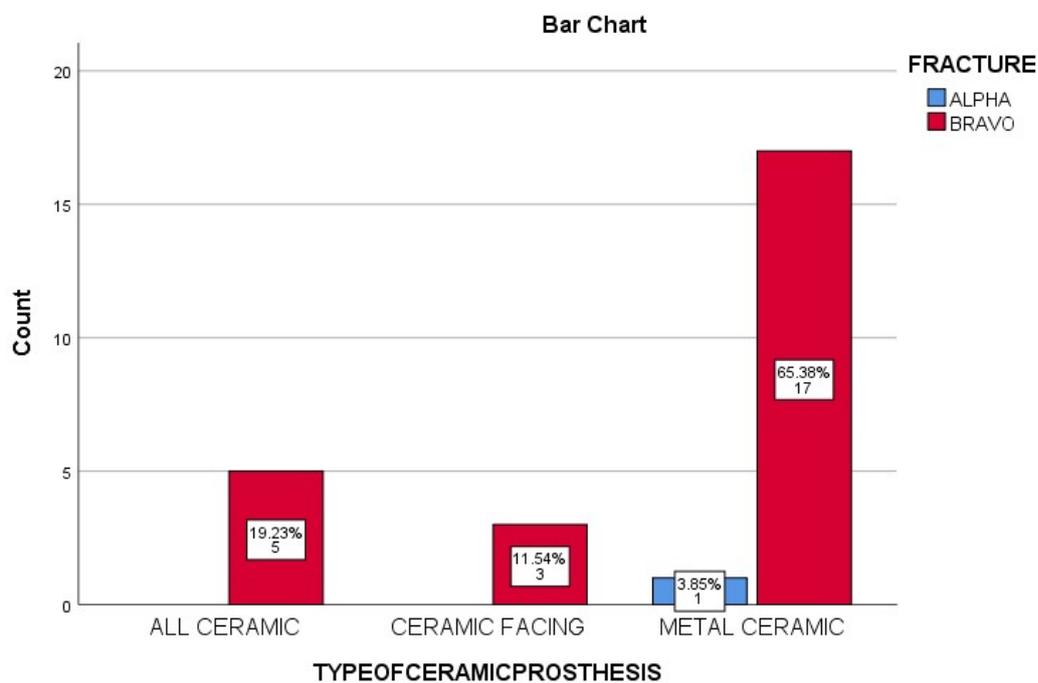

Figure 10: This bar graph represents the correlation between fracture and type of prosthesis, x - axis represents type of prosthesis and y - axis represents number of prosthesis with fracture in where blue colour denotes alpha and red colour represents bravo. Bravo (65.38%) form of fracture was more prevalent among all types of ceramic prosthesis. Chi square test was used to analyse the association between the variables and the p value was found to be 0.541 (p > 0.05). Hence, there is no significant association.
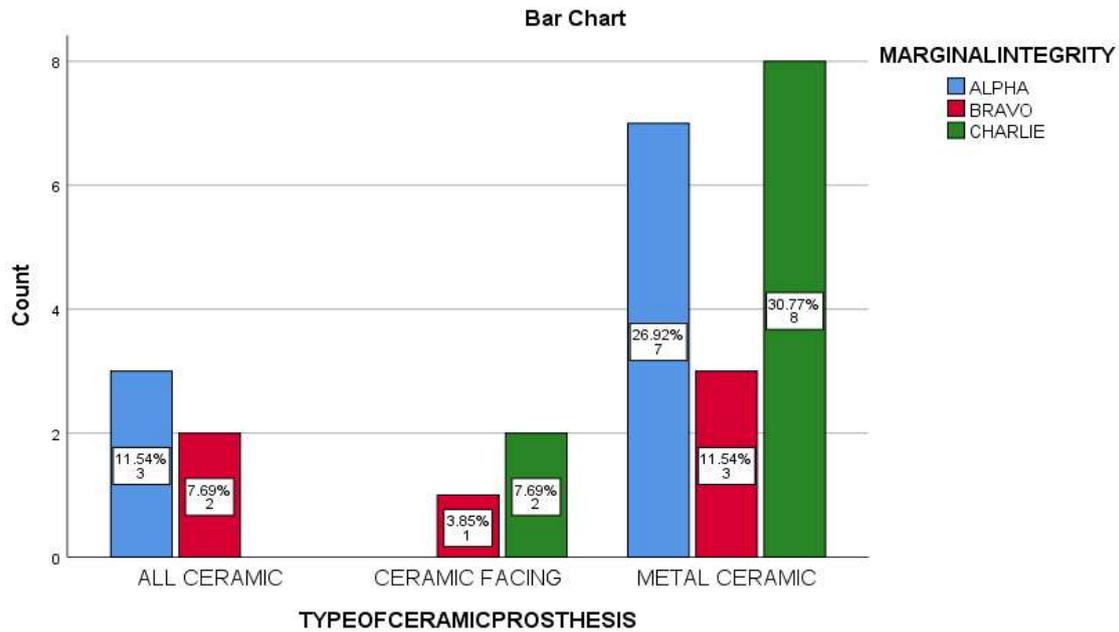
Figure 11: This bar graph represents the correlation between marginal integrity and type of prosthesis with type of prosthesis in x - axis and count of marginal integrity in y - axis where blue colour denotes alpha, red colour represents bravo and green colour denotes charlie. Charlie form of marginal integrity defect (30.77%) was more prevalent in metal ceramic prosthesis. Chi square test was used to analyse the association between the variables and the P value was found to be 0.280 (p > 0.05). Hence there is no statistical significance.
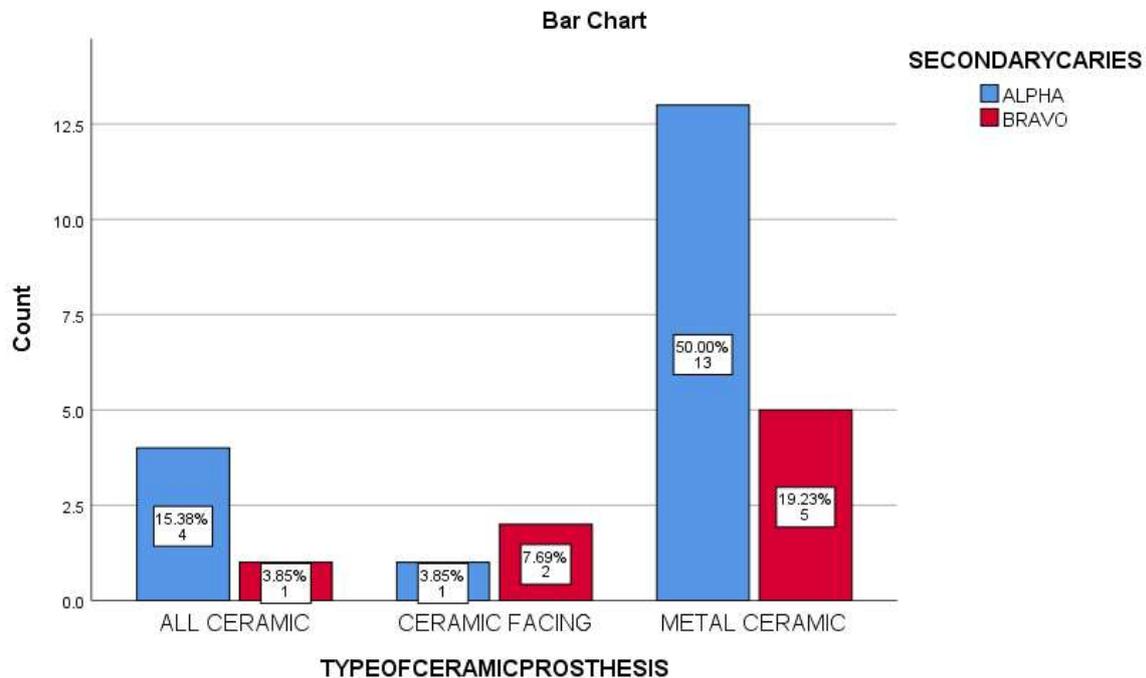
Figure 12: This bar graph represents the correlation between secondary caries and type of prosthesis with type of prosthesis in x - axis and count of secondary caries in y - axis where blue colour denotes alpha and red colour represents bravo. Alpha defect (50.)% was more prevalent among all ceramic and metal ceramic prosthesis. Chi square test was used to analyse the association between the variables, where the p value was found to be 0.000 (p < 0.05). Hence there is statistical significance.

Table 1: USPHS criteria for ceramic prosthesis

Characteristic	Rating	Criteria
Secondary caries	Alpha	No evidence of caries contiguous with the margin of the restoration.
	Bravo	Caries evident contiguous with the margin of the restoration
Marginal discolouration	Alpha	No discolouration on the margin between the restoration And the tooth surface.
	Bravo	Discoloration on the margin between the Restoration and the structure.
	Charlie	Discoloration as penetrated along the margin of the restrictive material in a pulpal direction
Surface texture	Alpha	Smooth surface.
	Bravo	Slightly rough or pitted, can be refinished.
	Charlie	Rough cannot be refinished
Marginal integrity	Alpha	No visible evidence of ditching along the margin.
	Bravo	Visible evidence of ditching along the margin not extending to the DEJ.
	Charlie	Dentin or base is exposed along the margin.
	Delta	Restoration is mobile, fractured or missing.
Color match	Alpha	No mismatch in colour, shade and translucency between restoration and adjacent tooth structure.
	Bravo	Mismatch between restoration and tooth structure within the normal range of colour, shade and translucency.
	Charlie	Mismatch between restoration and tooth structure outside the normal range of colour, shade and translucency.
Fracture	Alpha	No evidence of fracture.
	Bravo	Evidence of fracture.

CONCLUSION

Most commonly reported old prosthesis were of metal ceramic type. Ceramic fracture was the major observation of the present study following which secondary caries, marginal integrity and discoloration were observed. Such prosthesis tends to lead to abutment destruction and long term failure of abutment itself, hence any ceramic fractured or marginal discrepancy observed in old prosthesis required a prompt replacement

rather than waiting for it to become symptomatic abutment.

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