Type of Manuscript: Survey

Preference of Self Etch Vs Total Etch among Dental Practitioners in India- A Survey

V. T. Thamarai Selvi[1], Jayalakshmi[2], M.P. Brundha[3]

[1]Research Associate, [2]Chief Scientist, White Lab - Material Research Centre, [3]Associate Professor, Department of General Pathology, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences [SIMATS], Saveetha University, Chennai

Abstract

Buonocore introduced Adhesion into dentistry 1955. According to the preference of the practitioners, each generation of adhesive was replaced by the next generation which overcame the disadvantages of the previous generation. Now, the adhesive which is in use are Self Etch, Total etch Adhesives and Resin modified approach as it has unique properties of self adherence to the tooth. The concept of total etching or etch and rinse technique was given way back in the early 1980s by Fusayama. With this background, the aim of the present study is to survey the preference of Self etch VS Total etch among dental practitioners. A Cross-sectional survey was conducted among the dental practitioners about their preference for self-etch and total-etch adhesive. The data was collected and statistically analysed using the SPSS software version 23. Descriptive statistical analysis was carried out and the chi-square test was used and the p-value was calculated, with a p-value less than 0.05 to be statistically significant. The present survey included 209 dental practitioners of different categories with a clinical experience of at least 3 months, 32.69 % of the practitioners had clinical experience of 10 years and more than that. 71.15 % of the practitioners preferred the usage of Total Etch and remaining 28.85 % preferred the usage of self etch. According to the Practitioners, 68.75 % considered the total etching technique as the best technique and 31.25 % considered self etch as the beat technique. From this survey, it is seen that the majority of the practitioners preferred using total-etch compared to self etch. Despite having its disadvantage it is preferred by the practitioners.

Keywords: *Self etch, Total etch, Smear layer, Adhesive Systems, Dentin bonding Agent*

Introduction

About 50 years ago, adhesives evolved into dentistry. but the challenging point in adhesives is the effective bonding to the hard tissues. Bonding the adhesive to the enamel is easy and durable whereas bonding to dentin is a bit difficult and complicated procedure, a time-consuming procedure. The basic requirements for adhesives such as user-friendly, increased bond strength, less technique sensitivity etc., introduced different generations of adhesives as per requirement. Now the adhesives which are currently being used are Self etch and Total Etch adhesives [1]. The usage of the adhesives is according to the preference of the practitioner and clinical necessity [2]. The evolution adhesives into dentistry is illustrated as in (Figure 1).

Corresponding Author:
Jayalakshmi Somasundaram,
Chief scientist, White Lab - Material research centre,
Saveetha Dental College and Hospitals,
Saveetha Institute of Medical and Technical Sciences
[SIMATS], Saveetha University, P.H.Road, Chennai-600077, Tamilnadu, India, Mobile: 9600586858
E-mail I'd: jayalakshmisomasundaram@saveetha.com

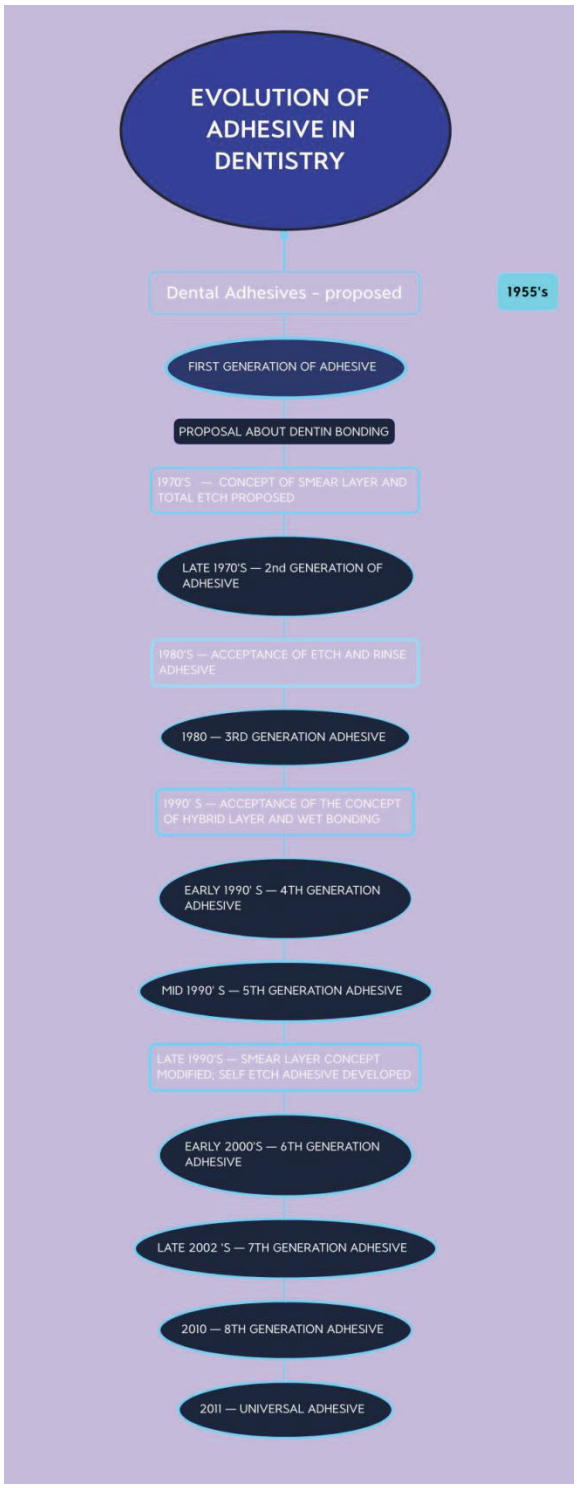

Figure 1 Elucidates the Evolution of adhesives into Dentistry

Total Etching Technique :

The concept of total etching or etch and rinse technique was given way back in the early 1980s by Fusayama. The turning point in the evolution of adhesives used in dentistry was the ability to remove the smear layer completely which was achieved in the 4th generation adhesives Total etch adhesive can be classified based on the number of clinical steps involved as 3 steps technique and 2 steps technique [3]. 4th generation adhesives come under 3 step technique, Etchant, Primer and Bonding agent are used in 3 different clinical steps. The characteristic feature of 4th generation is the ability to etch both enamel and dentin simultaneously, which is achieved using acid (Phosphoric acid) for 15 – 20 sec. The concept of wet bonding is used here to prevent the disintegration of collagen. The drawback is increased time consumption due to the increased number of clinical steps, this led to the need for newer adhesives evolution [4,5].

The 5th generation of Adhesives was introduced in the mid-1990s. This generation involves two clinical steps as Acid etching followed by a combination of primer and bonding agent. The advantages of this generation of adhesives are decreased time consumption and high bond strength. The resin – dentin interface is more prone to degradation, which increases postoperative sensitivity is the main disadvantage. Bonding to dentin is less reliable and difficult to bond compared to enamel; this is due to organic constituents present in the dentin [6,7].

Mechanism Of Bonding:

When the surface is etched with acid it exposes the collagen fibres that are devoid of hydroxyapatite crystals. The bonding will occur by the diffusion or infiltration of the resin within the collagen which forms the hybrid layer. After the polymerisation, the hybrid layer provides micromechanical retention for the restoration [8]. The hydrophilic and ionic monomers combine which results in the bonded interface. The solvents present in the adhesive are difficult to evaporate and get entrapped within the adhesive layer after polymerisation [9,10] .

Total etch technique is a gold standard technique and also the oldest technique of adhesion, used even till date, but they are incapable of preventing Nano leakage despite its clinical durability and performance [11,12].

Self Etch Technique

The self-etching technique was introduced into dentistry in the early 2000s. The self etch are classified as two-step and one-step adhesive based on the number of

clinical steps involved. Two-step adhesive includes 6th generation of adhesive, the steps involved are etchant and primer together and bonding agent separately or etchant separately and primer and bonding agent together [13]. The one-step adhesive includes 7th generation adhesives, Etchant, primer and bonding agent are used together in a single step. They can be used to etch the etched or even unetched enamel or dentin surface. They are also called as universal or Multimode adhesive [14]. The self etch adhesives contain water as the ionising medium which enables better adhesion but there are exceptional conditions like Acetone based adhesive [15,16].

These adhesives can demineralise and infiltrate the surface of the tooth, the adhesive can also penetrate for the same time and same depth. When the monomers in the adhesive and the tooth surface interacts there will be a formation of Adhesive – Tooth interface [17,18]. Based on this interaction, adhesive are classified as (i) Ultra Mild – interaction depth is few hundred nanometres (pH > 2.5) (ii) Mild – Interaction depth around 1 µm (pH approximately 2) (iii) Intermediately strong – interaction depth around 1-2 µm (pH 1- 2) (iv) Strong – interaction depth several µm (pH <1). When strong adhesives are used there will be the formation of typical resin tags but when mild or ultra-mild adhesives are used the resin tags are formed rarely, in case even if they are formed resin will get infiltrated because of the resin tag demineralisation [19].

Mechanism Of Bonding

Adhesives bond to the tooth surface by either micromechanical interlocking or by chemical bonding. Micromechanical bonding provides strength to bear the stress wherein chemical bonding increases the longevity of the restoration by reducing hydrolytic degradation [20]. The acid monomers will react with the hydroxyapatite crystals which are composed of specific carboxylic or phosphate group [4 –Methacryloxyethyl trimellitic acid (4 – MET), Phenyl P, 10- Methacryloxy decyl dihydrogen phosphate (10 – MDP)]. When 4 – MET acts as an adhesion-promoting monomer when carboxylic acid gets attached to the aromatic group. The aromatic group has hydrophobic properties which reduce the acidity of the carboxyl groups, 4-MET forms a compound by interacting with Calcium in Hydroxyapatite crystals and forms Ca-MET salt by ionic bond formation [21].

With this background, the present study aims to analyse about the preference of the dental practitioner for Total etch and Self etch adhesive and also study about reasons for their preference of adhesive among the dental practitioners.

Materials and Methods

A questionnaire was prepared which consisted of questions related to self etch and total-etch adhesive system. This questionnaire was circulated among dental practitioners of 21 years and above including the UG Students, PG Students, UG practitioners and PG practitioners were included in this study. Since this is randomly sampled study it was circulated randomly to all the dental practitioners through an online survey portal. The framed questions were uploaded in an online platform i.e., Google Forms and circulated to all the dental practitioners and were asked to fill the survey. The data was collected and analysed statistically using SPSS software 2.0. Chi-square test and Pearson correlation analysis were used for the data analysis, with a p-value less than 0.05 to be statistically significant.

Inclusion Criteria: The dental practitioners of all categories and clinical experience of at least 3 months were included for this study.

Exclusion Criteria: The UG dental students in 1st and 2nd year of study, persons with no clinical experience and knowledge were excluded from this study.

Results and Discussion

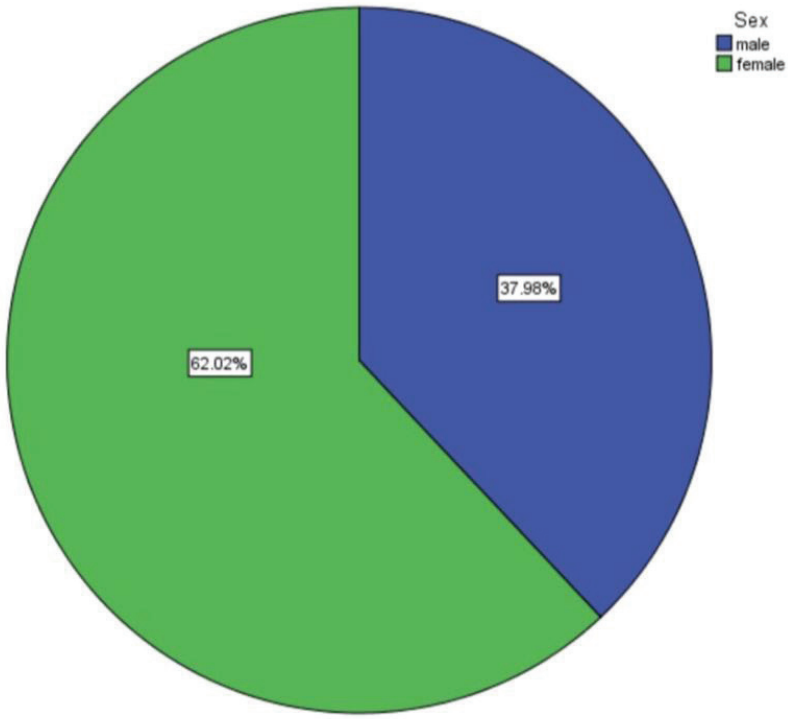

Figure 2, depicts the Gender of the practitioner who participated in the survey. The male practitioners are represented in Blue colour and female practitioners are represented by Green colour. 62.02% were female practitioners and 37.98% were male practitioners. This was a random sampling and there was no intention on emphasizing female dental practitioners to participate in the survey.

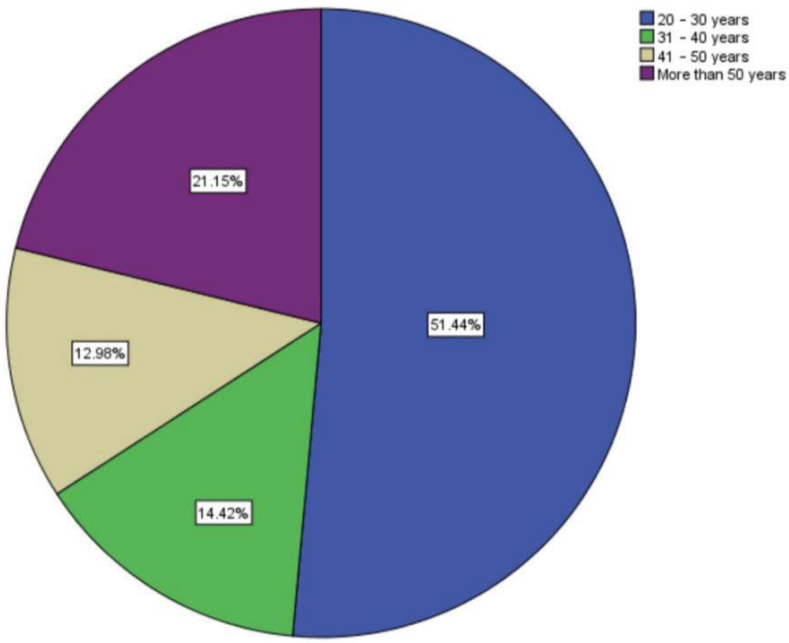

Figure 3 depicts the Age group of the practitioner, 51.44% were in the age group of 20 - 30 years (Blue), 14.42% in the group of 31 - 40 years (Green), 12.98% in the age group of 41 - 50 years(Brown), 21.15% in the age group of more than 50 years (Violet). Since there are no previous studies regarding the preference among adhesive, the data cannot be compared [22].

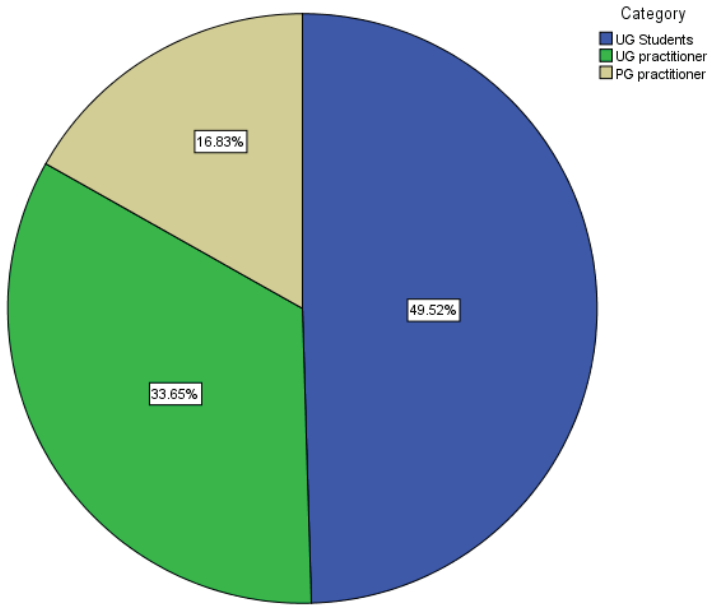

Figure 4 depicts the category to which the practitioner participated in the survey belongs, it was reported that 49.52 % were UG Students (Blue), 33.65 % were UG practitioners (Green), 16.83% were PG practitioners (Brown).

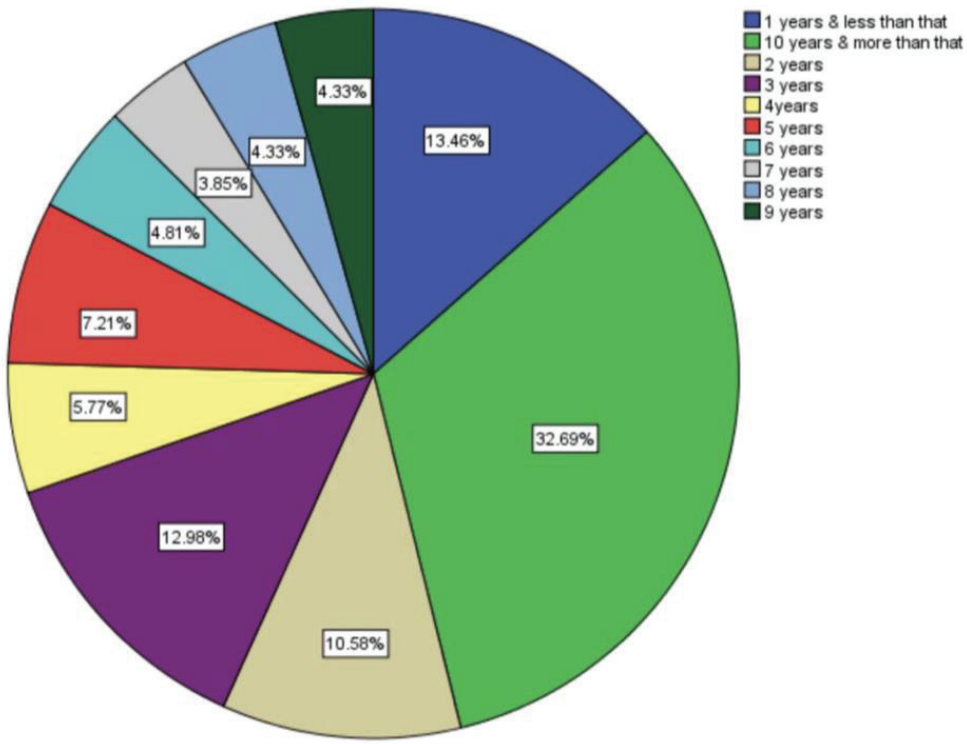

Figure 5 portrays the Clinical experience of the practitioner and it is reported that 13.46% had an experience of one year and less than that (Dark Blue), 32.69% had an experience of 10 years and more than (Light Green), 10.58 % had an experience of 2 years (Brown), 12.98 % had the experience of about 3 years (Violet), 5.77 % had an experience of 4 years (Yellow), 7.21 % experience of 5 years (Red), 4.81% experience of 6 years (Light Blue), 3.85 % experience of 7 years (Grey), 4.33 % experience of 8 years (Indigo) and practitioners with 9 years of clinical practice were 4.33 % (Dark Green).

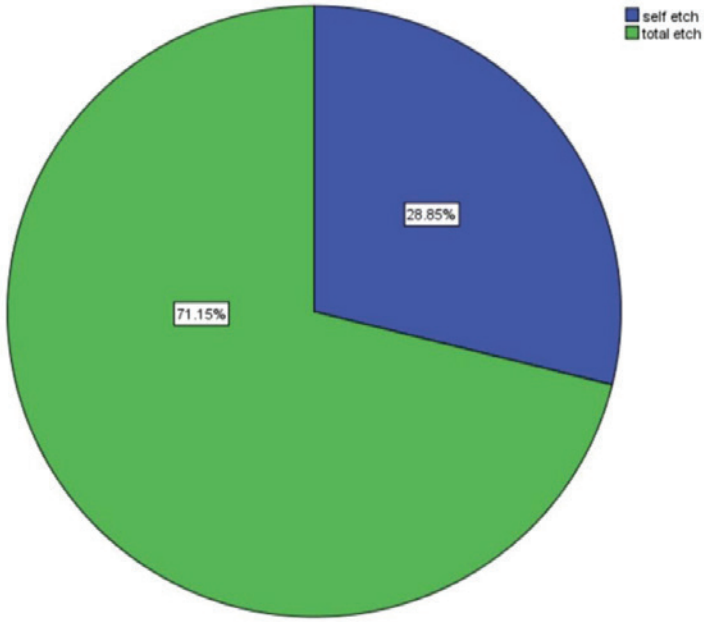

Figure 6, depicts the preference of adhesive by the Practitioner during their clinical practice, from the survey it is seen that that majority of practitioners 71.15 % preferred using Total etch (Green) and 28.85 % preferred using Self etch Adhesive (Blue).

The total-etch technique preference might be due to some lectures and practitioners who guided them must have strongly preferred towards total etching technique. But the self-etching technique also has its unique features, indications and contraindications [23]. So we cannot conclude that neither total-etch nor self etch preference alone[24,25]. The preference should be also based on the clinical preference, for example, cavities with exposed dentin, there will be a preference of self etch but due to Esthetic preference [26–28], it is less indicated or not even indicated since the cavity walls are located in the enamel [29,30].

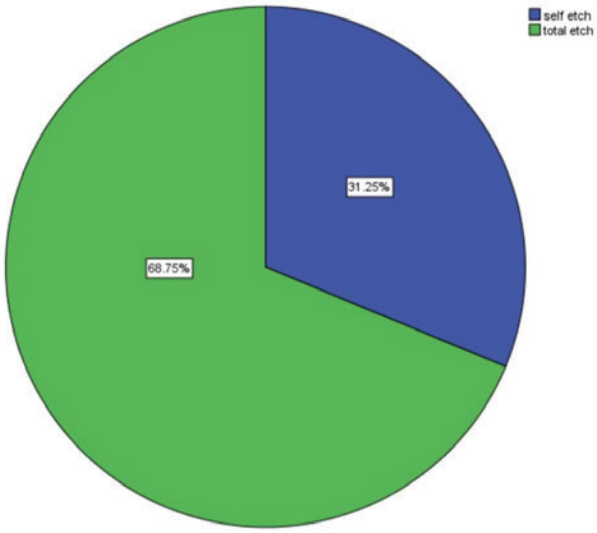

Figure 7 denotes the Best adhesive according to the Practitioner despite their usage in their clinical practice, 68.75% practitioners preferred usage of total-etch (Green) and 31.25% practitioners preferred self etch (Blue) as the best etching technique.

Despite using a particular adhesive in clinical practice, there would be an adhesive which the practitioner prefers as the best technique, it will differ among the practitioners. There are equal advantages and disadvantages in both the techniques and reason for selecting that particular adhesive is also controversial [31,32]. In a study conducted by

Mithra Hedge et al., it was concluded that self etch adhesives are the best and they are also preferred widely, this is in contrast to the present study wherein total-etch is preferred widely [33].

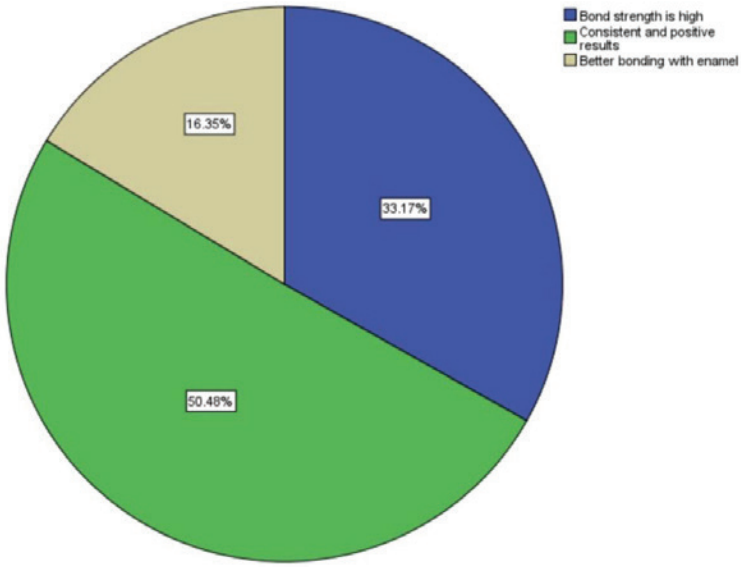

Figure 8 elucidates the reason for preferring Total etch by the practitioners, and it was reported that 33.17 % for high bond strength (Blue), 50.48 % preferred it for the positive results which were seen in clinical practice (Green) and 16.35 % for the better bonding with enamel nature (Brown).

When total-etch is widely preferred among the practitioners there should be a reason for that preference. The high bond strength nature is one of the reasons for its preference [34,35]. A study conducted by Michael schauseil et al., Evaluating the shear bond strength between self etch and total-etch adhesive concluded that there is no difference in the shear bond strength between both the adhesives [36].

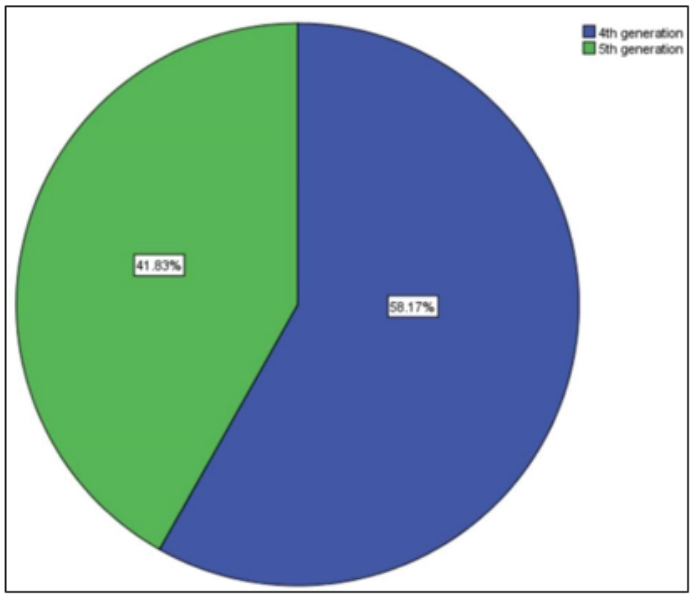

Figure 9 elucidates the preference of generation in the total-etch adhesive among the practitioners where it is seen that 58.17% preferred using 4th generation (Blue) and 41.83 % preferred using 5th generation adhesive (Green).

4th generation involves 3 steps Acid etching, Primer and Bonding agent are used in three different steps, which leads to the formation of the hybrid layer and increases bond strength. In 5th generation, adhesives involve two

steps Acid etchant followed by a combination of primer and bonding agent [37,38]. These adhesives decreased the time consumption and also improved the prevention of collagen collapsing in demineralised dentin but they will be more prone to water degradation [39].

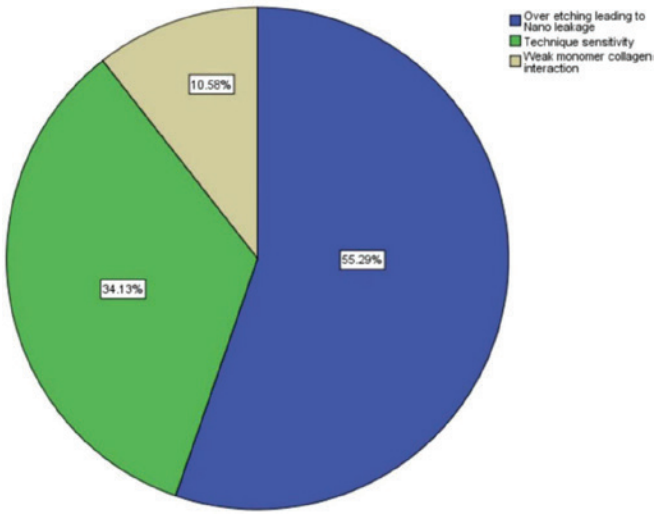

Figure 10 represents the disadvantages of total-etch adhesive according to the practitioners where it is documented that 55.29% did not prefer the usage of total-etch because over-etching leads to nano leakage (Blue), 34.13 % did not prefer because of Technique sensitivity (Green) and 10.58% for weak collagen - monomer interaction (Brown).

The technique sensitivity is attributed in dried dentin as there are more chances of collapsing the demineralizing dentin and low monomer diffusion which interrupts the hybrid layer formation, it not only contributes technique sensitivity it also plays an antagonistic role of water in bonding [40,41]. In which over setting leads to the separation of the component in the adhesive I.e., hydrophobic and hydrophilic which leads to the formation of voids in the resin - dentin interface [42,43].

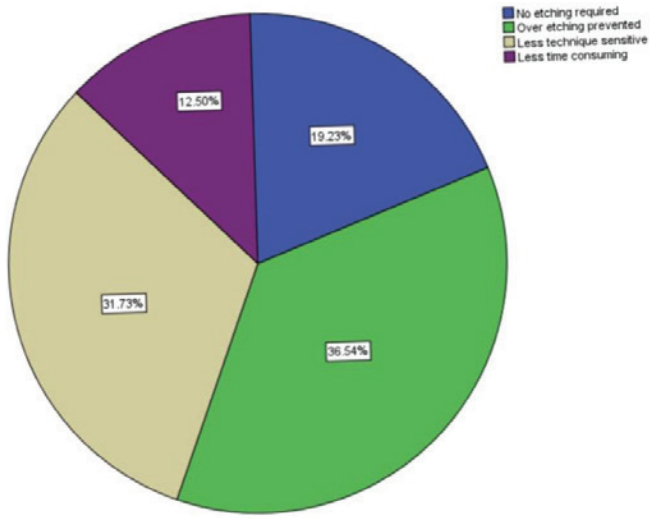

Figure 11 portrays the advantages of self etch according to the practitioner where it was recorded that, 19.23% for the property of no etching requirement (Blue), 36.54% preferred since over-etching is prevented (Green), 31.73% preferred for less technique sensitivity (Brown), 12.50% preferred for decreased time consumption (Violet).

Self etch adhesives reduce post-operative sensitivity since the residual smear plugs are left behind which leads to lesser exposure of dentinal tubules compared to total-etch [44,45]

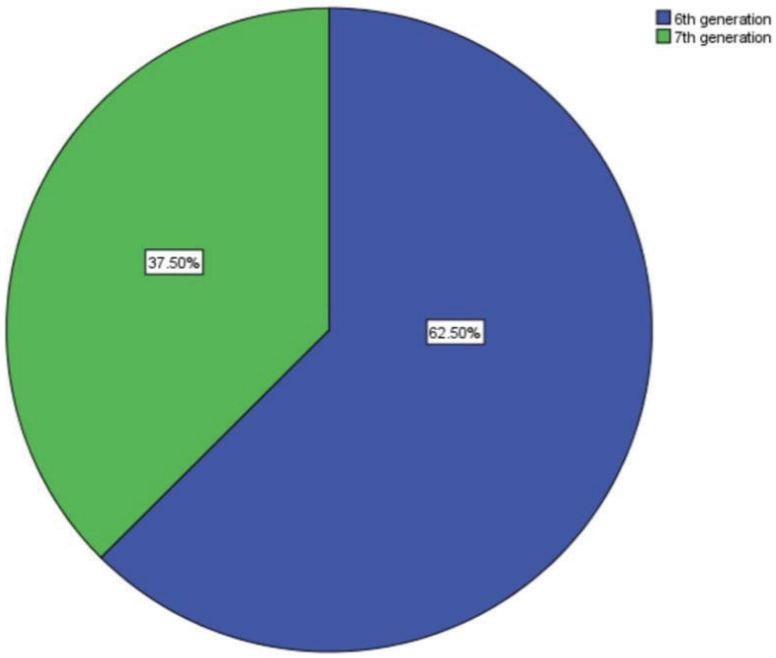

Figure 12 represents the preference among the generation of Self-etch among the practitioners, where 62.5% preferred 6th generation of adhesive (Blue) and 37.5 % preferred 7th generation of adhesive (Green).

6th generation adhesives have better adherence to the dentin in comparison to the total-etch adhesive. 7th generation adhesives are all in one adhesive [46]. They have lower initial and long term bond strength of any adhesive is a major disadvantage [47].

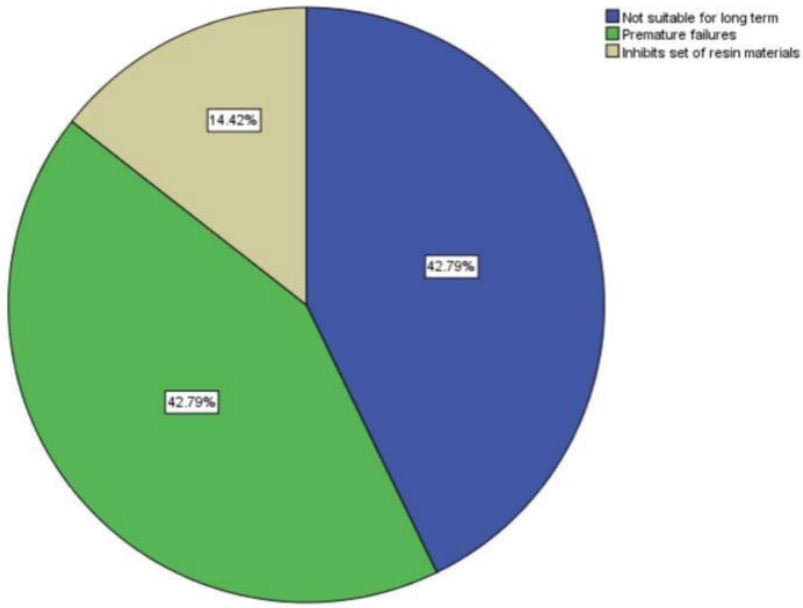

Figure 13 denotes the disadvantages of self etch adhesive among the practitioners, an equal number of practitioners reported that 42.79 % it is not preferred because they are not suitable for the long term (Blue) and due to premature failure (Green), 14.42% did not prefer due to inhibition of setting of resin materials (Brown).

When a thin layer of adhesive is applied it inhibits the polymerisation due to decreased Oxygen content [48,49]. In contrast to it when the adhesive is applied in multiple layers it increases the bond strength and premature failures are also prevented [50].

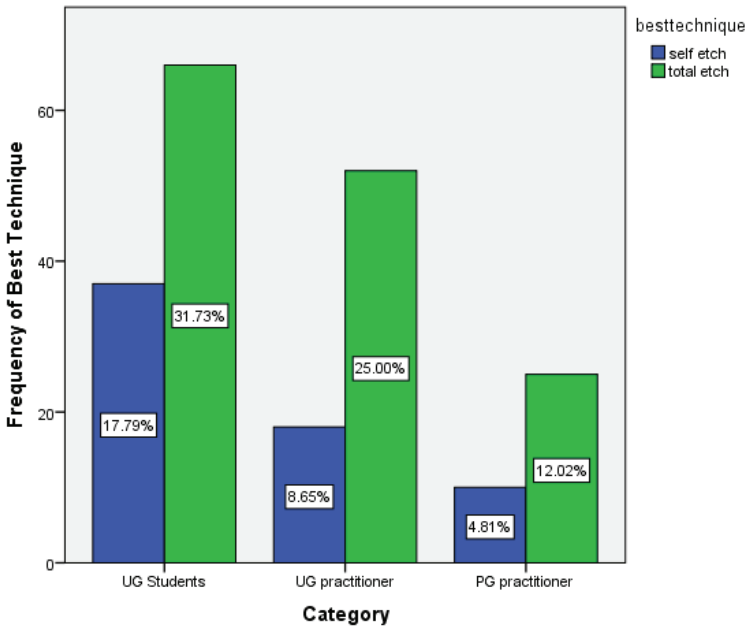

Figure 14 represents the association between Category of the Practitioner and Preference of Best adhesive according to the practitioner. The X-axis represents the Category of the Practitioner and Y-axis represents their Preference for adhesive. Blue colour represents Self etch and Green colour represents Total Etch technique was preferred mostly in all categories of the practitioners, 31.73% (n = 66) of the UG students, 25% (n = 52) of the UG practitioners and 12.02% (n =25). It is also seen that the UG students mostly preferred the usage of Total Etch compared to the other categories of practitioners. However this is statistically not significant with chi-square value - 2.162 and p-value = 0.3 (p-value > 0.05) hence insignificant.

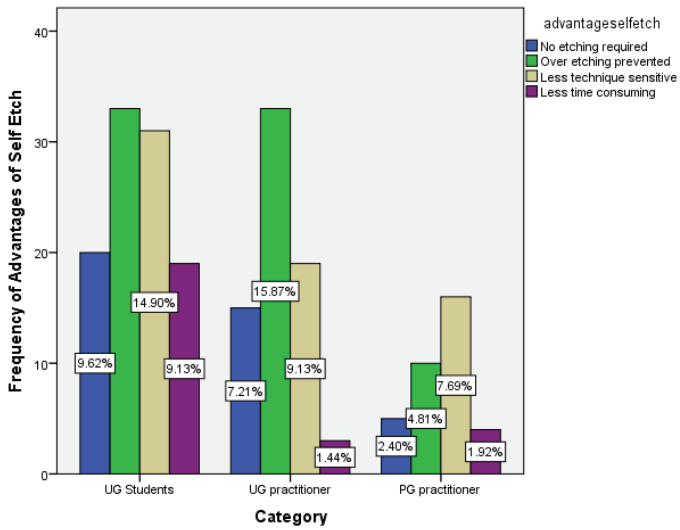

Figure 15 denotes the Chi-square analysis between Category of the Practitioner and Advantages of self etch according to the practitioner. The X-axis represents the Category of the Practitioner and Y-axis represents Advantages of Self etch according to the practitioner. Blue colour represents No etching required, Green colour represents Over etching is prevented, Brown colour represents Less technique sensitivity, Violet colour represents Less time-consuming.There are different reasons for preferring Self etch among the practitioners; Among the UG students 9.62% (n = 20) prefer for No requirement of etching, 14.90% (n = 33) since the over-etching is prevented, 14.85% (n = 31) for the less technique sensitive nature and 9.13% (n = 19) for less time consuming nature. Both UG students and UG practitioners mainly preferred Self etch because the Over etching is prevented than the PG practitioners. There is also a significant difference between the Category of the practitioner and the advantages of Self Etch with Chi-square value - 13.388 and p-value - 0.03 (p-value < 0.05) hence significant.

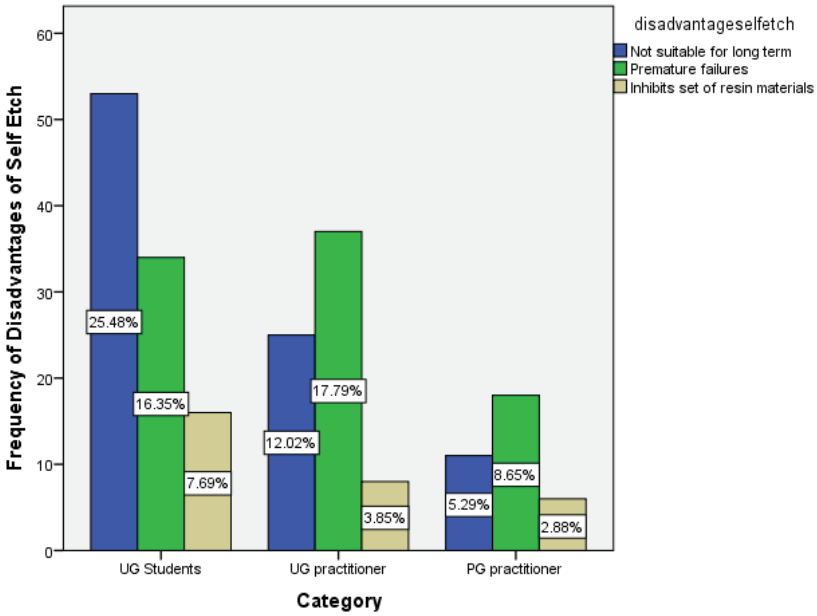

Figure 16 portraying the Chi-square analysis between Category of the Practitioner and Disadvantages of self etch according to the practitioner. The X-axis represents the Category of the Practitioner and Y-axis represents the Disadvantages of self etch according to the practitioner. Blue colour represents Not suitable for the long term, Green colour represents Premature failures and light brown colour represents inhibits set of resin materials. Majority of the UG students, 25.48% (n = 53) reported that self etch is not suitable for the long term, among the UG practitioners 17.79% (n = 37) considered Premature failures as a disadvantage, among the PG practitioner 8.65 (n = 18) also reported Premature failures as a disadvantage of Self etch. UG students found more disadvantages in self etch more than the UG and PG practitioners. This is proven statistically significant with a Chi-square value - 8.957 and p-value - 0.04 (p-value < 0.05), hence significant.

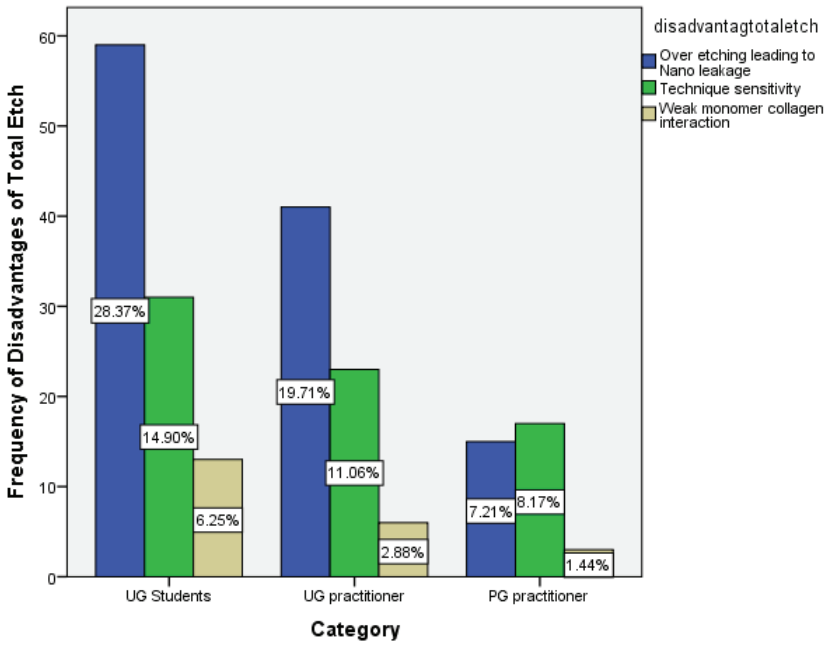

Figure 17 elucidates the Chi-square analysis between Category of the Practitioner and Disadvantages of Total etch according to the practitioner. The X-axis represents the Category of the Practitioner and Y-axis represents Disadvantages of Total etch according to the practitioner. Blue colour represents Over etching leading to nano leakage, Green colour represents Technique sensitivity and light brown colour represents weak monomer collagen interaction.

Among the UG students it is seen that 28.37% (n = 59) considered Over etching leading to nano leakage as a disadvantage of total-etch, 19.71% (n = 41) also opted Over etching leading to nano leakage as a disadvantage of total-etch, but among the PG practitioners Technique sensitivity was considered as the disadvantage by 8.17% (n = 17). There is no significant difference between the UG students, UG and PG practitioners with Chi-square value - 4.567 and p-value - 0.3 (p-value > 0.05) hence statistically not significant.

A comparative study between the Category of the Practitioners and different parameters like the best adhesive according to the practitioner (Figure 14), Advantages of Self Etch technique (Figure 15), Reason for preferring Total etch Adhesive (Figure 16) and Disadvantages of Total etch Adhesive were done using Chi-Square analysis in SPSS software version 23. It is also seen that the UG students mostly preferred the usage of Total Etch compared to the other categories of practitioners. However, this is statistically not significant (p-value > 0.05). Both UG students and UG practitioners mainly preferred Self etch because the Over etching is prevented than the PG practitioners. There is also a significant difference between the Category of the practitioner and the advantages of Self Etch with (p-value < 0.05). UG students found more disadvantages in self etch more than the UG and PG practitioners. This is proven statistically significant (p-value < 0.05). Chi-square analysis between Category of the Practitioner and Disadvantages of Total etch according to the practitioner. There is no significant difference between the UG students, UG and PG practitioners (p-value > 0.05) statistically.

Limitations

It is a cross-sectional study conducted online with a small sample size. With an increase in sample size, preference of adhesive among a wide group of practitioners can be obtained.

Future Scope

Based on the preference among the practitioner's adhesive type can be improved with the required criteria by the practitioners. The disadvantages of adhesive can be fulfilled so that there will be better clinical usage of adhesive.

Conclusion

From the present study, it can be concluded that the total-etch adhesive system was more likely preferred compared to self etch adhesive among the practitioners in their clinical practice. Despite the disadvantages of total-etch adhesive. However further studies can be conducted to overcome the disadvantages of total-etch adhesives to provide better clinical results.

Acknowledgement: The authors are thankful to Saveetha Dental College for providing a platform to express our knowledge.

Conflict of Interest: The authors declare no Conflict of interest.

Ethical Clearance: It is taken from "Saveetha Institute Human Ethical Committee" (Ethical Approval Number- SDC/SIHEC/2020/DIASDATA/0619-0320)

References

1. Ganapathy D, Sathyamoorthy A, Ranganathan H, Murthykumar K. Effect of Resin Bonded Luting Agents Influencing Marginal Discrepancy in All Ceramic Complete Veneer Crowns. J Clin Diagn Res [Internet]. 2016 Dec;10(12):ZC67–70. Available from: http://dx.doi.org/10.7860/JCDR/2016/21447.9028
2. Van Landuyt KL, Snauwaert J, De Munck J, Peumans M, Yoshida Y, Poitevin A, et al. Systematic review of the chemical composition of contemporary dental adhesives. Biomaterials [Internet]. 2007 Sep;28(26):3757–85. Available from: http://dx.doi.org/10.1016/j.biomaterials.2007.04.044
3. Nagpal R, Tyagi S, Manuja N, Sharma P. Bonding efficacy of etch-and-rinse adhesives after dentin biomodification using ethanol saturation and collagen cross-linker pretreatment [Internet]. Vol. 18, Journal of Conservative Dentistry. 2015. p. 331. Available from: http://dx.doi.org/10.4103/0972-0707.159751
4. Nishitani Y, Yoshiyama M, Donnelly AM, Agee KA, Sword J, Tay FR, et al. Effects of resin hydrophilicity on dentin bond strength. J Dent Res [Internet]. 2006 Nov;85(11):1016–21. Available from: http://dx.doi.org/10.1177/154405910608501108
5. Venugopalan S, Ariga P, Aggarwal P, Viswanath

A. Magnetically retained silicone facial prosthesis. Niger J Clin Pract [Internet]. 2014 Mar;17(2):260–4. Available from: http://dx.doi.org/10.4103/1119-3077.127575

6. King NM, Tay FR, Pashley DH, Hashimoto M, Ito S, Brackett WW, et al. Conversion of one-step to two-step self-etch adhesives for improved efficacy and extended application. Am J Dent [Internet]. 2005 Apr;18(2):126–34. Available from: https://www.ncbi.nlm.nih.gov/pubmed/15973833
7. Ashok V, Suvitha S. Awareness of all ceramic restoration in rural population [Internet]. Vol. 9, Research Journal of Pharmacy and Technology. 2016. p. 1691. Available from: http://dx.doi.org/10.5958/0974-360x.2016.00340.1
8. Subasree S, Murthykumar K, Dhanraj. Effect of Aloe Vera in Oral Health-A Review [Internet]. Vol. 9, Research Journal of Pharmacy and Technology. 2016. p. 609. Available from: http://dx.doi.org/10.5958/0974-360x.2016.00116.5
9. Gwinnett AJ, Matsui A. A study of enamel adhesives. The physical relationship between enamel and adhesive. Arch Oral Biol [Internet]. 1967 Dec;12(12):1615–20. Available from: http://dx.doi.org/10.1016/0003-9969(67)90195-1
10. Peumans M, De Munck J, Mine A, Van Meerbeek B. Clinical effectiveness of contemporary adhesives for the restoration of non-carious cervical lesions. A systematic review. Dent Mater [Internet]. 2014 Oct;30(10):1089–103. Available from: http://dx.doi.org/10.1016/j.dental.2014.07.007
11. Pioch T, Staehle HJ, Duschner H, García-Godoy F. Nanoleakage at the composite-dentin interface: a review. Am J Dent [Internet]. 2001 Aug;14(4):252–8. Available from: https://www.ncbi.nlm.nih.gov/pubmed/11699747
12. Duraisamy R, Krishnan CS, Ramasubramanian H, Sampathkumar J, Mariappan S, Navarasampatti Sivaprakasam A. Compatibility of Nonoriginal Abutments With Implants: Evaluation of Microgap at the Implant-Abutment Interface, With Original and Nonoriginal Abutments. Implant Dent [Internet]. 2019 Jun;28(3):289–95. Available from: http://dx.doi.org/10.1097/ID.0000000000000885
13. Tay FR, King NM, Chan K-M, Pashley DH. How can nanoleakage occur in self-etching adhesive systems that demineralize and infiltrate simultaneously? J Adhes Dent [Internet]. 2002 Winter;4(4):255–69. Available from: https://www.ncbi.nlm.nih.gov/pubmed/12666745
14. Van Meerbeek B, Yoshihara K, Yoshida Y, Mine A, De Munck J, Van Landuyt KL. State of the art of self-etch adhesives. Dent Mater [Internet]. 2011 Jan;27(1):17–28. Available from: http://dx.doi.org/10.1016/j.dental.2010.10.023
15. Pashley DH, Tay FR. aggressiveness of contemporary self-etching adhesives part ii. etching effects on unground enamel [Internet]. Vol. 16, Journal of Esthetic and Restorative Dentistry. 2004. p. 70–1. Available from: http://dx.doi.org/10.1111/j.1708-8240.2004.tb00456.x
16. Wang Y, Spencer P. Physicochemical interactions at the interfaces between self-etch adhesive systems and dentine. J Dent [Internet]. 2004 Sep 1;32(7):567–79. Available from: http://www.sciencedirect.com/science/article/pii/S0300571204000934
17. Garg N, Garg A. Bonding to Enamel and Dentin [Internet]. Textbook of Operative Dentistry. 2010. p. 237–237. Available from: http://dx.doi.org/10.5005/jp/books/11019_16
18. Ashok V, Nallaswamy D, Benazir Begum S, Nesappan T. Lip Bumper Prosthesis for an Acromegaly Patient: A Clinical Report. J Indian Prosthodont Soc [Internet]. 2014 Dec;14(Suppl 1):279–82. Available from: http://dx.doi.org/10.1007/s13191-013-0339-6
19. Moszner N, Salz U, Zimmermann J. Chemical aspects of self-etching enamel–dentin adhesives: A systematic review. Dent Mater [Internet]. 2005 Oct 1;21(10):895–910. Available from: http://www.sciencedirect.com/science/article/pii/S0109564105001600
20. Sano H, Shono T, Sonoda H, Takatsu T, Ciucchi B, Carvalho R, et al. Relationship between surface area for adhesion and tensile bond strength — Evaluation of a micro-tensile bond test [Internet]. Vol. 10, Dental Materials. 1994. p. 236–40. Available from: http://dx.doi.org/10.1016/0109-5641(94)90067-1
21. Yoshida Y, Nagakane K, Fukuda R, Nakayama Y, Okazaki M, Shintani H, et al. Comparative Study on Adhesive Performance of Functional Monomers

[Internet]. Vol. 83, Journal of Dental Research. 2004. p. 454–8. Available from: http://dx.doi.org/10.1177/154405910408300604

22. Van Landuyt KL, De Munck J, Snauwaert J, Coutinho E, Poitevin A, Yoshida Y, et al. Monomer-solvent phase separation in one-step self-etch adhesives. J Dent Res [Internet]. 2005 Feb;84(2):183–8. Available from: http://dx.doi.org/10.1177/154405910508400214
23. Vijayalakshmi B, Ganapathy D. Medical management of cellulitis [Internet]. Vol. 9, Research Journal of Pharmacy and Technology. 2016. p. 2067. Available from: http://dx.doi.org/10.5958/0974-360x.2016.00422.4
24. Koshiro K, Sidhu SK, Inoue S, Ikeda T, Sano H. New concept of resin-dentin interfacial adhesion: the nanointeraction zone. J Biomed Mater Res B Appl Biomater [Internet]. 2006 May;77(2):401–8. Available from: http://dx.doi.org/10.1002/jbm.b.30450
25. Ariga P, Nallaswamy D, Jain AR, Ganapathy DM. Determination of Correlation of Width of Maxillary Anterior Teeth using Extraoral and Intraoral Factors in Indian Population: A Systematic Review [Internet]. Vol. 9, World Journal of Dentistry. 2018. p. 68–75. Available from: http://dx.doi.org/10.5005/jp-journals-10015-1509
26. Basha FYS, Ganapathy D, Venugopalan S. Oral Hygiene Status among Pregnant Women [Internet]. Vol. 11, Research Journal of Pharmacy and Technology. 2018. p. 3099. Available from: http://dx.doi.org/10.5958/0974-360x.2018.00569.3
27. Jain AR, Nallaswamy D, Ariga P. Determination of Correlation of Width of Maxillary Anterior Teeth with Extraoral Factor (Interpupillary Width) in Indian Population [Internet]. JOURNAL OF CLINICAL AND DIAGNOSTIC RESEARCH. 2019. Available from: http://dx.doi.org/10.7860/jcdr/2019/41082.12988
28. Ranganathan H, Ganapathy DM, Jain AR. Cervical and Incisal Marginal Discrepancy in Ceramic Laminate Veneering Materials: A SEM Analysis. Contemp Clin Dent [Internet]. 2017 Apr;8(2):272–8. Available from: http://dx.doi.org/10.4103/ccd.ccd_156_17
29. Erickson RL, Barkmeier WW, Kimmes NS. Bond strength of self-etch adhesives to pre-etched enamel. Dent Mater [Internet]. 2009 Oct;25(10):1187–94. Available from: http://dx.doi.org/10.1016/j.dental.2009.04.004
30. Selvan SR, Ganapathy D. Efficacy of fifth generation cephalosporins against methicillin-resistant Staphylococcus aureus-A review [Internet]. Vol. 9, Research Journal of Pharmacy and Technology. 2016. p. 1815. Available from: http://dx.doi.org/10.5958/0974-360x.2016.00369.3
31. Jyothi S, Robin PK, Ganapathy D, Anandiselvaraj. Periodontal Health Status of Three Different Groups Wearing Temporary Partial Denture [Internet]. Vol. 10, Research Journal of Pharmacy and Technology. 2017. p. 4339. Available from: http://dx.doi.org/10.5958/0974-360x.2017.00795.8
32. Ganapathy DM, Kannan A, Venugopalan S. Effect of Coated Surfaces influencing Screw Loosening in Implants: A Systematic Review and Meta-analysis [Internet]. Vol. 8, World Journal of Dentistry. 2017. p. 496–502. Available from: http://dx.doi.org/10.5005/jp-journals-10015-1493
33. Hegde MN, Hegde P, Chandra CR. Morphological evaluation of new total etching and self etching adhesive system interfaces with dentin. J Conserv Dent [Internet]. 2012 Apr;15(2):151–5. Available from: http://dx.doi.org/10.4103/0972-0707.94589
34. Abdalla AI, Feilzer AJ. Four-year water degradation of a total-etch and two self-etching adhesives bonded to dentin. J Dent [Internet]. 2008 Aug;36(8):611–7. Available from: http://dx.doi.org/10.1016/j.jdent.2008.04.011
35. Abdollahi M, Ebrahimi M, Shirazi AS, Abdolhoseinpour F. Effect of Tannic Acid on Bond Strength of Etch and Rinse and Self-etch Adhesive Systems in Dentin of Primary Teeth [Internet]. Vol. 18, The Journal of Contemporary Dental Practice. 2017. p. 34–8. Available from: http://dx.doi.org/10.5005/jp-journals-10024-1984
36. Schauseil M, Blöcher S, Hellak A, Roggendorf MJ, Stein S, Korbmacher-Steiner H. Shear bond strength and debonding characteristics of a new premixed self-etching with a reference total-etch adhesive. Head Face Med [Internet]. 2016 Apr 30;12(1):19. Available from: http://dx.doi.org/10.1186/s13005-016-0117-x

37. Meena N, Jain N. Options for Dentin Bonding-Total Etch Or Self Etch? International Journal of Contemporary Dentistry [Internet]. 2011;2(2). Available from: https://www.researchgate.net/profile/Niharika_Jain/publication/48332712_Options_for_Dentin_Bonding_-_Total_Etch_Or_Self_Etch/links/00b495374999685001000000/Options-for-Dentin-Bonding-Total-Etch-Or-Self-Etch.pdf

38. Yoshiyama M, Tay FR, Doi J, Nishitani Y, Yamada T, Itou K, et al. Bonding of self-etch and total-etch adhesives to carious dentin. J Dent Res [Internet]. 2002 Aug;81(8):556–60. Available from: http://dx.doi.org/10.1177/154405910208100811

39. Ajay R, Suma K, Ali S, Sivakumar JK, Rakshagan V, Devaki V, et al. Effect of surface modifications on the retention of cement-retained implant crowns under fatigue loads: An In vitro study [Internet]. Vol. 9, Journal of Pharmacy And Bioallied Sciences. 2017. p. 154. Available from: http://dx.doi.org/10.4103/jpbs.jpbs_146_17

40. Lawson NC, Robles A, Fu C-C, Lin CP, Sawlani K, Burgess JO. Two-year clinical trial of a universal adhesive in total-etch and self-etch mode in non-carious cervical lesions. J Dent [Internet]. 2015 Oct;43(10):1229–34. Available from: http://dx.doi.org/10.1016/j.jdent.2015.07.009

41. Häfer M, Jentsch H, Haak R, Schneider H. A three-year clinical evaluation of a one-step self-etch and a two-step etch-and-rinse adhesive in non-carious cervical lesions [Internet]. Vol. 43, Journal of Dentistry. 2015. p. 350–61. Available from: http://dx.doi.org/10.1016/j.jdent.2014.12.009

42. Marshall SJ, Balooch M, Breunig T, Kinney JH, Tomsia AP, Inai N, et al. Human dentin and the dentin-resin adhesive interface [Internet]. Vol. 46, Acta Materialia. 1998. p. 2529–39. Available from: http://dx.doi.org/10.1016/s1359-6454(98)80037-2

43. Perdigão J, Lambrechts P, Van Meerbeek B, Braem M, Yildiz E, Yücel T, et al. The interaction of adhesive systems with human dentin. Am J Dent [Internet]. 1996 Aug;9(4):167–73. Available from: https://www.ncbi.nlm.nih.gov/pubmed/9002793

44. Migliau G. Evaluation of over-etching technique in the endodontically treated tooth restoration [Internet]. Annali di Stomatologia. 2015. Available from: http://dx.doi.org/10.11138/ads/2015.6.1.010

45. Garg N, Garg A. Restoration of Endodontically Treated Teeth [Internet]. Textbook of Endodontics. 2014. p. 428–428. Available from: http://dx.doi.org/10.5005/jp/books/12108_27

46. Owens BM, Johnson WW, Harris EF. Marginal Permeability of Self-etch and Total-etch Adhesive Systems [Internet]. Vol. 31, Operative Dentistry. 2006. p. 60–7. Available from: http://dx.doi.org/10.2341/04-185

47. Perdigão J, Geraldeli S, Hodges JS. Total-etch versus self-etch adhesive [Internet]. Vol. 134, The Journal of the American Dental Association. 2003. p. 1621–9. Available from: http://dx.doi.org/10.14219/jada.archive.2003.0109

48. Al-Saleh M, El-Mowafy O. Microtensile bond strength of restorative composite bonded with self-adhesive resin cements to enamel and dentin [Internet]. Vol. 1, Journal of Research in Dentistry. 2013. p. 3. Available from: http://dx.doi.org/10.19177/jrd.v1e120133-16

49. Kannan A, Venugopalan S. A systematic review on the effect of use of impregnated retraction cords on gingiva [Internet]. Vol. 11, Research Journal of Pharmacy and Technology. 2018. p. 2121. Available from: http://dx.doi.org/10.5958/0974-360x.2018.00393.1

50. Gre C, de Andrada MAC, Junior SM. Microtensile bond strength of a universal adhesive to deep dentin [Internet]. Vol. 19, Brazilian Dental Science. 2016. p. 104. Available from: http://dx.doi.org/10.14295/bds.2016.v19i2.1259