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Esthetic Consideration in Denture Prosthesis: A Review on Characterization Practices

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Abstract

Partial or complete loss of teeth and its associated supporting structures leads to functional, neuromuscular and physiological impairment over a period of time. Among numerous considerable expectations that completely or partially edentulous patients demands, appearance of the denture as close or similar to their existing natural teeth is challenging. Denture characterization is a technical procedure in which the specific anatomical quality characteristics of a person are introduced either by modification of teeth based on size; form; shape and color or the denture bases itself that simulates the color and shading of natural oral tissues to make it appear more real and life-like appearance. Factors like undercuts, reduced ridge space, diastema, rotations, length, mobility, and competency of lips are important. One of the notable advantages of this process is that finishing and polishing, subsequent adjustments, or relining cannot change the characterization. Dentures made by this process permit their anatomic progress after processing. The colors of natural tissue can be reproduced natural as close as possible that partial or complete dentures are no longer an esthetic concern.

Keywords: Esthetics, Characterization, Forensic odontology, Pigmentations, Stippling

Introduction

Maintaining a good oral hygiene and restoration of healthy tooth are essential factors determining the social, economic, and personal well-being of an individual [1].Partial or complete loss of teeth and its associated supporting structures hinder functional features such as chewing, grinding and speech, psychological status such as self-confidence and satisfaction with esthetically acceptable appearance and social aspects like oral health

discomfort in form of pain, bleeding or any infection[2]. Among numerous considerable expectations that completely or partially edentulous patients demands, appearance of the denture as close or similar to their existing natural teeth is challenging yet genuine. [3]. Several studies reported a significant relationship between oral health-quality of life (OHQoL) index and treatment satisfaction with respect to age of the patient, quantity of replaced dental segments, anterior teeth appearance, and nature of the opposing arch[4]. Thus, planning an esthetically acceptable denture is critical.

Denture esthetics

Denture esthetics is the effect created by the prosthesis that disturbs the attractiveness and appearance of the person. Factors like attitude of patient, esthetic perception, social behavior, and position in the society should be taken into consideration without compromising the oral health [5]. Reasonably a patient who is unhappy with an unrealistic poorly appearing denture prosthesis presents with complains of inability to wear the prosthesis although it is functionally good. A good esthetically fabricated prosthesis can motivate the patient to wear his new denture. In recent times, Implants have gained much consideration over removable prosthesis as a treatment alternative in partially edentulous conditions; however, several factors like anatomical, psychological, economical or medical considerations of the patients enforces the dentist to provide removable prosthesis in order to achieve the least possible benefits [6].

Denture characterization

In order to achieve patient`s expectations towards the final outcome, the art of characterization has evolved since 1951, when Pound incorporated specific features in the denture prosthesis based on the racial and individual pattern. Previously in 1944, Dummett establish the fact that physiologic pigmentation of the gingiva is a prominent and normal finding in Negroes and other dark-complexioned people based on investigatory clinical study on pigment variations in the healthy oral tissues of the Negros population[7].Denture characterization is a technical procedure in which the specific anatomical and esthetical quality characteristics of a person are introduced either by modification of teeth based on size; form; shape and color or the denture bases itself that simulates the color and shading of natural oral tissues to make it appear more real and life-like appearance. Although denture characterization has been primarily reported for complete dentures over the year's efforts have been made to match the staining, pigmentation and other characteristics of the existing natural teeth which were few in number in cases of single complete denture and removal partial denture[8]. Decisions regarding types of retaining components, material of choice, thickness of denture flanges, placement of artificial teeth, shade and color of teeth and various natural elements such as pigmentations, must be predetermined with the final esthetic expectations and factors like undercuts, reduced ridge space, diastema, rotations, length and mobility of the lips, competency of the lips are also important when the patient smiles or expresses his/her feelings[9].

The process of characterizing dentures is established based on a) Adapting laminations of Color balanced resins in the flask in order to create a lifelike blending of colors exposed on the labial and buccal surfaces of the oral tissues. (b) Incorporating color stimulating fibers in the laminations to reproduce the staggering realistic appearance of veins, characteristic of healthy oral tissues, thus allowing the dentist to construct an intrinsic worth denture of high economic value. The colors of the fibers and acrylic powders provide innumerable cross blending to produce any shade indicated or desired. One of the notable advantages of this process is that finishing and

polishing, subsequent adjustments, or relining cannot change the characterization. Dentures made by this process permit their anatomic progress after processing. The colors of natural tissue can he reproduced natural as close as possible that partial denture is no longer an esthetic concern[10].

Characterization of Complete Dentures

Complete denture can be characterized by two methods. These include:

1. Characterization by selection: Preparation, arrangement and modification of artificial teeth

2. Characterization of the denture bases:

1. Characterization by selection:[11](Preparation, modification and arrangement of artificial teeth):

The teeth can be altered to complement with the patient's age, gender, skin texture and physique to provide subjective unity. Fisher stated that gender, personality, and age can be used as guiding principle for selection, arrangement of tooth, and characterization to "enhance the natural appearance of the individual. The ways of characterization are;

- Changing the direction of the long axis of teeth.
- Placement of the teeth so that the tips of the maxillary lateral incisors are exposed when the patient speaks vigorously; the amount depends on the age and gender, slightly lesser for old than for young people and more for woman than for men respectively.
- Create divergence asymmetry on the proximal surfaces of the teeth from the contact points. It is true that “The key to esthetics lies in asymmetry” as said by Martone.
- Most things in nature are asymmetric, and in the human face many small and indirect differences are found from one side to the other.
- Use an eccentric midline. Place one maxillary central and lateral incisor parallel to the midline and rotate the other central and lateral incisors slightly in a posterior direction.
- Keep one maxillary central incisor slightly in an anterior direction to the other central incisor.
- Keep the neck of one maxillary central incisor in a posterior direction and the neck of other central incisor in an anterior direction.
- Construct asymmetry for the maxillary right and left canine. Rotate one in a posterior direction than the other.
- Gingival tissues regress with age. Selecting a long tooth, contouring the wax to show gingival recession and then staining it a bit, can give natural appearance, can reproduce this recession.
- Teeth abrade with age. Reshaping the incisal edges, grinding the incisal edges, adjusting the mesiodistal diameter makes it possible to modify any tooth to the desired form.
- A teeth arrangement that is too perfect may not be ideal. In fact, slight modifications in the position of teeth such as overlapping, tilting, rotation and incisal variations may contribute to a natural-looking denture.
- Spacing and diastemas often exist in natural dentition. Thus, slight diastema can be created between the lateral incisor and the cuspid on one side. The wearing away of the natural teeth at the contact points creates spaces between the teeth. The migration of teeth also creates spaces. To simulate the wear by positioning the artificial teeth to create spaces, can give a natural appearance. Diastema given should exceed 2-3mm and should be wider at the incisal edge than the base. In diastemas smaller than 2-3 mm, fibrous food tends to be trapped and can be a source of embarrassment.
- A hair line crack can be given in the teeth.
- Often, gold restorations are placed on occlusal surfaces on the teeth of prosthesis that contribute to its

clinical success to create the illusion of naturalness. On the other hand, silver alloy restorations are also preferred on posterior teeth though esthetically unpleasant.

- A discolored tooth or following a root canal treated tooth can be differentiated by selecting one or two teeth of darker shade compared to the rest of the teeth set. Older patients tend to have darker teeth as a result of discoloration from fillings and food stains.

2. Characterization of the denture bases[11, 12]**.**

Pound in 1951 was the first to propose a method of tinting or shading the artificial acrylic denture bases to simulate the gingival color based on the racial and individual color patterns. Numerous methods have been used to tint denture base resins to accomplish a more natural look. Usually heat curing or auto-polymerizing resins of various shades or colors are coated or smeared on the denture base or are shifted on to the mold during denture construction to obtain a tinted denture.

Indications

1. An active upper lip patient.
2. Prominent pre-maxillary process patients.
3. Actors, singers and others who may expose gum tissues areas during their performances.
4. The psychological acceptance of the dentures by the patient.

A) Pigmentations

Melanin pigmentation[13]

One of the three primary factors involved in reproducing complete nature-like realism is that denture bases should be color tinted to blend with the individual's intra and extra oral pigmentation. Spolsky and co-workers in their study showed the degree to which people avoid conversations because of the appearance of their teeth or gingiva. Many individuals may find it very embarrassing to speak or smile and display the stereotyped pink denture base, which discloses the 'false' or artificial denture look. The final dimension of color must be incorporated into the denture base matrix material to reproduce the patient's natural tissue tones in order to achieve the ultimate realistic goal in constructing artificial denture. Kemnitzer used a combination of blue and brown stain to reproduce the melanotic pigmentation .Melanin, melanoid, carotene, hemoglobin, keratin, and oxyhemoglobin were the six pigments believed to contribute to the color of the skin among which the melanin is most important pigmentation often found in the oral soft tissues (**Fig1A)**

Fig. 1A: Denture Characterization of Melanin Fig 1B: Gingival Pigmentation

Gingival Pigmentation[14]

Pigmentations of the oral soft tissues such as gingiva, mucous membranes, hard and soft palate, tongue, and tissues of the floor of the mouth are normal clinical observation in many people of all races and ethnic group. Dummett observed the pattern and color of the healthy gingiva ranges from a pale pink to a deep bluish purple depending upon the intensity of melanogenesis, the degree of epithelial cornification, keratinization, the depth of epithelization and the arrangement of gingival vascularity. Moreover, color variations may be uniform, unilateral, bilateral, mottled, macular or blotched, and may involve the gingival papillae alone or extend throughout the gingiva and other oral tissues. Non-pigmented gingivae are found more often in fair-skinned individuals while pigmented gingivae are usually seen in dark-skinned persons **(Fig 1B).**

B) Stippling[13, 14, 15]

Mimicking gingival contours, gingival texture, and soft tissue topography contributes to the natural appearance of removable prostheses. Common methods for enhancing soft tissue esthetics include festooning and stippling of the anterior acrylic resin flange. Festooning involves the carving of denture base material to simulate the contours of the soft tissues being replaced by the denture. Lynn C. Dirksen produced gingival stippling on the surface by using plastic veneer forms that enhances the esthetic appearance of plain pink acrylic resin which provides an inexpensive means of obtaining more natural appearing buccal and labial contours for complete dentures. Stippling mimics the appearance of orange peel (**Fig2A**). Dry, healthy mucosal tissues have an orange peel appearance on the facial aspect and interproximal areas. Stippling of the anterior denture flange enhances the natural effect of soft tissue by creating uneven reflection of light on the acrylic resin. With a trial denture, stippling is usually accomplished by tapping a brush wheel or stiff tooth-brush on the wax flange. Replicating the gingival texture and contours contributes to the natural appearance of labial flanges in complete dentures by causing uneven reflection of light. This, in turn, reduces the shine and reflection typically seen in highly polished denture flanges and provides a more natural appearance(**Fig2B**).

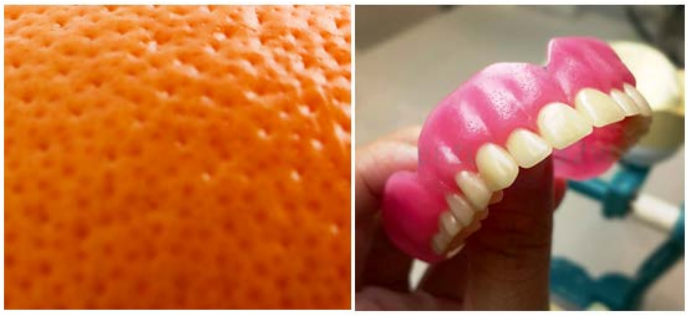

Fig. 2A: Orange-peel appearance Fig 2B: Denture characterization of stippling

C) Alveolar eminence [13, 14]

To improve additional natural effect, anatomy the gingivae and alveolus are often incorporated. The labial flange of a complete denture should not be a smooth curved sheet of acrylic, but instead should show a series of swellings corresponding to the alveolar eminencies over the roots of the teeth. These are most marked anteriorly and become progressively less marked in the pre-molar and molar region. In the upper anterior region, the canine eminence is most marked. The lateral incisor eminence is small. In the lower jaw, again the canine eminence is most marked and a series of smaller ridges mark the presence of the incisor roots.

D) Inflamed or bulbous gingiva [13, 14]

The reflection of inflamed or bulbous gingiva can also be reproduced by leaving more interdental wax. However, some food products have been able to impart color of denture base resin, but this is not permanent and can be removed partly or wholly within a period of days. Another significant precaution with surface tints is the lack of abrasion resistance of the stains which makes it compulsory that after packing minimum alteration is done on surface of the denture through finishing and polishing. To minimize that a layer of light cure clear acrylic resin coating may be used. Denture base materials are composed of an acrylic resin mostly made up of polymethyl methacrylate (PMMA). The major shortcomings that limit the use of PMMA are its insufficient flexure strength properties. Flexural fatigue of the prosthetic material usually results from chewing forces including compressive, tensile and shear stresses. Conversely, the flexural strength of conventional heat-cured acrylic resins has shown better results than that of high-impact resins. At the same time, the incorporation of rubber has not been entirely successful in that it can

contribute to reduced stiffness, enhanced creep, and water sorption[16].

3. Denture labels[17]

Identification of dentures provides important evidences in recognizing the denture-wearer in a forensic scenario effectively bringing closure to personal identification especially in natural and mass disasters. The surface labels included engraving, embossing, and marking whereas the inclusion labels included paper, OHP sheet, lead foil, stainless steel (SS) matrix band, Ni-Cr plate, brass palette, and barcode sticker. Positive identification of the denture is usually done with a tiny, discreet identification code which is embedded in the denture base. The purpose of denture marking thereby not only assists in the return of a lost denture, but also it facilitates the identification of edentulous persons who are either living or deceased. Over the years, various methods of denture marking have been reported in the literature. However, there are two main methods in marking dentures, namely the surface method and the inclusion method. The most common site for label insertion in a denture is the posterior palatal slope of the maxillary and the lingual flange of the mandibular denture. Labeling of all dentures is recommended by most international dental associations and forensic odontology (**Fig 3**).

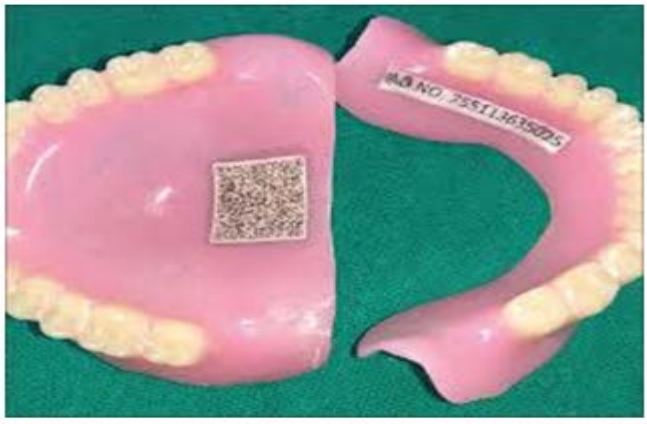

Fig. 3: Denture labels

II. CHARACTERIZATION OF REMOVABLE PARTIAL DENTURES:

RPD design should be created such that all its components are as simple as possible to further enhance esthetics. Clasps are the only components which are placed on visible surfaces of the teeth. Extra-coronal direct retainers are not pleasing for patients concerned about esthetics. The esthetic alternatives can be achieved by adapting one of the following modifications to conventional clasps inorder to eliminate visible display of metal and improve esthetics[18, 19].

A) **Equipoise system**[18, 19]**:** It is an esthetic retentive concept for distal extension conditions. Rests are placed away from edentulous span. 1mm Vertical interproximal reduction was made between the abutment and adjacent tooth. It is a lingual back action clasp that is fully reciprocated and extremely esthetic with no facial clasp display (Fig4).

Fig4: Equipoise clasp system

B) **Spring clasp/ twin clasp** [18, 19]

It consists of a wire clasp soldered into a channel that is cast in the major connector. As this clasp is flexible, it does not generate as much torque when the distal extension denture base is under occlusal load. The ability to adjust this clasp and its conventional path of insertion provides an excellent design option for retention to an adjacent edentulous segment.

C) Saddle lock clasp (Hidden clasp)[18, 19]

It uses the more pronounced mesial/ distal concave surfaces of the abutment adjacent to the denture saddle. Clasp terminals are positioned at each end of the denture saddle, effectively locking the segment onto the ridge (**Fig5**)

D) Round-rest distal depression clasp [18, 19]

A round-rest, distal depression clasp is suggested as an esthetic alternative to a conventional clasp for maxillary anterior teeth serving as abutments for a removable partial denture. A lingual round rest provides support for the prosthesis, and a mesiolingual reciprocating plate is present. A split minor connector engages a distal depression for retention. The facial surface of the abutment displays no metal and provides an esthetic result **(Fig 6**).

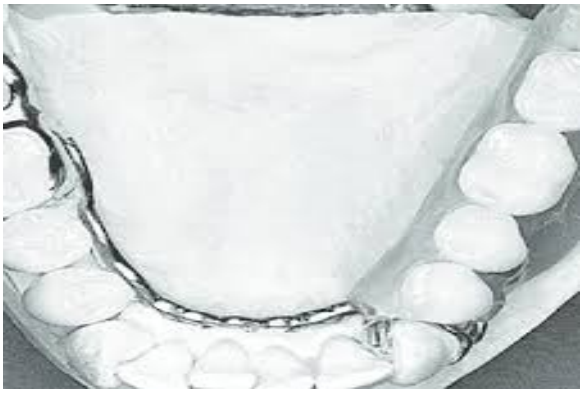

Fig. 5: Saddle lock clasp system

Fig. 6: Round-rest distal depression clasp

E) Metal free clasps [18, 19]**:** The metal free materials available currently such as Acetyl resin, flexible thermoplastic materials are ideal for flexibility and esthetics, thus allowing esthetic functional care in true sense. These may be combined with metal framework to provide esthetics. Masking of clasps with composites by macro/micromechanical retention is another way of improving esthetics (**Fig7**).

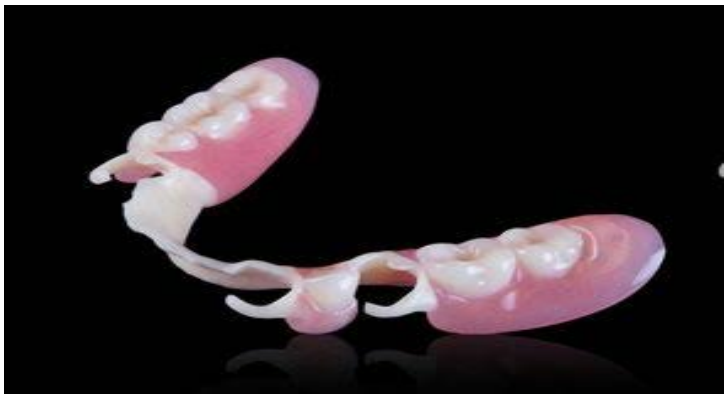

Fig. 7:Metal free clasp

F) Prosthetic Teeth [18, 19]

Artificial teeth are an important component of the removable partial denture that provides ideal esthetics, function and phonetics. Matching the anterior denture teeth with natural teeth requires proper attention to shade control, characterization and contours of the denture teeth to harmonize them with the natural teeth and correct denture teeth positioning. The patient`s natural teeth or present/old prosthesis acts as a valuable guide along with definite shade guides according to Hue, Value and Chroma gradations that will assist the clinician in selecting the appropriate tooth for selection and arrangement of teeth in the new prosthesis.

G) Gingival contour [18, 19]

H) The position and contour of the gingival margins created on the denture teeth and length of interdental papillae are few other important factors that should be kept in mind while fabricating the prosthesis that has to carefully match those of the adjacent natural teeth.

I) Denture Base Resin and Flanges [20]

The labial flange is a significant part, most important when restoring missing anterior teeth. When considerable bone loss is seen, it is sensible to incorporate a labial flange to restore the lost tissue contour and at the same time acquire proper lip support thereby also avoiding the placement of teeth more palatally to contact the ridge. Anterior flanges ideally should extend to the reflection of the mucosa in the labial sulcus to avoid the horizontal edge of the flange being visible. The thin resin is almost transparent and allows the color of the mucosa to show through. In addition, the coverage of the papilla immediately mesial to the abutment tooth avoids the dark shadow often created by a vertical edge of a flange in this region (**Fig 8A and B**).

Fig. 8A: Denture base resin Fig 8B: Flanges characterization

Conclusion

Ideally RPD design should be created such that all its components are as simple as possible to further enhance esthetics. The esthetic alternatives can be achieved by adapting one of the above said modifications to conventional clasps in order to eliminate visible display of metal and improve esthetics. One of the notable advantages of this process is that finishing and polishing, subsequent adjustments, or relining cannot change the characterization. Alternatively, significant precaution that should be carefully dealt with surface tints is the lack of abrasion resistance of the stains which makes it compulsory that after packing minimum alteration is done on surface of the denture through finishing and polishing. Dentures made by this process permit their anatomic progress even after processing. After characterization of partial or complete denture however it is possible to reproduce natural colors of tissue as close as possible for esthetic concern.

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