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Assessment of Color Dimension for Anterior Fixed Prosthesis- Key to successful smile makeover

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ABSTRACT :

Colour matching plays a major role in achieving morphological and optical acceptance in community setting. It improves patients esthetics, satisfaction level and also the efficacy of the dentist. Thus this study focuses on dimensions of colour and it's importance in clinical application. The aim of the study is to investigate the colour matching of anterior fixed prosthesis based on hue,chroma,value.This retrospective study was conducted using records of patients visited private Dental College. A total of 350 consecutive case records of patients who underwent treatment with fabrication of anterior fixed prosthesis were retrieved after reviewing 32,000 patients. Relevant photographs from their records were retrieved.Software was used to analyse the dimensions of color.Obtained data were entered and subjected to statistical analysis. Descriptive statistics was done to present the matching of hue,chroma and value.Chi-square association was performed to find the colour matching and its association with location of teeth and the performance of dental undergraduate and postgraduate students . Colour

matching of anterior fixed prosthesis based on dimension of colour showed the prevalence of hue (96.3%), chroma (96.2%), value(30.5%). There was no statistical significance between hue, chroma ($p>0.005$) but value had statistical significance ($p<0.001$). Within the limitations of the study, hue and chroma matching are highly satisfactory but there is a deficiency in matching value. So, there is need of application of VITA 3D master and spectrophotometer for value matching which may further blend to patient's existing dentition and provide improved esthetics

Keywords: chroma, colour, esthetics, hue, shade, value

1. INTRODUCTION :

The dental appearance is an integral component of facial beauty (1). Good dental appearances are thought to be a requirement of prestigious occupations among some professional group (2,3). Placement of a restoration or prosthesis which improves dental appearance results in a positive effect on a patient's self esteem and quality of life (4). Aesthetically pleasing teeth are associated with kindness, popularity, intelligence, and high social status. Arguably even more important is the fact that the level of satisfaction with one's own smile attractiveness is directly correlated with self-perception and certain psychological traits.An unattractive smile is correlated with the personality characteristics of neuroticism and self-esteem ,ultimately affecting overall well-being and health (5,6).

Historically, a large variety of materials was used for removable and fixed prosthesis, with ceramics providing a favorable combination of aesthetics and durability.Over the past 50 yrs, developments were geared toward metal-free all-ceramic materials that offer tooth-like aesthetics with superior physical properties, even for posterior teeth. These include aluminous feldspathic ceramics (7) and, more recently, leucite-reinforced feldspathic ceramics and lithium disilicates for single-unit monolithic all-ceramic restorations (5,8). Glass-infiltrated ceramics was deemed the first "high-strength" ceramic materials with excellent clinical success (9). Thus several factors are to be satisfied to create natural esthetics.

Colour is a property of light. Objects have no colour of their own. They just reflect a particular wavelength from the colour spectrum (10,11). Most of the colour found in the natural tooth is established within the tooth. The semitransparent structure of the tooth makes the colour matching more complex (12). The most popular method for describing colour is the Munsell system. The three attributes of colour in this system are Hue, Chroma and Value [10,13].

Hue is referred to as the colour of an object. Hue is directly related to the wavelength of luminous radiation observed. It is specified as the dominant range of wavelength in the visible spectrum that yields the perceived colour, even though the exact wavelength of the perceived colour may not be present (14,15).Chroma is the intensity or saturation of a hue is called Chroma (10). The increase in chroma has a corresponding change in value.As chroma increases, value decreases.Value is the relative darkness or lightness of a colour is value (10). Value is the amount of light returned from an object. It was described as a white to black gray scale by Munsell Lowering value means diminished light returns from the object illuminated, more light is being absorbed/scattered or transmitted [14,16].

In addition to hue, chroma and value, there are other secondary optical properties which include translucency, opacity, opalescence, surface gloss,surface texture and fluorescence. They contribute to the natural appearance of restoration. According to Vaneni, tooth colour is composed of five dimensions which include, chromaticity, value, intensity, opalescent, characterization (17).

Shade selection involves perception of colour. It depends on illumination, environment and the viewer. Initial shade selection should initially be made with daylight or colour-corrected lighting, and then the shade should be matched under different lights to avoid metamerism(18,19).There are two techniques which are visual technique and instrumental techniques (20).

Dental shade guides are the most commonly used technique by clinicians in day to day practice (21). The most popular shade guides used are Vitapan Classical shade guide, Vita 3D master shade guide, Chromascop shade guide system (22,23).
Vitapan 3d-Master Shade guide was introduced in 1998 which reflects distribution of tooth shades in nature (24). Vitapan 3D-Master (VITA Zahnfabrik, Bad Sackingen, Germany), a systematically arranged shade guide, is made up with six series of fired porcelain, built up with cervical, dentinal, and incisal powders, which are composed of

feldspar nepheline and high-temperature ceramic pigments from the VITA family porcelains. These six series consist of 29 shade tabs ranging from the lightest to the darkest lightness, from the lowest to the highest chroma and from yellow to red hue. The shade tabs in this shade guide are designated with 3-digit number and letter combinations. For example, for the 2M3 designation, the first number (2) indicates the lightness, the letter (M) indicates the hue, and the last number (3) indicates the chroma. As stated by the manufacturer, the letter L indicates yellow hue, M indicates middle hue and R indicates red hue (25).But this is not widely used in India.

To overcome certain errors in commercial shade guides, different machines and devices are used in order to make the colour assessment more simple, rapid, precise and perfect (20) . Computer assisted shade analysis is more accurate and more consistent compared with human shade assessment. Advantages include no influence on surroundings or lighting and results being reproducible (26,27). They include RGB devices, digital cameras, spectrophotometers, colorimeters (20,28).Spectrophotometer is a photometer that can measure intensity as a function of the colour, more specifically,the wavelength of light (29). It measures the reflectance for each wavelength and allows to calculate values (30,31).Previously our team has a rich experience in working on various research projects across multiple disciplines The (32–34)(35–46).Colour matching plays a major role in achieving morphological and optical acceptance in community setting. It improves patients esthetics, satisfaction level and also the efficacy of the dentist. Thus this study was done to investigate the colour matching of anterior prosthesis based on dimensions of colour.

2. MATERIALS AND METHODS :

2.1 Study Design and Setting :

A retrospective study was conducted by reviewing 86,000 patient records of the authors University hospital for a period of nine months from June 2019 to March 2020. Ethical clearance was obtained from the Institutional ethical board.

2.2 Case record selection:

About 8564 consecutive case records of patients with age ranging from 20 - 90 years were sorted. 1289 case reports of patients with complete edentulism were excluded. Of 7275 patient records. Overall 450 patients were assessed from which 350 patients' relevant photographs of anterior fixed prosthesis fabricated in the author university were retrieved.

2.3 Data collection:

Relevant photographs of anterior fixed prosthesis done by undergraduates and postgraduates fulfilling the inclusion criteria were gathered and finalised by 3 reviewers.Shade matching used was Vita Classic.

2.4 Procedure:

- Selected photographs imported in Photoshop software (Adobe Photoshop)
- Hue was assessed by observation of basic colour of adjacent teeth
- Chroma was checked changing intensity of picture colour
- Value was checked making the picture black and white as the movement is based on brightness
- All dimensions of colour was verified with three observer to avoid observer bias

2.6 Statistical analysis:

Statistical analysis was done using Statistical Package for the Social Sciences (SPSS) Version 23.0. Dependent variable was the dimension of colour (hue,chroma and value) and the independent variable was age, gender.Descriptive statistics was done to present colour matching based on dimensions of colour.Chi square association using crosstabs was done. A p value <0.05 was considered to be significant.

3. RESULTS AND DISCUSSION :

The final data set consisted of 350 patients of Indian origin who underwent treatment for anterior fixed prosthesis in Saveetha Dental College. Figure 1 showed the colour matching using patients' photographs based on

dimensions of colour. Hue, chroma, value was matched more in tooth no. 21 [Figure 2,3,4]. Colour matching of anterior fixed prosthesis based on dimension of colour showed the prevalence of hue (96.3%), Chroma (96.2%), and value(30.5%) [Figure 5]. There was no statistical significance between hue,chroma but value shows statistically significant difference ($p<0.001$. Our study showed that knowledge of colour matching was better among postgraduate students compared to undergraduate students.[Table 1]. But the percentage of value matching was lower in postgraduate students too(30.8%).

There was no statistical significance between hue,chroma but value shows statistically significant difference ($p<0.001$).The brightness of a crown is usually increased in two ways: by lowering chroma or by increasing the reflectivity of the surface. Lowering value means less light returns from the illuminated object and the remaining light is being absorbed or scattered elsewhere (47,48).Thus value is of utmost importance during colour matching. Our study showed that hue and chroma was matched well but value was deficient.

Accuracy and precision are two separate aspects of color measurement. Accuracy indicates the ability of the method to provide a correct shade match. In other words, accuracy or conformity refers to the concept of examining how closely the observed measurement conforms to a "correct result," which is available as the "reference," "criterion," or "gold standard" value for each measurement. Precision comprises the repeatability of the measuring method over time or the reproducibility of the whole measuring process.The degree of accuracy depends on the instrument used, type of material, opacity, texture, and translucency of the measured side.To apply digital shade selection for human teeth, the accuracy and reproducibility, as well as inter examiner reliability, must be considered [(49)].

The reflectance from the dentin altered by the absorption, scattering, and thickness of the enamel result for the actual color of natural teeth (50,51). Hence, recognition of the optical properties of teeth is imperative for precise and harmonious color reproduction. Esthetics of dental restoration are shaped by color and its elements, such as hue, value, and chroma; translucency and opacity; light transmission and scattering; and metamerism and fluorescence (52). A number of studies have shown that the dependability of the VITA 3D-Master shade guide to be superior to that of VITA classic among general dentists, even though the two systems displayed one and the same consistency amid prosthodontists [(53)]. Hence there is a need for communication with the lab through photographs and a need for spectrophotometer and Vita 3D Master for effective value matching .

A study by Dilak Nalbant showed that value scores were increased in instrumental matching rather than visual shade matching (54,55). Similar study done by Zarko Udiljak et.al showed that those who used shade guides arranged according to hue over a longer period of time found it more difficult to assess the colour according to value (56). According to Sagars J, the use of shade guide showed that hue and chroma can be easily discerned but value is not determined correctly. 75% of improper shade matching involves deviation in value (57,58). The distribution of chroma of the shade tabs within the same value group were relatively ordered; but the values of different value groups were overlapped in several instances (59). Thus in many other literatures; it has been proved that value was not properly determined using traditional methods. Thus advanced techniques like Vita 3D master shade guide or spectrophotometer can be used to measure the value accurately.The variation in our result may be due to this usage of traditional methods. But the advantage of our study would be the usage of photoshop software which helped to assess easily and accurately with much less time.

Our belief is that prosthetic users, wearing prosthesis perceived as aesthetically attractive, are more confident with their personal body perception and, consequently, gain psychological well-being. However, many users are unsatisfied with the aesthetics of their prosthesis. With our research, we hope to improve future prosthetic devices and positively impact the emotional aspect of users of prosthetics. Limitation of the study was a sample size not generalised by the entire population. Thus multicentre study with large sample size should be conducted for confirmation of this study . Our institution is passionate about high quality evidence based research and has excelled in various fields ((60–70).

4. CONCLUSION :

Within the limitations of the study,hue and chroma matched highly satisfactory but there is deficiency of matching value of anterior teeth, which is most important pillar for shade matching.So, there is need of value matching using VITA 3D master, spectrophotometer in day to day shade selection procedures to make the artificial prosthesis more nature and lifelike.

5. AUTHOR'S CONTRIBUTION:

First author A.Ashwatha Pratha performed data collection, analysis, and interpretation and wrote the manuscript.Second author Jessy P and Third author Subhabrata Maiti contributed to conception, study design, analysis, interpretation and critically revised the manuscript and fourth author Jain contributed to review the manuscript. All the authors have discussed the results and contributed to the final manuscript.

6. **ACKNOWLEDGEMENT:**

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7. CONFLICT OF INTEREST:

Nil

8. REFERENCES:

1. Newton JT, Prabhu N, Robinson PG. The impact of dental appearance on the appraisal of personal characteristics. Int J Prosthodont. 2003 Jul;16(4):429–34.
2. Jenny J, Proshek JM. Visibility and prestige of occupations and the importance of dental appearance. J Can Dent Assoc. 1986 Dec;52(12):987–9.
3. Jain AR, Nallaswamy D, Ariga P, Ganapathy DM. Determination of correlation of width of maxillary anterior teeth using extraoral and intraoral factors in Indian population: A systematic review. World J Dent. 2018;9:68–75.
4. Davis LG, Ashworth PD, Spriggs LS. Psychological effects of aesthetic dental treatment. J Dent. 1998 Sep;26(7):547–54.
5. Blatz MB, Chiche G, Bahat O, Roblee R, Coachman C, Heymann HO. Evolution of Aesthetic Dentistry. J Dent Res. 2019 Nov;98(12):1294–304.
6. Jyothi S, Robin PK, Ganapathy D, Anandiselvaraj. Periodontal Health Status of Three Different Groups Wearing Temporary Partial Denture. Research Journal of Pharmacy and Technology. 2017 Dec 30;10(12):4339–42.
7. McLean JW, Hughes TH. The reinforcement of dental porcelain with ceramic oxides. Br Dent J. 1965 Sep 21;119(6):251–67.
8. 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. 2019 Jun;28(3):289–95.
9. Degrange M, Sadoun M, Heim N. [Dental ceramics. Part 2: The new ceramics]. J Biomater Dent. 1987 Mar;3(1):61–9.
10. Shammas M, Alla RK. Color and Shade Matching in Dentistry. Trends Biomater Artif Organs. 2011 Sep 8;25(4):172–5.
11. Selvan SR, Ganapathy D. Efficacy of fifth generation cephalosporins against methicillin-resistant Staphylococcus aureus-A review. Research Journal of Pharmacy and Technology. 2016;9(10):1815–8.
12. Cal E, Güneri P, Kose T. Comparison of digital and spectrophotometric measurements of colour shade guides. J Oral Rehabil. 2006 Mar;33(3):221–8.
13. 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. 2016 Dec;10(12):ZC67–70.
14. Department of Conservative Dentistry and Endodontics, Govt. Dental College & Hospital, Ahmedabad, India, Vadher DR, Parmar DG, Kanodia DS, Chaudhary DA, Kaur DM, et al. Basics of Color in Dentistry: A Review. IOSRJDMS. 2014;13(9):78–85.
15. Ajay R, Suma K, Ali SA, Kumar Sivakumar JS, 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. J Pharm Bioallied Sci. 2017 Nov;9(Suppl 1):S154–60.
16. Subasree S, Murthykumar K, Others. Effect of Aloe Vera in Oral Health-A Review. Research Journal of Pharmacy and Technology. 2016;9(5):609–12.
17. Vanini L. Conservative composite restorations that mimic nature: A Step-by-Step Anatomical Stratification Technique. Journal of cosmetic dentistry. 2010;26(3).
18. Ho CCK. Principles of Shade Selection. In: Banerji S, Mehta SB, Ho CCK, editors. Practical Procedures in Aesthetic Dentistry. Oxford, UK: John Wiley & Sons, Ltd; 2017. p. 34–8.
19. Ranganathan H, Ganapathy DM, Jain AR. Cervical and Incisal Marginal Discrepancy in Ceramic

Laminate Veneering Materials: A SEM Analysis. Contemp Clin Dent. 2017 Apr;8(2):272–8.
20. Bhat V, Prasad DK, Sood S, Bhat A. Role of colors in prosthodontics: application of color science in restorative dentistry. Indian J Dent Res. 2011 Nov;22(6):804–9.
21. Paravina RD. Color in Dentistry: Is “Everything We Know” Really So? CDE World. 2010;
22. Brewer JD, Wee A, Seghi R. Advances in color matching. Dent Clin North Am. 2004 Apr;48(2):v, 341–58.
23. Vijayalakshmi B, Ganapathy D. Medical management of cellulitis. Research Journal of Pharmacy and Technology. 2016;9(11):2067–70.
24. Okubo SR, Kanawati A, Richards MW, Childress S. Evaluation of visual and instrument shade matching. J Prosthet Dent. 1998 Dec;80(6):642–8.
25. Lee Y-K, Yu B, Lim H-N. Vitapan 3D-master shade guide showed no fluorescence emission. Indian J Dent Res. 2012 Nov;23(6):742–6.
26. Paravina R, Stankovi D, Aleksov L, Mladenovi D, Risti K. Problems in standard shade matching and reproduction procedure in dentistry: A review of the state of the art dentistry. Plan Perspect. 4(1):1997.
27. Fundamentals of Color: Shade Matching and Communiation in Esthetic Dentistry - Overlightly. Overlightly. Overlightly; 2020.
28. Ganapathy DM, Kannan A, Venugopalan S. Effect of Coated Surfaces influencing Screw Loosening in Implants: A Systematic Review and Meta-analysis. World Journal of Dentistry. 2017;8(6):496–502.
29. Marcucci B. A shade selection technique. J Prosthet Dent. 2003 May;89(5):518–21.
30. Cal E, Sonugelen M, Guneri P, Kesercioglu A, Kose T. Application of a digital technique in evaluating the reliability of shade guides. J Oral Rehabil. 2004 May;31(5):483–91.
31. Ashok V, Suvitha S. Awareness of all Ceramic Restoration in Rural Population. Research Journal of Pharmacy and Technology. 2016 Oct 28;9(10):1691–3.
32. Hafeez N, Others. Accessory foramen in the middle cranial fossa. Research Journal of Pharmacy and Technology. 2016;9(11):1880.
33. Krishnan RP, Ramani P, Sherlin HJ, Sukumaran G, Ramasubramanian A, Jayaraj G, et al. Surgical Specimen Handover from Operation Theater to Laboratory: A Survey. Ann Maxillofac Surg. 2018 Jul;8(2):234–8.
34. Somasundaram S, Ravi K, Rajapandian K, Gurunathan D. Fluoride content of bottled drinking water in Chennai, Tamilnadu. J Clin Diagn Res. 2015;9(10):ZC32.
35. Felicita AS, Sumathi Felicita A. Orthodontic extrusion of Ellis Class VIII fracture of maxillary lateral incisor – The sling shot method [Internet]. Vol. 30, The Saudi Dental Journal. 2018. p. 265–9. Available from: http://dx.doi.org/10.1016/j.sdentj.2018.05.001
36. Kumar S, Rahman R. Knowledge, awareness, and practices regarding biomedical waste management among undergraduate dental students. Asian J Pharm Clin Res. 2017 Aug 1;10(8):341.
37. Gurunathan D, Shanmugaavel AK. Dental neglect among children in Chennai. J Indian Soc Pedod Prev Dent. 2016 Oct 1;34(4):364.
38. Sneha S, Others. Knowledge and awareness regarding antibiotic prophylaxis for infective endocarditis among undergraduate dental students. Asian Journal of Pharmaceutical and Clinical Research. 2016;154–9.
39. Dhinesh B, Isaac JoshuaRamesh Lalvani J, Parthasarathy M, Annamalai K. An assessment on performance, emission and combustion characteristics of single cylinder diesel engine powered by Cymbopogon flexuosus biofuel. Energy Convers Manage. 2016 Jun 1;117:466–74.
40. Choudhari S, Thenmozhi MS. Occurrence and Importance of Posterior Condylar Foramen. Laterality. 2016;8:11–43.
41. Paramasivam A, Vijayashree Priyadharsini J, Raghunandhakumar S. N6-adenosine methylation (m6A): a promising new molecular target in hypertension and cardiovascular diseases. Hypertens Res. 2020 Feb;43(2):153–4.
42. Wu F, Zhu J, Li G, Wang J, Veeraraghavan VP, Krishna Mohan S, et al. Biologically synthesized green gold nanoparticles from Siberian ginseng induce growth-inhibitory effect on melanoma cells (B16). Artif Cells Nanomed Biotechnol. 2019 Dec;47(1):3297–305.
43. Palati S, Ramani P, Shrelin H, Sukumaran G, Ramasubramanian A, Don KR, et al. Knowledge, Attitude and practice survey on the perspective of oral lesions and dental health in geriatric patients residing in old age homes [Internet]. Vol. 31, Indian Journal of Dental Research. 2020. p. 22. Available from: http://dx.doi.org/10.4103/ijdr.ijdr_195_18
44. Saravanan M, Arokiyaraj S, Lakshmi T, Pugazhendhi A. Synthesis of silver nanoparticles from Phenerochaete chrysosporium (MTCC-787) and their antibacterial activity against human pathogenic bacteria. Microb Pathog. 2018 Apr;117:68–72.
45. GovinDaraju L, Gurunathan D. Effectiveness of Chewable Tooth Brush in Children-A Prospective Clinical Study. J Clin Diagn Res. 2017;11(3):ZC31.

46. Vijayakumar Jain S, Muthusekhar MR, Baig MF, Senthilnathan P, Loganathan S, Abdul Wahab PU, et al. Evaluation of Three-Dimensional Changes in Pharyngeal Airway Following Isolated Lefort One Osteotomy for the Correction of Vertical Maxillary Excess: A Prospective Study. J Maxillofac Oral Surg. 2019 Mar;18(1):139–46.
47. Sikri VK. Color: Implications in dentistry. J Conserv Dent. 2010 Oct;13(4):249–55.
48. Ashok V, Nallaswamy D, Benazir Begum S, Nesappan T. Lip Bumper Prosthesis for an Acromegaly Patient: A Clinical Report. J Indian Prosthodont Soc. 2014 Dec;14(Suppl 1):279–82.
49. Parameswaran V, Anilkumar S, Lylajam S, Rajesh C, Narayan V. Comparison of accuracies of an intraoral spectrophotometer and conventional visual method for shade matching using two shade guide systems. J Indian Prosthodont Soc. 2016 Oct;16(4):352–8.
50. Seghi RR, Johnston WM, O'Brien WJ. Spectrophotometric analysis of color differences between porcelain systems. J Prosthet Dent. 1986 Jul;56(1):35–40.
51. Venugopalan S, Ariga P, Aggarwal P, Viswanath A. Magnetically retained silicone facial prosthesis. Niger J Clin Pract. 2014 Mar;17(2):260–4.
52. Lee YK, Lim BS, Kim CW, Powers JM. Comparison of color of resin composites of white and translucent shades with two shade guides. J Esthet Restor Dent. 2001;13(3):179–86.
53. Hammad IA. Intrarater repeatability of shade selections with two shade guides. J Prosthet Dent. 2003 Jan;89(1):50–3.
54. Nalbant AD, Babaç YG, Türkcan İ, Yerliyurt K, Akçaboy C, Nalbant L. Examination of Natural Tooth Color Distribution Using Visual and Instrumental Shade Selection Methods. Balkan Journal of Dental Medicine. 2016 Jul 1;20(2):104–10.
55. Kannan A, Venugopalan S. A systematic review on the effect of use of impregnated retraction cords on gingiva. Research Journal of Pharmacy and Technology. 2018;11(5):2121–6.
56. Udiljak Ž, Illeš D, Knezović Zlatarić D, Ćelić R. Effect of Clinical Experience on the Shade Matching Accuracy in Different Dental Occupational Groups. Acta Stomatol Croat. 2018 Jun;52(2):132–9.
57. Shade Matching for Today's Dentistry. Dental Economics. 2002.
58. Basha FYS, Ganapathy D, Venugopalan S. Oral Hygiene Status among Pregnant Women. Research Journal of Pharmacy and Technology. 2018 Jul 31;11(7):3099–102.
59. Ahn J-S, Lee Y-K. Color distribution of a shade guide in the value, chroma, and hue scale. J Prosthet Dent. 2008 Jul;100(1):18–28.
60. Vijayashree Priyadharsini J. In silico validation of the non-antibiotic drugs acetaminophen and ibuprofen as antibacterial agents against red complex pathogens. J Periodontol. 2019 Dec;90(12):1441–8.
61. Pc J, Marimuthu T, Devadoss P. Prevalence and measurement of anterior loop of the mandibular canal using CBCT: A cross sectional study. Clin Implant Dent Relat Res [Internet]. 2018; Available from: https://europepmc.org/article/med/29624863
62. Ramesh A, Varghese S, Jayakumar ND, Malaiappan S. Comparative estimation of sulfiredoxin levels between chronic periodontitis and healthy patients - A case-control study. J Periodontol. 2018 Oct;89(10):1241–8.
63. Ramadurai N, Gurunathan D, Samuel AV, Subramanian E, Rodrigues SJL. Effectiveness of 2% Articaine as an anesthetic agent in children: randomized controlled trial. Clin Oral Investig. 2019 Sep;23(9):3543–50.
64. Sridharan G, Ramani P, Patankar S, Vijayaraghavan R. Evaluation of salivary metabolomics in oral leukoplakia and oral squamous cell carcinoma. J Oral Pathol Med. 2019 Apr;48(4):299–306.
65. Ezhilarasan D, Apoorva VS, Ashok Vardhan N. Syzygium cumini extract induced reactive oxygen species-mediated apoptosis in human oral squamous carcinoma cells. J Oral Pathol Med. 2019 Feb;48(2):115–21.
66. Mathew MG, Samuel SR, Soni AJ, Roopa KB. Evaluation of adhesion of Streptococcus mutans, plaque accumulation on zirconia and stainless steel crowns, and surrounding gingival inflammation in primary molars: Randomized controlled trial. Clin Oral Investig. 2020;1–6.
67. Samuel SR. Can 5-year-olds sensibly self-report the impact of developmental enamel defects on their quality of life? Int J Paediatr Dent. 2021 Mar;31(2):285–6.
68. R H, Hannah R, Ramani P, Ramanathan A, R JM, Gheena S, et al. CYP2 C9 polymorphism among patients with oral squamous cell carcinoma and its role in altering the metabolism of benzo[a]pyrene [Internet]. Vol. 130, Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology. 2020. p. 306–12. Available from: http://dx.doi.org/10.1016/j.oooo.2020.06.021
69. Chandrasekar R, Chandrasekhar S, Sundari KKS, Ravi P. Development and validation of a formula for objective assessment of cervical vertebral bone age. Prog Orthod. 2020 Oct 12;21(1):38.
70. Vijayashree Priyadharsini J, Smiline Girija AS, Paramasivam A. In silico analysis of virulence genes in an emerging dental pathogen A. baumannii and related species. Arch Oral Biol. 2018 Oct;94:93–8.

Figure 1: Adobe Photoshop Images representing Hue, Chroma and Value of Anterior Fixed Prosthesis present in 11

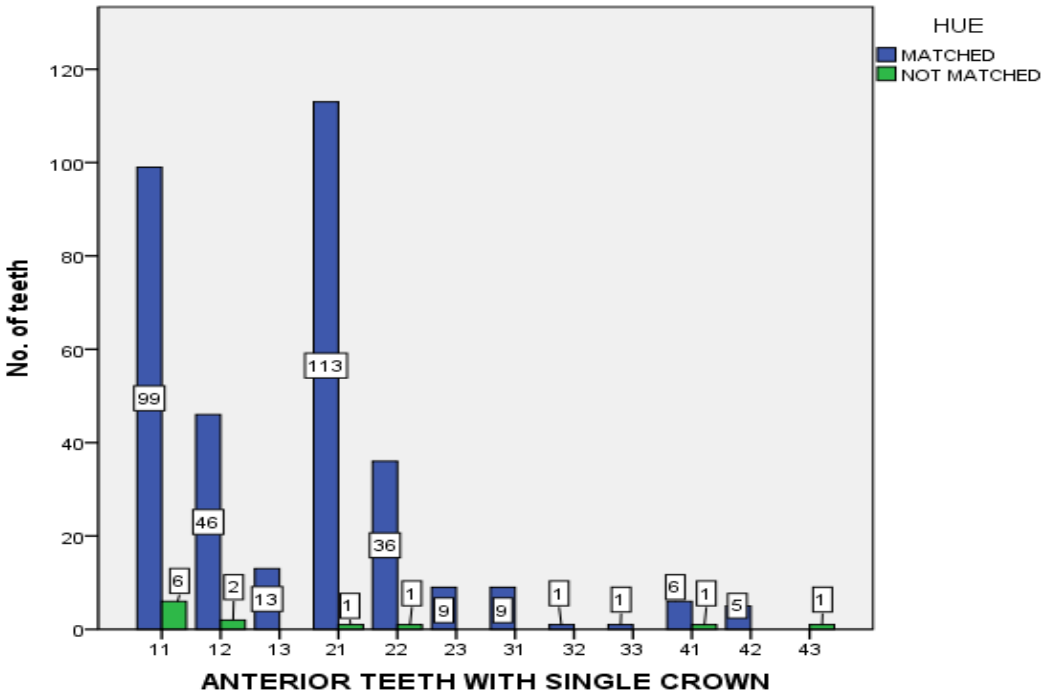

Figure 2: shows a bar graph representing the association between the anterior teeth with single crown and and colour matching based on hue. X-axis represents the anterior single crown and Y-axis represents the number of teeth. Association between the anterior teeth with single crown and colour matching based on hue was done using Chi- square test and was significant. Pearson Chi- square test= 33.993, p<0.001 (statistically significant). Hue was matched more in 11 and 21 compared to other anterior teeth.

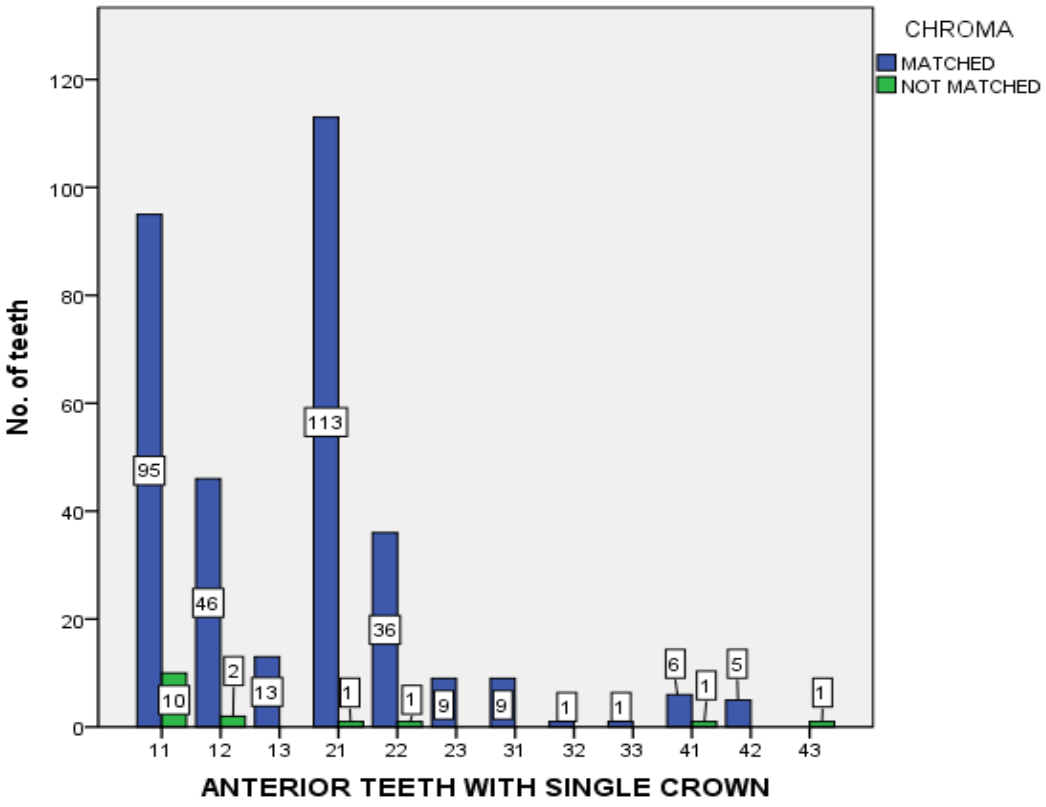

Figure 3: shows a bar graph representing the association between the anterior teeth with a single crown and colour matching based on chroma. X-axis represents the anterior single crown and Y-axis represents the number of teeth. Association between the anterior single crown and colour matching based on chroma was done using Chi- square

test and was significant. Pearson Chi- square test=33.993, p<0.001 (statistically significant). Chroma was matched more in 11 and 21 compared to other anterior crowns.

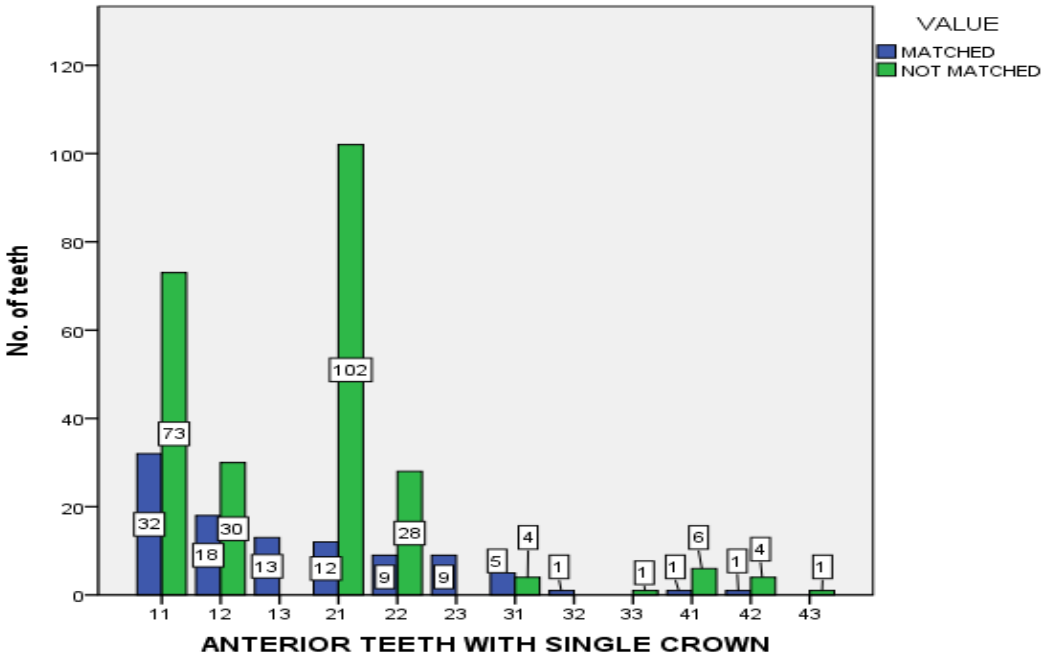

Figure 4: shows a bar graph representing the association between the anterior teeth with a single crown and colour matching based value. X-axis represents the anterior teeth with a single crown and Y-axis represents the number of teeth. Association between the anterior teeth with single crown and colour matching based on value was done using Chi- square test and was significant. Pearson Chi- square test= 82.464, p<0.001 (statistically significant). Value was matched more in 11 and 21 compared to other anterior teeth.

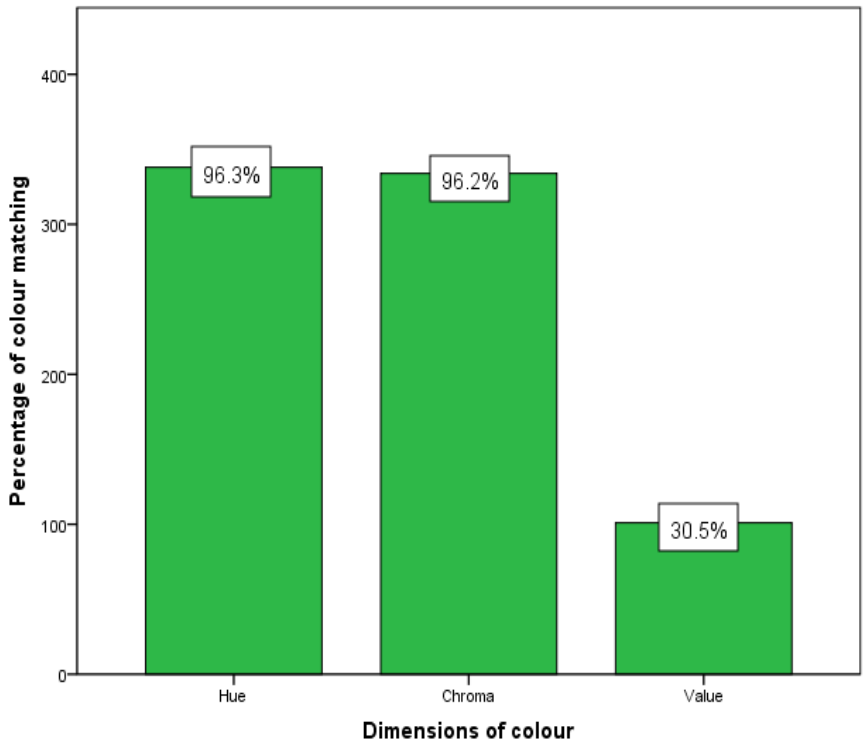

Figure 5: Bar graph representing the distribution of hue(96.3%), Chroma (96.2%), and Value (30.5%) matching status. Here X-axis represents the dimensions of colour and Y-axis represents the percentage of colour matching.

DIMENSION OF COLOR		STUDENT		STATISTICAL VALUE	
		UG	PG	Pearson Chi-square value	P value
HUE	Matched	92.7%	96.9%	2.31	0.12
	Non-Matched	7.3%	3.1%		
CHROMA	Matched	92.7%	96.9%	2.31	0.12
	Non-Matched	7.3%	3.1%		
VALUE	Matched	18.2%	30.8%	3.62	0.05*
	Non- Matched	81.8%	69.2%		

Table 1: Representing quality of colour matching among undergraduate (UG) and postgraduate (PG) students. It was found that quality of colour matching was better among postgraduate students when compared to undergraduate students. But the percentage of 'value' matching was comparatively lower among both the categories.(*statistically significant)