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Different Types of Finish Lines, Gingival Retraction Methods and Impression Techniques Used During Single Crown Preparation

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ABSTRACT

Tooth preparation is part of the daily routine for dentists. Each step involved in the tooth preparation is important. This study focuses on three parameters, finish lines, gingival retraction methods and impression technique. Gingival retraction and impression technique go hand in hand, as retraction of the gingival sulcus is mandatory to expose the prepared finish line and record them accurately. This study aimed to determine various types of finish lines, gingival retraction methods and impression techniques incorporated during single crown preparation in Saveetha Dental College and Hospitals. Case records were collected from DIAS (Dental Information Archiving Software). This university setting study involved a sample size of 812 patients. Data was tabulated with parameters of name, age, sex, finish line, gingival retraction, no. of cords, type of impression. The gingival retraction method used was a mechanical gingival retraction method which comprised 794 teeth and 554 of the gingival retraction was done using "2 cords (000+1)". 2 stage putty wash technique was commonly employed during impression taking in tooth preparation of 746 teeth. Chi-square test done for association between tooth no and finish lines, gingival retraction methods, no. of cords used and impression technique did not show any statistical significance ($p>0.05$) while association of finish line with no. of cords and type of impression showed statistical significance ($p<0.05$).

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INTRODUCTION

Finish line refers to the border of the preparation where the prepared tooth structure meets the unprepared surface of the tooth; line of demarcation, terminal portion of the prepared tooth. The adaptation of a restored tooth to the abutment tooth can be one of the most important factors that affect restoration prognosis (Komine *et al.*, 2007). Factors such as finish lines influence the marginal adaptation of the crown restorations (Alkumru *et al.*, 1988; Syu, 1993; Shearer *et al.*, 1996). Location of finish lines can be either subgingival, supragingi-

val or equigingival. Different types of finish lines are knife/feather edge, shoulder, bevelled shoulder, chamfer. Although tooth preparation is part of the daily routine, dentists select the cervical finish lines based mainly on their experience and personal choice (Ravinthar and Jayalakshmi, 2018). Rounded shoulders and chamfer have been advocated by the manufacturers of various ceramic systems.

The retraction of the gingival tissue is a long established technique. It can be defined as a process of deflection of the marginal gingiva away from the tooth. The gingival retraction is to allow access for the impression material beyond the margins and to create space for impression material to be sufficiently thick. Gingival retraction should be mandatory prior to impression so as to expose the prepared tooth surfaces (Goldberg *et al.*, 2001; Ramamoorthi *et al.*, 2015; Kumar *et al.*, 2016). Gingival retraction measures fall into one of four major categories (a) mechanic (b) chemomechanical (c) rotary gingival curettage and (d) electro-surgical methods (Benson *et al.*, 1986). The mechanical aspect involves placing of a string into the gingival sulcus to displace the marginal gingiva physically. The chemo-mechanical aspect is basically treatment of the string that will induce temporary shrinkage of the tissues. Of these four categories; the chemo-mechanical method is most widely used (Donovan *et al.*, 1985; Ramanathan and Solete, 2015; Siddique, 2019).

Although crown preparation is a common factor in daily practice, little is known about the prevalence of different techniques that may exist regionally or by each practitioner. Transfer of an accurate replication of the patient's hard and soft tissue to the dental laboratory is important. Most dentists have experienced the results of making a poor impression. The ability to identify and analyze inaccurate impressions and to understand how to avoid them is key to successful restoration. There are various techniques for making single crown impressions. The advancement in material and development of technique is a critical factor (Boulton *et al.*, 1996; Caputi and Varvara, 2008; Rajakeerthi and Nivedhitha, 2019). Various impression techniques are available but most commonly employed technique may be single step or two-step impression technique. The impression technique may be performed with putty, light body putty, medium body or heavy body rubber base impression material. Since impressions replicate both the teeth and the gingiva, success is based on understanding the anatomy of the periodontal tissues, creating an accurate and decipherable preparation (especially at the finish line), using the correct impression material and appropriate techniques (Chiche *et al.*, 1994; Millar, 2001; Anusavice *et al.*, 2003; Rajendran *et al.*, 2019).

This study aimed to determine various types of finish lines, gingival retraction and impression techniques incorporated during single crown preparation in Saveetha Dental College.

MATERIALS AND METHODS

This was a retrospective study regarding different finish lines, gingival retraction methods and impression technique incorporated during single crown preparation done in Saveetha Dental College and Hospitals among patients from June 2019 to March 2020. The approval for this university setting was obtained from the Institutional Review Board.

The sample size of this study was found to be 812 patients with a mean age of 35.27 ± 11.37, of which 453 of them were males and 359 of the patients were females. These patient details were obtained from a software system known as DIAS (Dental Information Archiving Software) which is exclusive for Saveetha Dental College and Hospitals. The data was extracted and tabulated in the Microsoft Excel based on the parameters required.

Inclusion Criteria

Patients treated with Single Crowns.

Exclusion Criteria: Incomplete Data

Once the case details have been obtained, the data was then extracted and tabulated based on the parameters which are age, gender, tooth no., finish line, gingival retraction, impression technique etc.

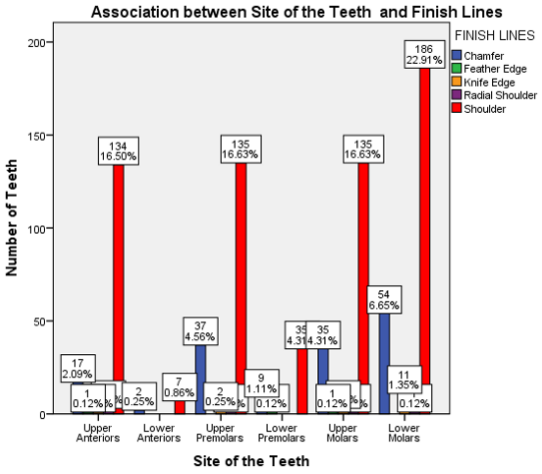
Statistical analysis

Once the results have been tabulated based on the parameters, the data was then exported to SPSS software. Associations of the parameters were done to detect the significance in SPSS. P-value less than 0.05 was considered to be statistically significant. Graphs were added to represent the association between the parameters.

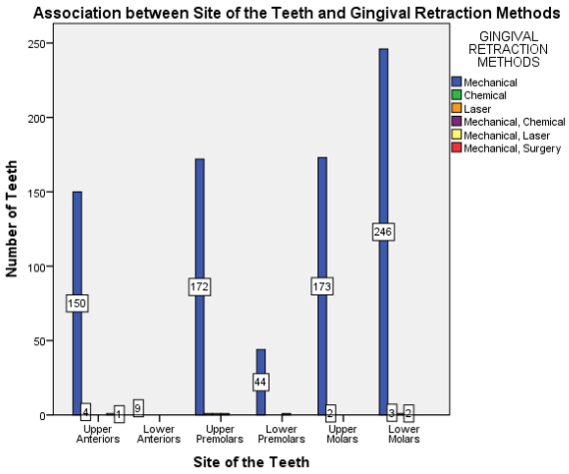
RESULTS AND DISCUSSION

Total sample size of this study was 812 patients, out of which 252 of the patients were treated for mandibular molars and 632 of the tooth preparations had shoulder finish lines. The gingival retraction method used was a mechanical gingival retraction method which comprised 794 teeth and 554 of the gingival retraction was done using "2 cords (000+1)". 2 stage putty wash technique was commonly employed during impression taking in tooth preparation of 746 teeth. Chi-square test done for

association between tooth no and finish lines, gingival retraction methods, no. of cords used and impression technique did not show any statistical significance (p>0.05) while association of finish line with no. of cords and type of impression showed statistical significance (p<0.05).

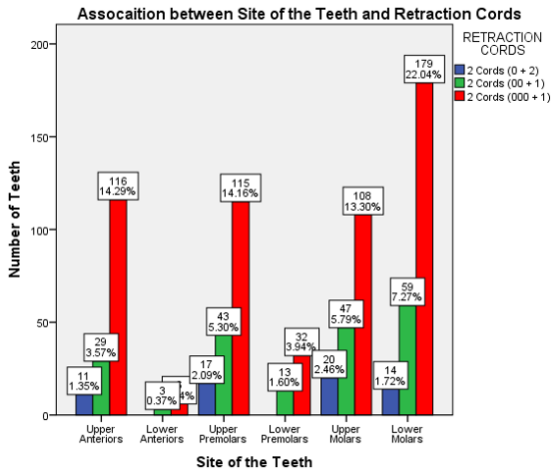


Graph 1: Bar graph representing the association between the site of the teeth and finish lines

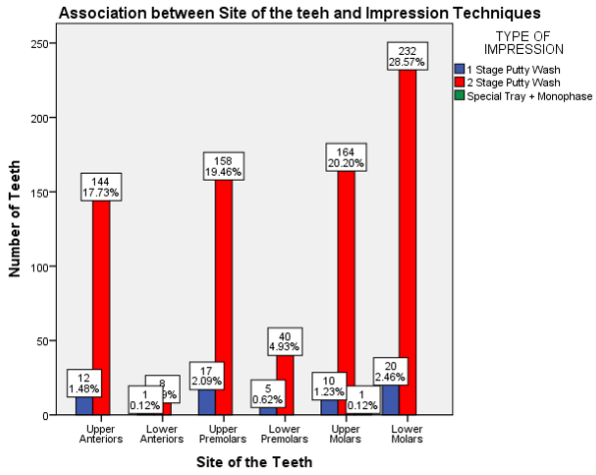


Graph 2: Bar graph representing the association between the site of the teeth and gingival retraction methods

As a whole procedure during crown preparation each step is important starting from tooth preparation to impression making for successful treatment to be achieved. From this study, it can be inferred that the most commonly treated teeth for single crown are mandibular molars, meaning mandibular molars were the most commonly endodontically treated teeth requiring a single crown. These results coincided with a study done by Ahmed and Rahman (2009) in which he stated that mandibular molars were the most common teeth that required restoration post endodontic treatment (Ramesh *et al.*, 2018; Janani *et al.*, 2020; Jose *et al.*, 2020).



Graph 3: Bar graph representing the association between the site of the teeth and cords used during retraction



Graph 4: Bar graph representing the association between the site of the teeth and type of impression techniques

This study is one of a kind as we have studied the association of tooth no. with finish lines, gingival retraction methods, impression techniques. Tables 1, 2, 3 and 4 & Graphs 1, 2, 3 and 4 show the association between teeth and finish lines, gingival retraction methods, no. of cords used, impression techniques, in which we can see that mandibular molars were commonly treated with shoulder finish lines (22.91%). Mechanical gingival retraction (30.30%) with 2 cords (000+1) (22.04%) was used and 2 step putty wash technique (28.57%) was commonly employed during single crown preparation.

Table 5 & Graph 5 shows association of finish lines with gingival retraction; where, shoulder is the

Table 1: This table represents the association of the site of tooth preparation and different finish lines

Site of Tooth Preparation	Finish Line					Total
	Chamfer	Feather Edge	Knife Edge	Radial Shoulder	Shoulder	
Upper Anteriors	17	1	1	3	134	156
Lower Anteriors	2	0	0	0	7	9
Upper Premolars	37	0	2	1	135	175
Lower Premolars	9	1	0	0	35	45
Upper Molars	35	1	3	1	135	175
Lower Molars	54	0	11	1	186	252
Total	154	3	17	6	632	812

Table 2: This table represents the association of the site of tooth preparation and different gingival retraction methods

Site of Tooth Preparation	Gingival Retraction						Total
	Mechani	Chemical	Laser	Mechanical, Chemical	Mechanical, Laser	Mechanical Surgery	
Upper Anteriors	150	4	0	0	1	1	156
Lower Anteriors	9	0	0	0	0	0	9
Upper Premolars	172	1	1	1	0	0	175
Lower Premolars	44	0	0	1	0	0	45
Upper Molars	173	2	0	0	0	0	175
Lower Molars	246	3	1	2	0	0	252
Total	794	10	2	4	1	1	812

Table 3: This table represents the association between the site of tooth preparation and no. of cords used while retracting the gingiva

Site of Tooth Preparation	No. of cords			Total
	2 Cords (0 + 2)	2 Cords (00 + 1)	2 Cords (000 + 1)	
Lower Anteriors	0	3	6	9
Upper Premolars	17	43	115	175
Lower Premolars	0	13	32	45
Upper Molars	20	47	108	175
Lower Molars	14	59	179	252
Total	62	194	556	812

Table 4: This table represents the association between the site of tooth preparation and different impression techniques employed

Site of Tooth Preparation	Type of Impression			Total
	1 Stage Putty Wash	2 Stage Putty Wash	Special Tray + Monophase	
Upper Anteriors	12	144	0	156
Lower Anteriors	1	8	0	9
Upper Premolars	17	158	0	175
Lower Premolars	5	40	0	45
Upper Molars	10	164	1	175
Lower Molars	20	232	0	252
Total	65	746	1	812

Table 5: This table represents the association between the finish lines and gingival retraction methods

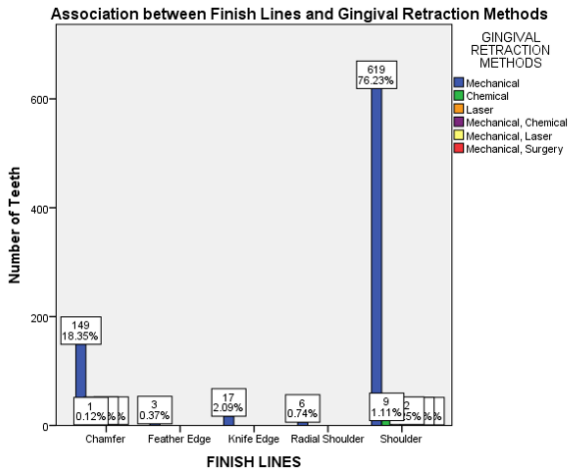
Finish Lines	Gingival Retraction						Total
	Mechanic	Chemical	Laser	Mechanical, Chemical	Mechanical Laser	Mechanical, Surgery	
Chamfer	149	1	2	2	0	0	154
Feather Edge	3	0	0	0	0	0	3
Knife Edge	17	0	0	0	0	0	17
Radial Shoulder	6	0	0	0	0	0	6
Shoulder	619	9	0	2	1	1	632
Total	794	10	2	4	1	1	812

Table 6: This table represents the association of the finish lines with no. of cords used during gingival retraction

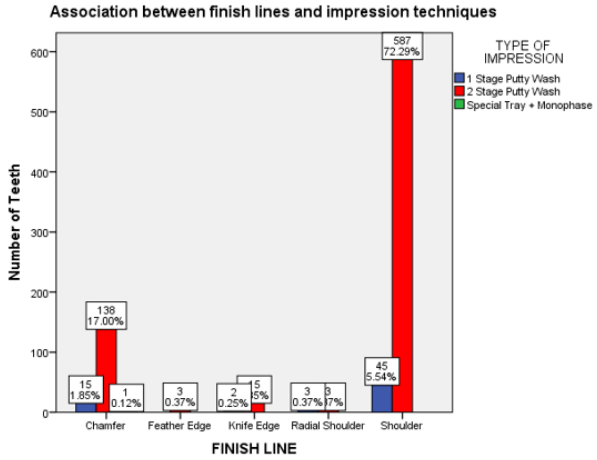
Finish Lines	No of Cords			Total
	2 Cords (0 + 2)	2 Cords (00 + 1)	2 Cords (000 + 1)	
Chamfer	24	43	87	154
Feather Edge	0	0	3	3
Knife Edge	1	2	14	17
Radial Shoulder	0	3	3	6
Shoulder	37	146	449	632
Total	62	194	556	812

Table 7: This table represents the association of the finish lines with the type of impression technique employed

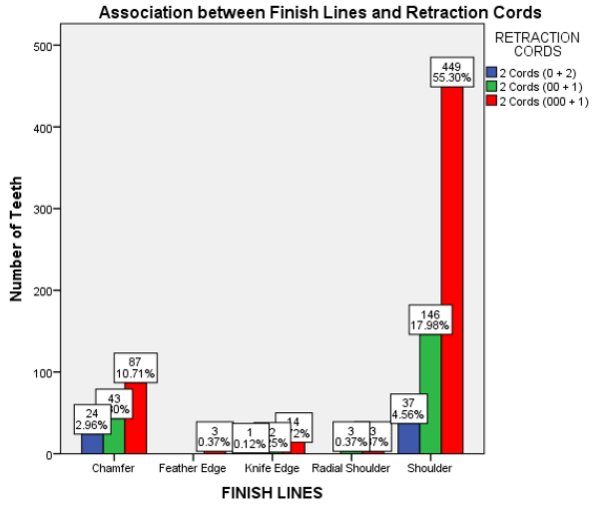
Finish Lines	Type of Impression			Total
	1 Stage Putty Wash	2 Stage Putty Wash	Special Tray + Monophase	
Chamfer	15	138	1	154
Feather Edge	0	3	0	3
Knife Edge	2	15	0	17
Radial Shoulder	3	3	0	6
Shoulder	45	587	0	632
Total	65	746	1	812



Graph 5: Bar graph representing the association between the finish lines and gingival retraction methods



Graph 7: Bar graph representing the association between the finish lines and impression techniques used



Graph 6: Bar graph representing the association between the finish lines and no. of cords

most commonly used finish line (76.23%) followed by chamfer finish line (=18.35%) and the least being feather edge finish line (0.37%). Mechanical retraction was commonly employed in shoulder finish lines which was followed by chamfer finish lines. Chemical, chemo-mechanical retraction methods were only used during shoulder and chamfer finish line preparations among which chemical method of retraction was mostly employed in shoulder finish line preparation and chemo mechanical method of retraction had an equal distribution among the two finish lines while laser retraction method was only used with chamfer finish line.

Tables 6 and 7 and Graphs 6 and 7 showed association of finish lines with no of cords used and different impression techniques. 2 cords (000+1) was seen highest (55.30%) followed by 2 cords (00+1) (17.98%) among shoulder finish lines. Among chamfer finish lines, 2(000+1) was the highest (10.71%) and 2 cords (0+2) the least (2.96%) among chamfer finish lines. As for impression technique, 2 stage putty wash technique was the most common impression technique followed for most of the single crown preparations and they were specifically common among the shoulder finish lines (72.29%) and they were least among the feather edge and radial shoulder finish lines (0.37%). The 1 stage monophase impression technique was the least followed by the dentists and was employed in chamfer finish line preparations with a percentage rate of 0.12%.

Different finish line designs have been advocated for tooth preparations of ceramic crowns. All anterior restorations are fabricated with shoulder finish line margin where aesthetics is of primary concern and this coincides with our study (Edelhoff and Sorensen, 2002; Manohar and Sharma, 2018; Teja and Ramesh, 2019). The type of finish line used in the preparation of the teeth influences the fabrication of the restoration and the final outcome of the treatment.

Clinicians place retraction cords by using cord packing instruments. Serrated round end cord packing instruments are generally used with braided cord since small indentations in the instrument's head sink in the cord and prevent the instrument slippage and further trauma to the epithelial attachment. Non-serrated flat end instruments are applied in twisted cords with sliding motion (Hansen *et al.*, 1999; Prasad *et al.*, 2011; Noor *et al.*, 2016). Gingival sulcus can be enlarged by placing a cord into the

sulcus and leaving it in place for a period of time. It can either be single or double cord, they alone cannot control the sulcular hemorrhage hence used in conjunction with medicaments.

The use of a single retraction cord often provides inadequate gingival retraction. The dual-cord technique in which the first cord remains in the sulcus reduces the tendency for the gingival cuff to recoil and partially displace the setting impression material (Cloyd and Puri, 1999). Results from a survey showed that most of the dentists (98%) used mechanical gingival retraction with double cord packing method (48%) and 44 percent using a single-cord technique (Hansen *et al.*, 1999; Albaker, 2010; Nasim and Nandakumar, 2018). These results coincide with our study, where mechanical gingival retraction was the most commonly employed retraction method by the dentists during single crown preparations which was followed by chemical retraction method.

There are several impression techniques and protocols suggested; in the 2 stage putty wash technique, high viscosity material is used for a preliminary impression, lower viscosity material used for final impression. Many studies have suggested that 2 stage putty wash technique is widely accepted, adopted and offers good accuracy (Nissan *et al.*, 2000; Caputi and Varvara, 2008; Dugal *et al.*, 2013; Hussainy, 2018; Nissan *et al.*, 2002). This accuracy of impression is of utmost importance during tooth preparation and fabrication of a crown (Kumar and Antony, 2018); the impression taken after tooth preparation not just replicates the tooth structure but also the anatomical structures which gives us an understanding and a clear negative picture of the tooth prepared for the fabrication of the crown.

In Table 1, it shows that the lower molars were commonly treated with shoulder finish line (n=176) followed by upper molars and premolars (n=135) and then upper anteriors(n=134). Chi-square test was done and was found to be statistically not significant [Chi-square value= 28.598; p=0.096 (p>0.05)]. In Graph 1, X-axis represents the site of the teeth among the patients and Y-axis represents the number of teeth receiving single crown. From this graph, we can infer that shoulder finish lines (Red) were commonly employed and lower molars had the highest percentage compared to the other sites. Chamfer finish lines (Blue) were also used among the patients and it was also highest among the lower molars. Chi-square test was done and was found to be statistically not significant [Chi-square value= 28.598; p=0.096(p>0.05)].

In Table 2, it shows that the mechanical gingival retraction was commonly used in lower molars(n=246) and the least was seen among lower anteriors (n=9). Chi-square test was done and was found to be statistically not significant [Chi-square value= 18.856; p=0.804 (p>0.05)]. In Graph 2, X-axis represents the site of the teeth among the patients and Y-axis represents the number of teeth receiving single crown. From this graph, it can be seen that mechanical retraction (Blue) was commonly employed and lower molars had the highest rate compared to the other sites. Chi-square test was done and was found to be statistically not significant [Chi-square value= 18.856; p=0.804(p>0.05)].

In Table 3, it shows that the most commonly used cords were “000” and “1” size cords during single crown preparation while the size “0” and “2” were not commonly used during the preparation. The size “000+1” was commonly employed in lower molars while the sizes “0+2” were commonly employed for upper molar teeth. Chi-square test was done and was found to be statistically not significant [Chi-square value= 15.695; p=0.109 (p>0.05)]. In Graph 3, X-axis represents the site of the teeth among the patients and Y-axis represents the number of teeth receiving single crown. From this graph we can infer, 2 cords (000+1) (Red) were commonly used during retraction of the gingiva and lower molars (22.04%) had the highest rate compared to the other sites. The 2 cord(0+2) (Blue) were commonly used among the upper molars. Chi-square test was done and was found to be statistically not significant [Chi-square value= 15.695; p=0.109 (p>0.05)].

In Table 4, it shows that the most commonly used impression technique was “2 stage putty wash” technique(n=746) followed by “1 stage putty wash”(n=65) which was common among the lower molars, and the least being “special tray+monophase” technique(n=1). Chi-square test was done and was found to be statistically not significant [Chi-square value= 6.266; p=0.792(p>0.05)]. In Graph 4, X axis represents the site of the teeth among the patients and Y-axis represents the number of teeth receiving single crown. From this graph, it can be seen that 2 stage putty wash (Red) was widely used among most of the teeth and had the highest incidence among the lower molars. Special tray+monophase technique(green) was used only among the upper molar teeth. Chi-square test was done and was found to be statistically not significant [Chi-square value= 6.266; p=0.792(p>0.05)].

In Table 5, it shows that mechanical gingival retraction method was commonly employed among the different finish lines, shoulder(n=619) being the

highest followed by chamfer(n=149) and the least being feather edge finish line(n=3). The teeth with Feather edge, knife edge and radial shoulder finish lines were employed only with mechanical gingival retraction methods. Chi-square test was done and was found to be statistically not significant [Chi-square value= 12.63; p=0.892(p>0.05)]. In Graph 5, X axis represents the different finish lines used and Y-axis represents the number of teeth receiving single crown. From this Graph, it can be seen that mechanical retraction(Blue) was commonly used among the shoulder finish lines followed by chamfer finish lines. Chi-square test was done and was found to be statistically not significant [Chi-square value= 12.63; p=0.892(p>0.05)].

In Table 6, it shows that the retraction cord '000+1' was commonly used and was seen mostly with the shoulder finish lines(n=449) followed by chamfer(n=87). The teeth with Feather edge finish lines were employed only with '000+1' retraction cords(n=3). Chi-square test was done and was found to be statistically significant [Chi-square value= 25.863; p=0.001(p<0.05)]. In Graph 6, X axis represents the different finish lines used and Y-axis represents the number of teeth receiving single crown. From this Bar Graph, it can be seen that the retraction cord '000+1' (Red) was commonly used and was seen mostly with the shoulder finish lines followed by chamfer finish lines. Chi-square test was done and was found to be statistically significant [Chi-square value= 25.863; p=0.001(p<0.05)].

In Table 7, It shows that the 2 stage putty wash technique was mostly used(n=746) among all the teeth but most common among the shoulder finish lines(n=587) followed by chamfer finish lines(n=138). The 1 stage putty wash technique(n=65) was also used during single crown preparation but not as much as 2 stage putty wash technique. The special tray+monophase technique was employed only in the teeth with chamfer finish line and not in any other finish lines. Chi-square test was done and was found to be statistically significant [Chi-square value= 20.576; p=0.008(p<0.05)]. In Graph 7, X axis represents the different finish lines used and Y-axis represents the number of teeth receiving single crown. From this bar graph, it can be seen 2 stage putty wash technique (Red) was mostly used among the shoulder finish lines followed by chamfer finish lines. The special tray+monophase technique (green) was employed only in the teeth with chamfer finish line and not in any other finish lines. Chi-square test was done and was found to be statistically significant [Chi-square value= 25.863; p=0.001(p<0.05)].

Study limitations

This study was done in a small population among the patients who required a single crown in Saveetha Dental College and Hospitals in a given period of time.

Future Scope

This study can be done in a larger population among the patients without any specific time period. Other parameters like material of choice for the crown in single crown preparations can be included in future studies.

CONCLUSION

Within the limit of the study, the most widely used finish lines were shoulder finish line and mechanical gingival retraction method was commonly employed with 2 stage putty wash impression technique.

Conflict of Interest

The authors declare that they have no conflict of interest for this study.

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