PREVALENCE OF ERRORS IN TOOTH PREPARATION IN PATIENTS VISITING A UNIVERSITY DENTAL HOSPITAL- A RETROSPECTIVE STUDY

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ABSTRACT

Tooth preparation is a procedure done for replacements of missing teeth, where it not only reduces the tooth structure but also preserves the biological value of the tooth. These are carried out for Fixed Partial Dentures and Full Mouth Rehabilitation. Fixed partial dentures are commonly done in cases of single missing tooth as it mainly depends upon the span length and the abutment health. The abutment teeth play a main role in partial dentures where replacements depend upon the abutment health. The aim of this cross sectional study was to determine the prevalence of errors in tooth preparation. The sample size of this study was 200 subjects. This study is conducted in a university setting, Chennai. Data was collected from a digital case sheet record of 200 subjects and coding was done in MS Excel sheets and statistically analysed using IBM SPSS Version 20.0. Chi square tests were used to analyse the data statistically. These data were then graphically represented. In this study, prevalence of various errors in tooth preparation were noticed, among which over reduction (67.5%), under reduction (93%) and gingival damage (75%) were more prevalent among other errors in tooth preparation. Damage is mostly seen on the posterior regions especially in the mandibular distal aspects. To prevent these errors, low speed handpieces and proper equipment with utmost care should be provided. Therefore in conclusion, tooth preparation can lead to various errors and care has to be taken while doing tooth preparation.

Keywords: Damage, Errors, FPD, Tooth preparation

INTRODUCTION

Fixed partial dentures are one of the most preferred definitive treatment options in prosthodontics. Replacement of missing teeth represents the patients preference for better esthetics and functional teeth (Talabani, 2016). This can be restoring a single tooth to full mouth rehabilitations (Sumeet *et al.*, 2014). Prosthetic rehabilitation is a procedure that is mainly done to regain the speech, function and esthetics in an individual (Ashok *et al.*, 2014). Replacement of missing teeth promotes the masticatory functions, esthetics and patient comfort. After tooth preparation, impression plays a major role in restoring the missing tooth and disinfecting the impression is important in order to prevent the contamination of the impression (Rbds and Ganapathy, 2016). Proper tooth preparation is the basic foundation for a successful

fixed partial denture prosthesis. The Tooth preparation designs are governed by biological, mechanical and aesthetic principles

Tooth preparation in FPD is the foremost procedure in replacement of missing teeth.This not only reduces the size of tooth structure but also enhances and preserves the biologic width and its value (Dykema, 1962). Before tooth preparation on the abutment teeth, the abutment has to be evaluated for its strength and properties (Reynolds and Marvin Reynolds, 1968). Width of maxillary anterior teeth and various anthropometric related studies can be conducted in order to assess the health of abutment teeth (Ariga *et al.*, 2018). Removable partial dentures are least common in tooth replacements as they are known to affect the periodontal health of the individual (Jyothi *et al.*, 2017). During pregnancy, hormonal changes in the body can occur that can increase the risk of developing gum diseases,therefore care should be taken while tooth preparation (Basha, Ganapathy and Venugopalan, 2018). There are various factors that determine the abutment selection. Some of them are the crown root ratio, arch form, radiographic evaluation, root configuration, biologic width, crown length, crown form, root length, root form, span length, pulpal health. Span length is an important aspect of FPD in restoring the teeth in the posterior region as only a minimum of 2 or 3 missing teeth are normally replaced. Ideal crown root ratio is 2:3 and a ratio of 1:1 is considered as minimum (Shillingburg and Sather, 2012)

Over Reduction/ Under Reduction
Over reduction or under reduction of tooth structure is one of the common errors in tooth preparation performed by dentists. Only the required amount of tooth structure has to be prepared , if not can lead to lack of retention and inherent strength of the prosthesis (Christensen, 2007).

Inadequate Occlusal Reduction
Occlusal reduction is necessary for the placement of prosthesis. Inadequate clearance can interfere with the opposing teeth. This also provides insufficient space for the provisional restoration (Adams, 2004).

Excessive Taper Of The Prepared Tooth
The degree of taper has an impact on the good retentive feature of the restoration. It is recommended to have a taper of about 8 degree to 10 degree from the long axis of the tooth.

Gingival Damage

During tooth preparation, careless use of the bur can result in damage to the gingiva, Subgingival preparations can often lead to gingival damage. This can also happen during the gingival retraction procedure , when more force is exerted on the gingival margin for retraction.
Gingival margins exposure during tooth preparation before impression making is one of the most technique-sensitive procedures for the dentist to perform (Jain and Nallaswamy, 2018; Kannan and Venugopalan, 2018).

Margin Preparation
A well rounded preparation without any undercuts results in good resistance and retention of the prosthesis. Several factors influence the marginal fit such as type of the finish lines, thickness of the die spacer used, restorative materials, luting agents and the fabrication techniques (Ganapathy, 2016). Marginal discrepancy is most common seen in the incisal regions than in the cervical region (Jain, Ranganathan and Ganapathy, 2017). Various marginal preparations are done depending on the tooth structure, its strength and the type of prosthesis to be given. Shoulder margins are the most preferred margins for tooth preparation (Donovan, 2008; Jain, Ranganathan and Ganapathy, 2017).

There can be various side effects of gingival damage like irritation on the gingiva and mucosa, leading to various forms of bacterial infection (Selvan and Ganapathy, 2016; Vijayalakshmi and Ganapathy, 2016). The periodontal health of the abutment can be affected by various factors, mostly being the iron deficiency

anemia resulting in poor oral health and strength of the individual (Malay, Duraisamy and Brundha, 2018). Implants are one of the upcoming trends in replacement of the tooth , and commonly used for single and multiple tooth replacements with good bone and ridge support (Ajay *et al.*, 2017). Therefore the aim of this cross sectional study was to determine the prevalence of errors in tooth preparation in patients.

MATERIALS AND METHODS

Study Design
This was a cross sectional study containing a sample size of 200 subjects. This study was conducted in a university setting. The pros of this study was the similar ethnicity and cons of the study were the geographic limitations, locations and trends cannot be accessed. The time period of this study was from June 1,2019 to April 1, 2020 and ethical approval was given by the ethics committee. There was no sorting process and all the data was included. Internal validity was the errors in tooth preparation and external validity was the homogenisation and cross comparison.

Data collection and tabulation
Data was collected from a case sheet record of 200 subjects. These data were then verified by one reviewer and coding was done in MS Excel Sheet. This data was then imported to SPSS for statistical analysis.

Analytics
The statistical tests used were the inferential tests (chi square test) and the descriptive statistics. Software used was the SPSS by IBM. The independent variables were age and gender. The dependent variables were the various errors in tooth preparation. Graphical illustration was done using SPSS Version 20.0.

RESULTS AND DISCUSSION

Majority of the subjects belonged to the 25-35 years age group (69.0%) whereas 31.0% of subjects belonged to the 36-45 years age group.(Figure 1). Majority of the subjects were males (60.0%) followed by females (40.0%)(Figure 2). 47.5% of subjects had errors in the anteriors and 52.5% of subjects had errors in the posteriors. (Figure 3). 67.5% of subjects had over reduction of tooth whereas 32.5% of subjects had no over reduction. (Figure 4). 93.0% of subjects had under reduction of tooth whereas 7.0% of subjects had no under reduction. (Figure 5). 93.0% of subjects had adequate occlusal reduction of tooth whereas 7.0% of subjects had inadequate occlusal reduction. (Figure 6).75.0% of subjects had gingival damage during tooth preparation whereas 25.0% of subjects had no gingival damage.(Figure 7).Shoulder finish line was more predominant (68%), followed by chamfer finish line (28.5%), radial shoulder (2.5%) and knife edge preparation (1%). (Figure 8). The distribution for the subjects between 25-35 years were high in the anteriors 71.6% , whereas for the subjects between 36-45 years were predominantly higher in the posterior regions 33.3% . Posterior regions had a higher percentage of errors in tooth preparation than the anteriors,however,this was not statistically significant. (Pearson chi-square test;P-=0.747 ,P >0.05). (Figure 9)..Males patients had 69.5 % errors in anterior tooth preparation and females had 30.5% errors . The male patients had more errors in tooth preparation than the females with a statistically significant difference. (Pearson chi-square test;P=0.01 ,P<0.05) (Figure 10).

Treatment planning for a fixed partial denture is most important. The main objectives being the retention of function, prevention of future diseases etc. In replacement of single teeth, using a single cantilever for support as abutment can be poor (Cheung *et al.*, 1990). In areas where invasive procedures are not feasible , it's better for a defined fixed prosthesis over implants. Common errors done by dentists are the over reduction of the crown structure. Regardless of the crowns being metal or ceramic , a minimum of 1.5-2 cm of the occlusal reduction is necessary. Burs are the main armamentarium. Self limiting burs are more useful at the marginal area preserving the gingiva (Green, 1965). To prevent the over reduction of crown structure, low speed handpieces are preferred or maximum care should be given on the distal aspect of the molars due to lack of accessibility and vision. Air-water coolant is necessary to prevent damage to the

instrument as well as the tooth structure (Johnston *et al.*, 1986; Charbeneau, 1988) Commonly , the mandibular molar teeth are mostly tilted or angulated lingually, therefore angulating the bur prevents errors in tooth preparation (Shillingburg, Richard Jacobi ,D D and Brackett, 1987). All ceramic restorations are mostly preferred for anterior replacements as they provide better esthetics (Ashok and Suvitha, 2016)

On occlusal preparation, the inclination of functional cusp bevel is given according to the opposing tooth and and should be parallel. Proximal preparation is first done followed by occlusal preparation (Rosenstiel, Land and Fujimoto, 2001). The gingival damage being the most prevalent error in this study could be due to improper angulation and encroachment on the gingiva. Sharp edges and angles on the finished preparation creates undercuts and this leads to improper seating of the provisional restoration resulting in poor retention of the restoration. This will in turn lead to insufficient gingival embrasure space to accommodate the papilla and results in poor self cleansing and poor oral hygiene, leading to poor periodontal health (Malone, Tylman and Koth, 1989). Tooth preparation and fixed partial dentures are also given as post endodontic restoration and this can be due to high caries prone commonly seen in the posterior region, this can be prevented by incorporating adequate amount of fluoridated water, use of fluoridated toothpaste which will prevent the formation of caries (Kabilan *et al.*, 2018). Studies have shown that the use of aloe vera, a natural herbal product is useful in treating bleeding gums and periodontitis and other ayurvedic products with various herbal preparations are the new line of treatments used (Subasree and Murthykumar, 2016; Bokadia, Priya and Ariga, 2018). During impression making of complete dentures , spacer designs may be used in order to relieve the stress bearing areas , whereas they are not used in fixed partial dentures (Jain and Dhanraj, 2016). Replacements for multiple teeth with good bone support is mostly done by implants and implant stability is the most important parameter that assesses the loading time and implant success (Duraisamy *et al.*, 2019; Prakash, Ganapathy and Mallikarjuna, 2019). The main problems encountered in implant failure after years are the screw loosening and poor osseointegration (Ganapathy, Kannan and Venugopalan, 2017). Other recent advances are the Silicone elastomers facial prosthesis, which is aesthetically better as it contains magnets for better retention (Venugopalan *et al.*, 2014).

Errors in tooth preparation can lead to harmful periodontal effects, non anesthetic results and improper occlusal relationship. The limitation of this study was the geographic limitation.The future scope of this study is to prevent the errors in tooth preparation and reduce the tendency to under prepare the tooth on labial and buccal surface and prevent the gingival damage using accurate depth gauge burs.

CONCLUSION

Therefore, from this study, it can be concluded that the more prevalence for errors done is the gingival damage during tooth preparation mosty in cases of subgingival margin preparations, and improper positioning or angulation of burs and the over preparation of tooth for obtaining adequate finish line. The errors were more prevalent in the posterior regions due to lack of accessibility and visibility.

AUTHOR CONTRIBUTIONS

Author 1 (Anupama Deepak) carried out the retrospective study by collecting data and drafted the manuscript after performing the necessary statistical analysis. Author 2 and 3 (Dhanraj and M. Jeevitha) aided in the conception of the topic, participated in the study design, statistical analysis and supervised in

preparation of the manuscript and helped in study design and coordinated in developing the manuscript. All the authors have equally contributed in developing the manuscript.

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CONFLICTS OF INTEREST
There are no conflicts of interest.

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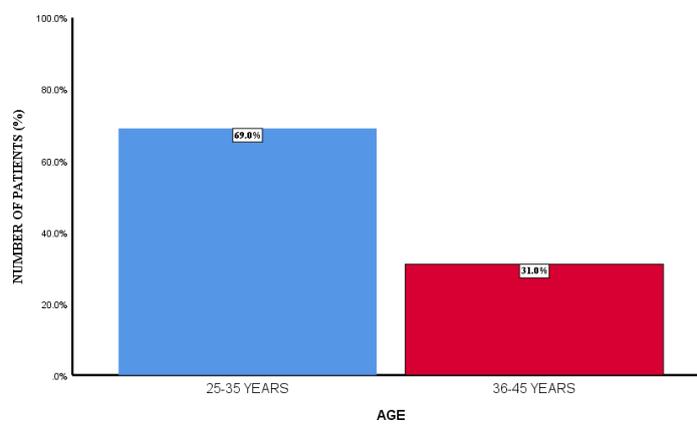
Figure 1: Bar graph represents the study subjects based on Age, where X-axis represents age of the subjects and Y-axis represents the number of patients in percentage. Majority of the subjects belonged to the 25-35 years age group (69.0%) whereas 31.0% of subjects belonged to the 36-45 years age group.
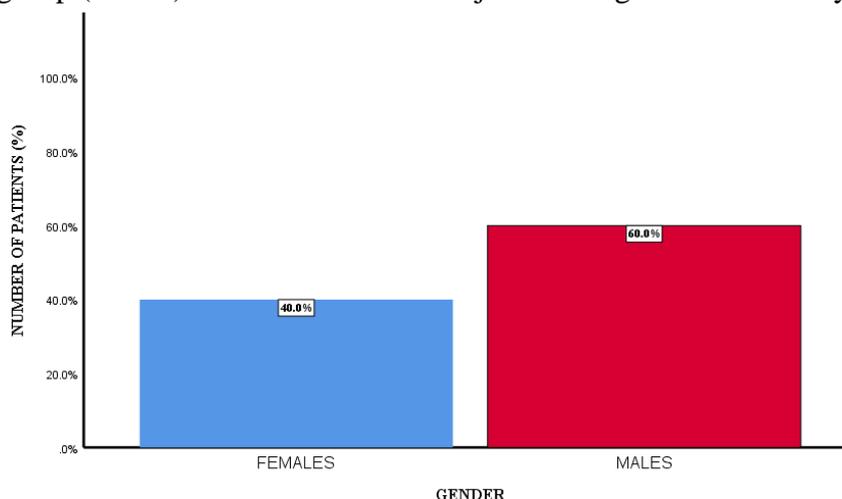
Figure 2: Bar chart represents the study subjects based on Gender, with X-axis representing the gender of the subjects and Y-axis representing the number of patients in percentage. Majority of the subjects were males (60.0%) followed by females (40.0%).
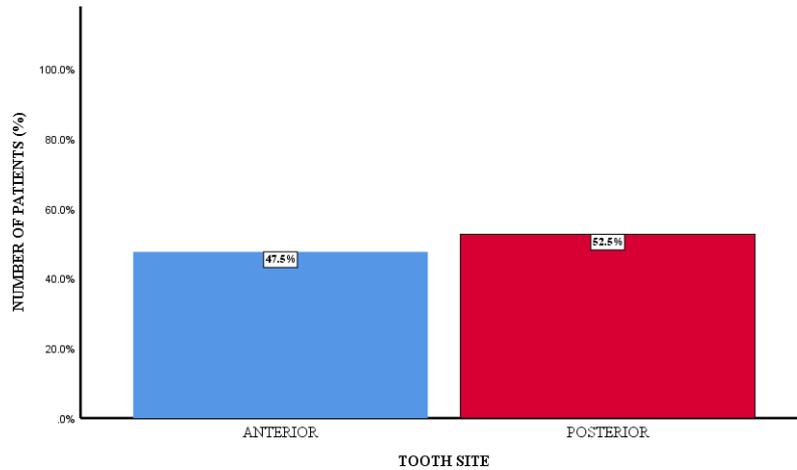
Figure 3: Bar chart represents the study subjects based on Tooth site, with X-axis representing tooth site and Y-axis representing the percentage distribution. 47.5% of subjects had errors in the anteriors (blue) and 52.5% of subjects had errors in the posteriors (red).
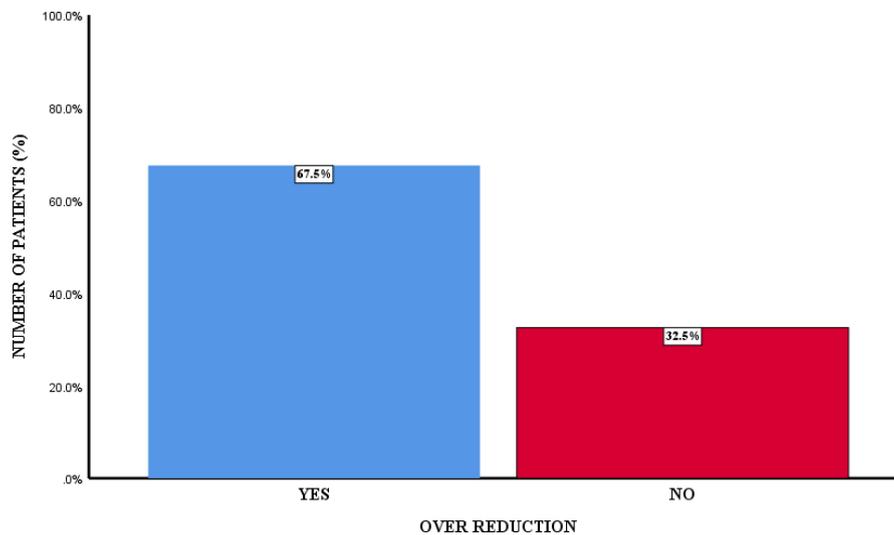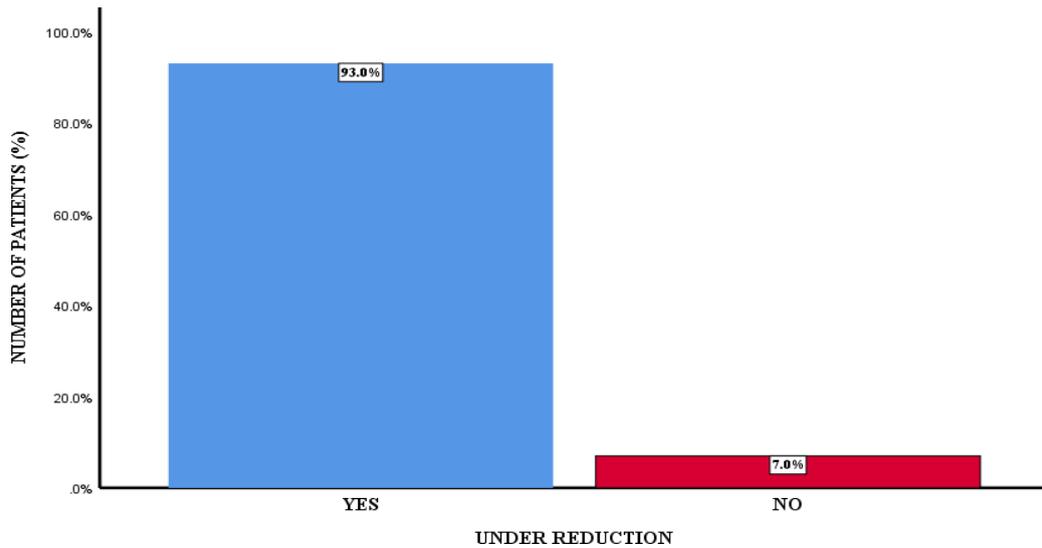

Figure 4: Bar chart represents study subjects based on Over reduction of the tooth, with X axis representing over reduction in the tooth and Y axis representing the number of patients in percentage. 67.5% of subjects had over reduction of tooth (blue) whereas 32.5% of subjects had no over reduction (red).

Figure 5: Bar chart representing study subjects based on Under reduction of the tooth, with X-axis representing under reduction in the tooth and Y axis representing the number of patients in percentage. 93.0% of subjects had under reduction of tooth (blue) whereas 7.0% of subjects had no under reduction (red).
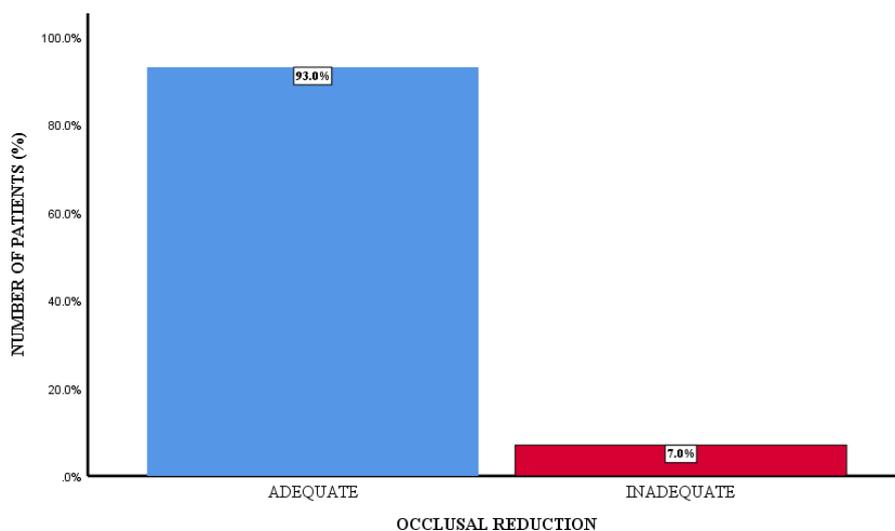

Figure 6: Bar chart representing study subjects based on Occlusal reduction of the tooth, with X-axis representing occlusal reduction in the tooth and Y-axis representing the number of patients in percentage. 93.0% of subjects had adequate occlusal reduction of tooth (blue) whereas 7.0% of subjects had inadequate occlusal reduction (red).
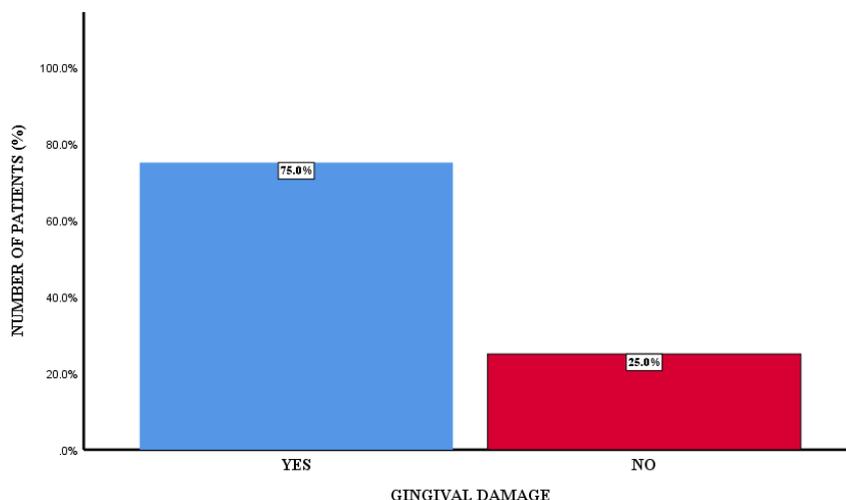
Figure 7: Bar chart shows the distribution of subjects based on Gingival damage of the tooth, with X-axis representing gingival damage of the tooth and Y-axis representing the number of patients in percentage 75.0% of subjects had gingival damage during tooth preparation (blue) whereas 25.0% of subjects had no gingival damage (red).
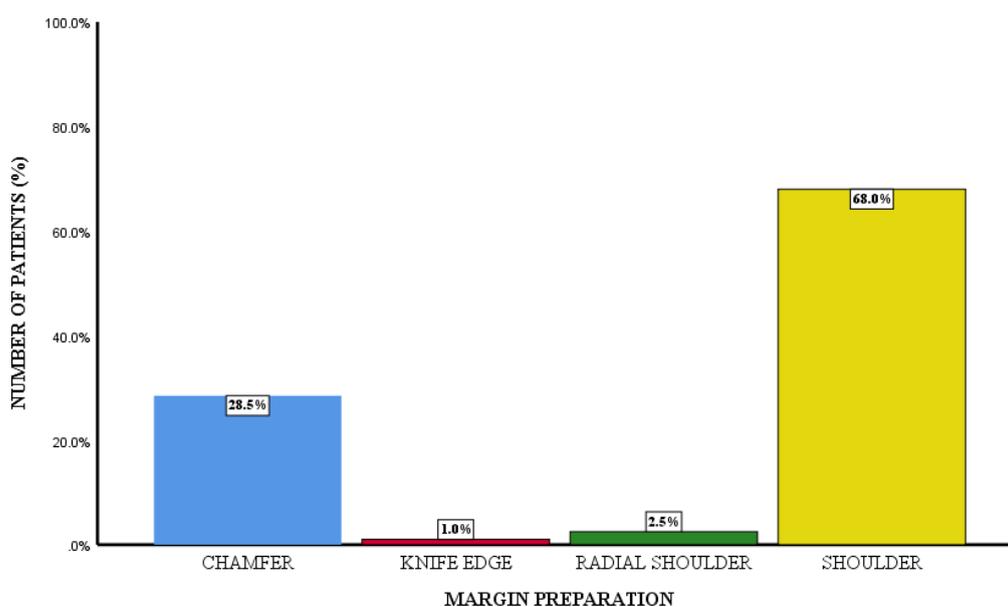

Figure 8: Bar chart represents study subjects based on Margin preparation of the tooth, with X-axis representing marginal preparation of the tooth and Y-axis representing the number of patients in

percentage. Shoulder finish line was more predominant in patients (yellow, 68%), followed by chamfer finish line (blue, 28.5%), radial shoulder (green, 2.5%) and knife edge preparation (red, 1%).
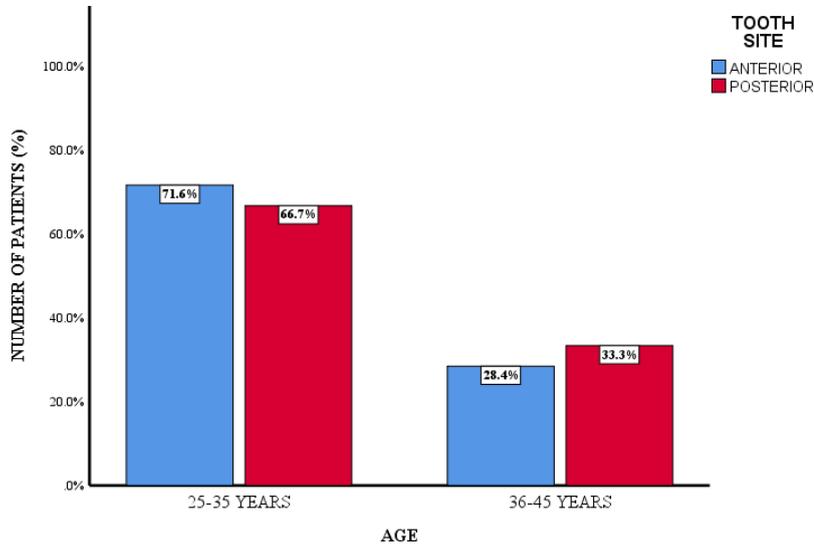

Figure 9: Bar graph represents association between tooth site and Age. X-axis represents age groups of the patients and Y-axis represents the number of patients in percentage. The distribution for the subjects between 25-35 years age group were high in the anteriors 71.6% (blue), whereas for the subjects between 36-45 years age group were predominantly higher in the posterior regions 33.3% (red). (Pearson chi-square test; P=0.747 ,P >0.05), statistically not significant. Even though the results were statistically not significant, posterior regions had a higher percentage of errors in tooth preparation than the anterior, which means that there is no significant association between age and tooth site for tooth preparation.
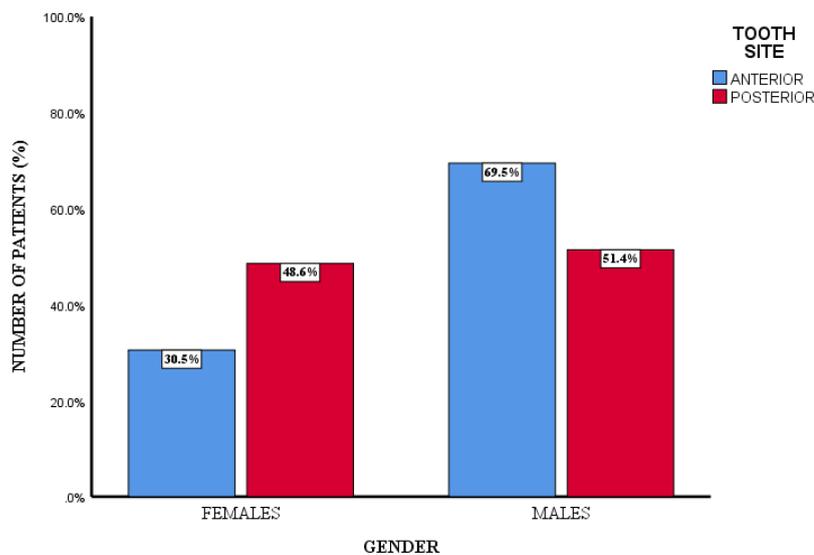
Figure 10: Bar graph represents the association between Gender and errors in tooth preparation. X axis represents gender and Y axis represents the no of patients in percentage. Males patients had 69.5 % errors in anteriors (blue) and females had 48.6% error in the posteriors (red) . The male patients had more errors in tooth preparation than the females with a statistically significant difference. (Pearson chi-square test;P=0.01 ,P<0.05), hence proving that there is a significant association between the gender and the tooth site for tooth preparation.