

Encompassing The Concept Of Shade Selection In Maxillofacial Prosthodontics

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Review Article

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Abstract :

The defects which are seen on the maxillofacial region are caused due to various causes like trauma, surgical intervention to cancerous lesion or congenital disorders however they affect the psychological and social health of an individual. In such patients an aesthetic maxillofacial prosthesis rehabilitates the anatomic defect but also restores the psychological health of the patient. Out of many factors which are required for the success of the maxillofacial prosthesis, the most important is "AESTHETICS" amongst other factors like retention and close adaptation & Aesthetics of a Maxillofacial Prosthesis depends on proper shade matching. Also one of the major goals of Prosthodontic Dentistry is the restoration of the lost tissues and replacement of the missing structures but also to make the restoration or prosthesis look natural which blends easily with the anatomic structures and remain undetected. All the maxillofacial prosthetic materials and prostheses matched aptly with the skin shade of the patient increases the aesthetic value and makes the prostheses acceptable to the patient. Various visual shade guides are available in the field along with specified shade tabs that are commonly used for shade selection. However there is no literature review which states about the properties, pros and cons of all these

maxillofacial prosthetic materials. Proper shade matching makes the maxillofacial prosthetic material biomimetic. So the following Literature Review is intended to encompass all the theories and studies regarding shade matching in area of Maxillofacial Prostheses. It also includes the various techniques applied and a wide array of shade guides fabricated for the easier and apt shade matching.

Keywords: *Esthetic, Shade Selection, Maxillofacial Prosthesis.*

INTRODUCTION

Aristotle has rightly remarked beauty as “Beauty is a greater recommendation than any letter of introduction.”¹ The defects in the Maxillofacial region can be caused due to varied array of reasons like treatment of cancerous lesions and certain surgical intervention; defects caused due to trauma or defects which are present from the birth and their rehabilitation demands for more experienced and greater quality checked prosthetic therapy. These maxillofacial defects are situated in aesthetic body area which is seen in association with one’s own image which is envisioned. Any of the minute changes in the appearance of facial features endangers the physical, physiological, social, and psychosomatic health of these patients. A prosthesis fabricated for rehabilitation of maxillofacial defects paves a way for the patient to travel through all difficulties and also enhances the quality of life of the patient.² Quality of Life of patients is the required outcome of the treatment of any health related treatment³ which is incorporated into daily Dental Clinics and reviews.⁴

Facial prostheses are fabricated using restorative material such as acrylic resin or silicone, and the color results from the addition of colorants to them.⁵ Silicones also called by the name “polydimethyl siloxane” which has a great share of success in materials used for prostheses made for maxillofacial defects. Silicones gained popularity compared to other materials used for maxillofacial prostheses because they have advantages like greater tear and tensile strength over a large temperature range, their manipulation is easier, possess high degree of chemical inertness, is least toxic, is stable over large range of temperatures and also has oxidative stability.⁶

Color matching has always been a challenge to the maxillofacial Prosthodontists. Accurate matching shade knowledge of human skin is a crucial step in the synthesis of maxilla-facial prostheses. Amongst the various communities of the globe the skin shade of the Indian community is considered as an exclusive composition formed by alloying variety of light and dark complexions.

In the ancient times the only way the coloring of maxillofacial prostheses was done by extrinsic coloring to match the skin shade. Barnhart et al was successful in fabricating silicone which was commercially available which gave a greater natural appearance, good depth orientation, and a long lasting skin tone by coloring the silicone rubber intrinsically.⁷

Edwards and Duntly attributed skin color of natural human skin to be induced by five pigments namely Melanin, Melanoid, Oxidized Haemoglobin, Reduced Haemoglobin and Carotene. It was also stated that the characteristics regarding absorption of these five pigments, especially that of the Melanin, has a great contribution to the total amount of light which is reflected and it determines the Hue, Value and Chroma of the human skin.⁸

There are surely varied ways to approach and numerous techniques that are being put into use for achieving a perfect shade of maxillofacial prostheses. In spite of numerous technological advances and progress in the science of materials, the usage of trial and error technique for shade matching is being used on a wide scale in the practice of clinics.⁹ Skin is

made of multiple layers and this structure puts a limit to the usage of such methods which require instruments. They have disadvantages like more time consumption along with precision wise less significant in shade duplicating.¹⁰ The following Literature Review aims at stating down all the studies and techniques which were put forward for the purpose of shade simulation from the earliest of times along the present techniques. Additionally special shade guides available for the unique skin shades of the people in Indian Community are also discussed.

Shade Matching Techniques By Various Authors :

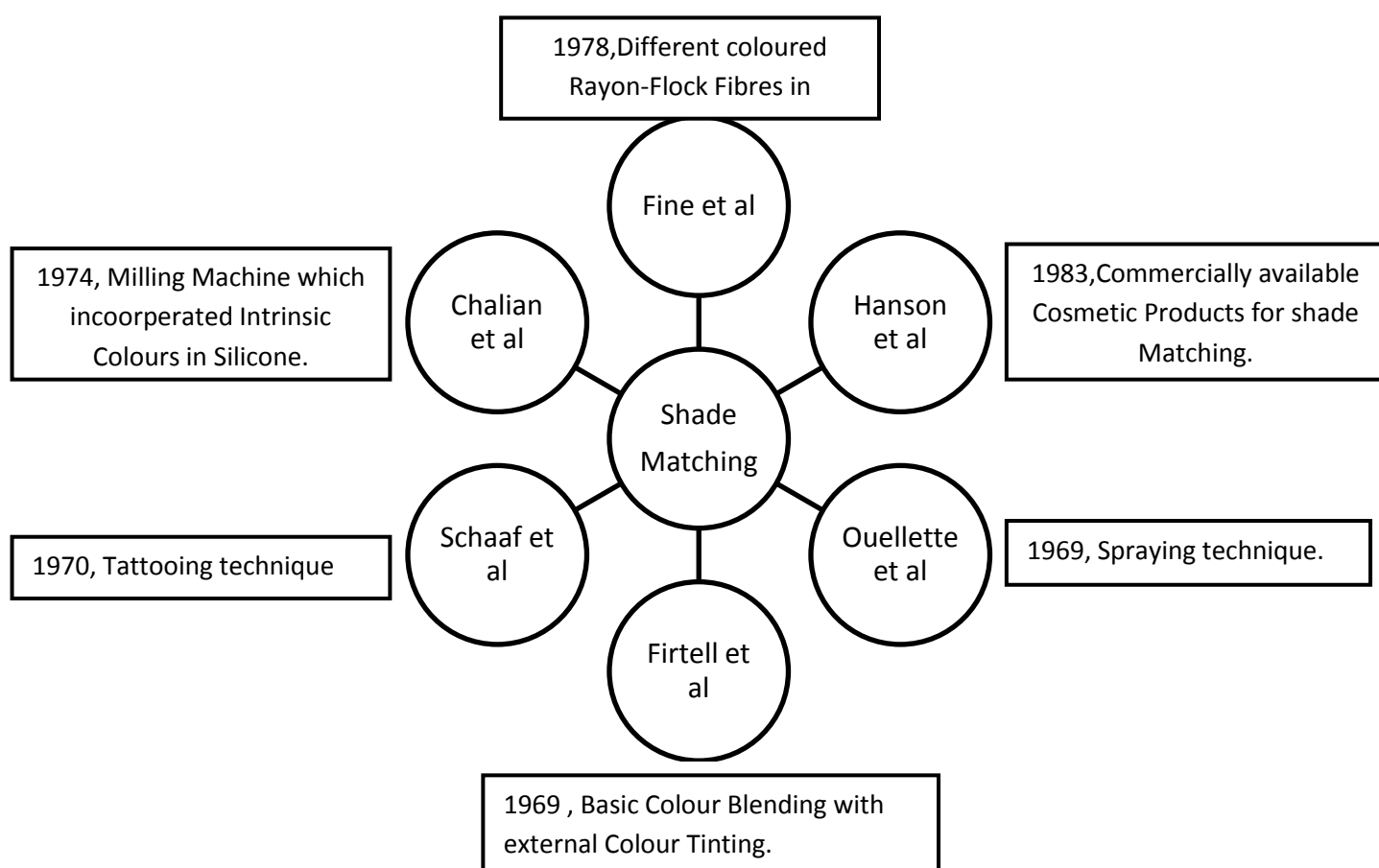


Chart No.1 depicting the studies, techniques and shade guides from the time period of 1969 to 1983 for shade simulation of maxillofacial prostheses.

Ouellette et al¹¹ :

In the year 1969, Ouellette et al developed a spraying technique for coloring facial prosthesis. In this technique external spraying over the facial prosthesis was done after the core shade was casted.

Advantages : this technique provided a feasible method for realistic tinting silicone prostheses.

Firtell and Barlett et al¹² :

in the same year of 1969 , a new method was introduced by Firtell and Barlett which was used for tinting the external surface of the facial prosthesis. It consisted of four steps namely, preparation of the basic color , blending of basic shade , surface tinting and record keeping. Advantages : the surface tinting of the maxillofacial prosthesis became reproducible.

Schaaf et al :

A method of tattooing was developed fro color characterization in 1970 . The technique consisted of Painting a coloring material on prosthesis surface, then inserting the paint with the help of a syringe and a needle to a total depth of 1–2 mm, in this manner it carries some of the pigments below the surface.

Advantages : this technique was user friendly .

Chalian et al :

Developed a milling machine in 1974 with a primary intention of simulation of the color of the human skin with its texture in the prostheses which is considered as final and is to be delivered .switching on the milling machine incorporates some colors which considered as intrinsic stains in the material made up of silicone . This is done by addition of small pieces of silicone material which have just a dab of the shade of color that are required to simulate the skin of the patient.

Advantages : the milling machine which was manufactured is portable and specially fabricated for staining of silicone which are heat vulcanised.

Fine et al :

In the year 1978 studied shade & its usage in facial prosthesis and stated a unique technique of staining maxillofacial prostheses. Technique involved the usage of different colors, named as “Different- colored Rayon Flock Fibers”, & the eradication of the silicone fluid used previously as a thinner. Also his extensive work on coloring led to a final statement that shade simulation is obtained on a “trial and error” visual basis or by the utilization of instruments and computed methods.

Advantages : the new technique led to eradication of the silicone fluid previously known as thinner.

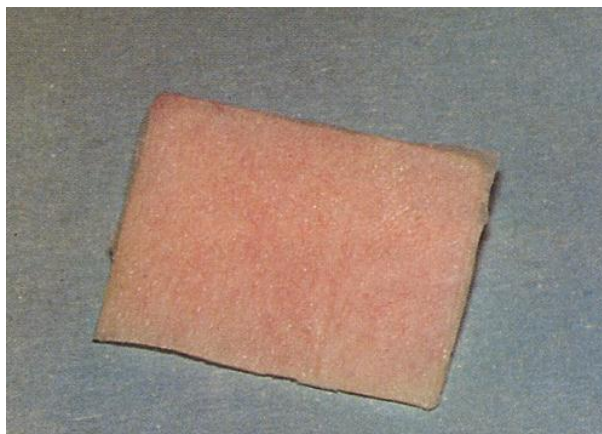
Hanson et al¹³ :

studied the role of commercial cosmetic in coloring maxillofacial prostheses in 1983. “Mary Kay Cosmetics” and “Elizabeth Arden” were the manufacturers which were considered. The first manufacturer provided samples with liquid. It was introduced directly into the crystal-clear, non-cured “Dow Corning MDX4- 4210” silicone polymers. Usage of these sequence of premixed cosmetic earth pigments in facial prosthesis coloring techniques provides an method which is efficient and also increases predictability of manufacturing of prosthesis which have the color of the skin.

Advantages : it was an effective and predictable method for fabricating maxillofacial prostheses which have the shade of the skin.

Ma et al :

Used for color verification of facial prosthesis before the final processing in the year 1988. He fabricated rectangular wedge-shaped medical grade silicone specimen for matching color for skin prostheses for maxillofacial prostheses.



(Figure No.1 depicts fabricated rectangular wedge-shaped medical grade silicone specimen for matching color for skin prostheses for maxillofacial prostheses by Ma et al in 1988)

Godoy et al :

He fabricated a guide in the year 1992 for acrylic resin color matching by mixing and matching different pigments with the assistance of a “roch wax carver” & a “Hu- Friedy Cleoid discoid carver”, which carries a load of 0.0158 g and 0.0024 g, respectively on an average. He fabricated a acrylic shade guide (color acrylic tabs of 6 cm×3 cm×1.5 mm were prepared).

Gozalo- Diaz et al. :

In the year 2007 conducted a study with the intention of determining the colour of living maxillofacial tissues & evaluation of the validity and reliability gained by test and retest for a non-contacting “45°/0° optical” configuration . A spectroradiometer along with an external source of light which were configured in the similar fashion . it was given a valid and reliable which is recommended as a viable alternative to obtained CIELab values shade simulation for rehabilitation of maxillofacial defects .

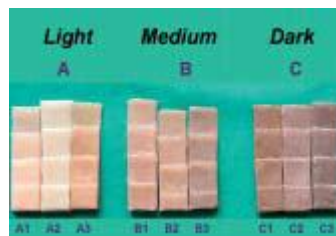
Advantages : the technique gives good acceptability and reliability.

Guttal et al

Conducted a study in 2008 whose purpose was to fabricate a color simulation guide for skin colour of the community in India for the technique four step wedge of silicone 1, 2, 4, and 6 mm were made and powder pigments were added, measured by digital analyzer, tested in

malar region . So silicone shade guide of three basic skin tones: light, medium, and dark complexion was fabricated.

Advantages : Shade Guide fabricated for the people of Indian community .



(Figure No.2 depicts silicone shade guide of three basic skin tones: light, medium, and dark complexion which was fabricated in 2008)

Hu et al¹⁴ :

In the year 2010 conducted a study to compare the accuracy of contact and noncontact measuring systems. Relatively thick “MFE” specimens which were 23 mm in diameter & whose translucency was different were made with “A- 2000”. It was a silicone-platinum elastomer (factor II) mixed with five pigments, i.e., tan, black, red, yellow, and titanium dioxide powder. Five instruments were utilized, and the color of each elastomer was measured three times by each instrument studied. Within the limitations of this study, the noncontacting measuring system performs differently in accuracy but comparable in precision when compared with contact measuring systems.

Advantages : accurate and the technique has great precision.

Wee et al¹⁵:

Wee et al in 2013 developed a skin shade guide for human skin of different racial groups . In his study one hundred and nineteen participants were screened and removed any cosmetic product applied on face, mandible and forehead region was at rest on the frame, and spectrophotometric scan was done as a result five unique skin shade tabs were developed for skin shade matching for maxillofacial prosthesis.

Advantages : Five distinct skin shade tabs’ clustering analysis was carried out .

KV Anitha et al in 2013 created a intrinsic shade guide for silicone maxillofacial prosthesis which had groups differentiated by Yellow , Red and Blue bases . A survey which was cross-sectional in nature was carried out on a number of 100 randomly picked Indians for skin shade simulation with the help of guide. A “95% confidence interval” with “5.0% margin of error” was supposed to have “power of 80” in this study. A sampling method of convenience type was done in the Undergraduate students which had volunteered which studied in the same college to involve in the project. Students between the age group of 17-25 years of age in the ratio of 1:1 were involved in the study irrespective of the gender.



(Figure No. 3 depicts intrinsic shade guide for silicone maxillofacial prosthesis which had groups differentiated by Yellow , Red and Blue bases by KV Anitha et al in 2014)

R Rani in 2016 proposed a systematic review within the range of the given data with respect to shade simulation in prosthesis made for maxillofacial defects. An electronic search reviews was limited to English and literature in dental was run through to isolate the articles which were relevant based upon shade matching & colouring in prostheses for maxillofacial defects. The articles published before December 2015 were all included in the study

M Aparajita et al :

In the year 2014 Conducted a study among all the different materials used for the fabrication of maxillofacial prosthesis. All the materials used for maxillofacial prosthesis since ancient times are included in this article along with the recent advances. It gives us a scope to adapt with the fields where the maxillofacial materials needs improvement to provide the individual the maxillofacial prostheses which is of best quality.

Rox A R et al :

In the year 1981 Conducted a study which stated about the optical visualization of different shades of skin correlated with anatomy of the skin . It was found out out that stratum corneum and Stratum Corneum provide an optical barrier primarily by absorption of radiation and then to some certain degree by scattering of radiation. The degree of scatering and absorption depends upon the site and anatomy of skin.

1981 , Study on Optical Visualization of Different Shades of Skin.

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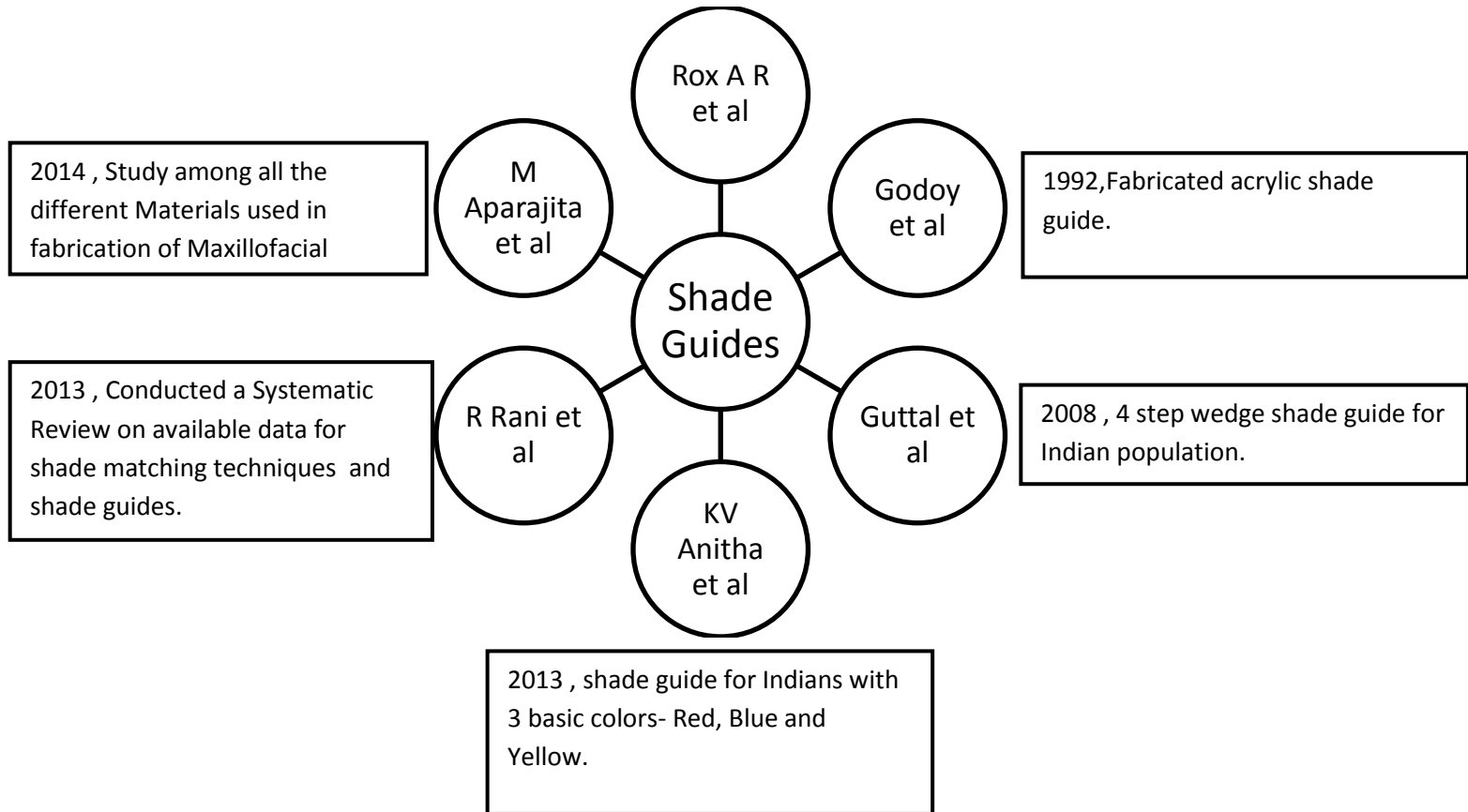


Chart No.2 depicting the studies , techniques and shade guides from the times period of 1981 to present which are available for shade simulation of Maxillofacial Prostheses.

Discussion :

Shade matching forms the core of maxillofacial prostheses because proper shade matching is required for depth orientation, heterogeneity of shades and tones and also to match the varying degrees of translucency . Studies and techniques regarding color matching are heterogeneous due to great variation in them which are discussed above .

Autopolymerising acrylic resin for the fabrication of shade guide was used by Schaff as a result of its readily available nature & its usage which is easy to understand by most dental practitioners. Shade tabs of diameter of about 1.5 mm were fabricated for the colour guide, which was close to the ideal thickness stated for a prosthesis made up of acrylic resin. One of the major aspects of a prostheses which should be considered while matching shade should be its thickness as the basic nature of the defect is going influence the shade of the prostheses.[3] Godoy prepared an colour guide for acrylic resin by adding various colors of autopolymerising acrylic resin or by combining the different color mixes with dry earth pigments.[2] Guttal et al. developed a silicone shade guide for Indian skin color using readily available powder with added pigments to it. The dominant colours which simulate the skin color of the Indian community are light red, burnt umber, yellow ochre, burnt sienna, and Vandyke brown.

Five pigments such as reduced haemoglobin , melanoid , oxyhaemoglobin and melanin, melanoid, along with carotene, which are proved to be present in skin in its varied layers, as stated by Edwards et al. The absorptive uniqueness of these pigmentations of skin, specially melanin, provides the total light which is reflected & hence is useful for determination of

value, hue, and Chroma of the shade of the skin. Wasserman et al conducted spectrophotometric studies for skin shade in racial groups which were different & came to a conclusion that the predominant hue which is reflected is red irrespective of the race. Dissimilarity of races & the variances in same community are influenced by the content of melanin. Gillman et al pressed on the necessity of shading of materials required for facial prostheses with colors that will lead to spectrophotometric curves which are close to that of skin & so may affect a shade match which is acceptable. The more close these spectral curves are the lesser of metamerism occurs.

Hanson et al. reported that the usage of combination with cosmetic earth pigments which are usually premixed in maxillofacial prostheses colouring technique provide a very efficient & easy method of fabricating skin coloured prosthesis.

Newer studies occurring on the change in color of the maxillofacial prosthesis depending on the investment mold used for packing procedures show that die stone shows most statistically significant color change, hence color matching is influenced by the type of mold.

Most of the times, shade matching for maxillofacial prosthesis is done using trial and error method during packing procedure either for resin prosthesis or silicone prosthesis. Tinting of the prosthesis using oil color is also a commonly advocated technique for color matching of ocular prosthesis.

Recently the evidence which discusses the skin shade matching technique which is best for the manufacturing of maxillofacial prosthesis is not available. The techniques which are recently introduced which include spectrophotometry & colorimetry are efficient in matching the shade of the skin prostheses. In addition, there is no RCT indicating the superiority of one method of color matching over the other for producing the best color match, so more research in the area and in particular RCT studies are clearly indicated to determine the best technique for color matching.

Conclusion :

Color matching is a crucial step in the fabrication of maxillofacial prostheses. There are diverse methods to match the color to facial skin in maxillofacial prosthetics. With the advent of newer methods, the procedure of coloration has been more accurate and less time taking.

The systematic review by Ranabhatt et al published in the year 2017 is the latest review published in his field and rightly demonstrated that the most common technique utilized in clinical practice for color matching of facial prostheses is trial and error method. Although the available data for color matching of facial prostheses are limited, there is no current evidence indicating the superiority of one technique over the other.

Further studies need to be conducted on the color stabilization which is offered by the various techniques as it is one of the major problems faced by the Dental Clinicians.

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