Digital Smile Designing for Completely Edentulous Patients and its Aesthetic Outcome

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Abstract
Objective: To evaluate the aesthetic outcome of digital smile designing for completely edentulous patients and access its use as an patient education tool. Methodology: 5 completely edentulous patients undergoing complete denture fabrication were selected .Extra oral wide smile and necessary pictures during jaw relation stage were collected. Pictures were exported to 3Shape Smile Designing Software and smile simulation was done using oval, square, rectangular and triangular teeth form. An online questionnaire survey was created for dentists on their opinion on complete denture aesthetics. Results: 21% of clinicians felt that digital smile designing for completely edentulous patients is not justified. There was a significant association between Qualification of the dentist and the choice for the aesthetic outcome.($p<0.05$) Conclusion: Majority of dental practitioners think that smile designing for Complete denture aesthetics may be justified by the patient's satisfaction and inclusion in the treatment protocol.
Keywords: Innovation, Smile designing, edentulous patients, aesthetic outcome

1. Introduction

The term aesthetics comes from the Greek word "aisthetike," and was coined by philosopher Alexander Gottlieb Baumgarten in 1735 to describe "the study of how objects are perceived by the senses."[1] Facial appearance is a major concern for everyone and impacts one's self-image. The loss of teeth causes significant psychological distress and needs immediate replacement.[2] The main goals of rehabilitation in an edentulous patient are to restore oral function and facial contour[3]. The loss of natural dentition entails some amount of residual ridge resorption, resulting in alterations of the maxillomandibular relationship on one hand, and changes in facial musculature and morphology on the other[4]. Even if a patient needs dental care for the purpose of mastication, many patients prioritize aesthetics over function[5]. It is the dentist's responsibility to educate the patient about the aesthetic principles that govern the treatment. As the therapy is much more complicated in circumstances when both jaws must be replaced, recognising the progressive atrophy of both jaws, that is, bone resorption and the resulting loss of soft and hard tissues, is essential for proper treatment planning. Bone availability, general status of the mucosa, hygienic issues, economic costs, and particular prosthetic factors such as the emergence profile of the artificial teeth, degree of residual ridge resorption, facial support, and smile line are all factors to consider when evaluating a patient [6,7].

Several authors have found sufficient evidence that esthetics is the predominant factor in success of a complete denture and the psychological importance of a pleasing facial appearance.8–12 These authors came to the conclusion that clinicians typically overlook the favourable impact that denture aesthetics can have on the treatment's overall outcome.13,14. The temperamental theory15, the typal form theory16 and the dentogenic theory17 are among some of the traditional denture esthetic concepts. Recently a more patient centered approach has come to light due to increased reliance on the patient's own body image.18,19 This approach frequently contradicts the principles of dentist derived philosophies and has been highlighted in research comparing preferences between laypersons and dental professionals.20,21

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The primary question remains whether completely edentulous patients seek a different teeth appearance than dentulous patients. As most of the patient preference research and data on anatomical averages are gathered from dentulous subjects, there always remains a possibility that this information is not entirely applicable to all of the edentulous subjects. Edentulous patient perception of how teeth should look may be different from that of dentulous patients. The edentulous patient population tends to be of older age. It is known that the appearance of natural teeth changes with age.

In 2006, Waliszewski and colleagues performed an investigation of edentulous esthetic preferences.22 Three denture trial arrangements, each representing one of the esthetic concepts, were made for each of six patients of varying age and gender demographics. Frontal smile photographs of the test subjects were combined into a booklet for evaluation by respondents. Edentulous respondents then answered questions regarding their preference among the three appearances. Of 147 respondents, the natural arrangement was preferred by 55%, supernormal by 19%, and denture look by 26%. The primary conclusion was that appearances far from what was considered average or normal were selected nearly half the time. As this study was the first looking exclusively at the esthetic preferences of edentulous patients, it remains to be determined whether this preference is in fact different from the preference of clinicians treating the patients. If it can be conclusively determined that edentulous patients view esthetics differently, research can further specify what these differences are. It is practically not feasible to do multiple teeth settings for the patient during try-in procedure, therefore digital smile designing can play a major role in saving the clinician's time along with including the patient in the outcome of treatment.Thus,the aim of this study was to evaluate the aesthetic outcome of digital smile designing for completely edentulous patients and assess its use as a patient education tool.

2. Materials and Method

A total of 5 completely edentuluous test subjects visiting Saveetha Dental College, Chennai,India for complete denture fabrication were selected and therapy was started. At the time of jaw relation, occlusal rims were used to determine the smile line and appropriate photographs were taken which included extraoral natural wide smiles with occlusal rims and retracted pictures with occlusal rims. These pictures were exported to 3 Shape TRIOS smile designing software, and the in-built tooth library was used with each of the standard acrylic tooth shapes commercially available- oval, triangular, rectangular and square, to provide a simulation of complete denture. [Figure 1] An online questionnaire survey was created consisting of 14 questions on knowledge and perception of dentists and dental students on digital smile designing for completely edentulous patients. The survey was undertaken after the due approval of the institutional ethical board following which the questionnaire was pilot tested among the dental students and professionals working or visiting our institution to check the feasibility of the survey. The face validity of the questionnaire was checked by submitting it to five experts in the field of prosthodontics, who approved the online questionnaire before it was distributed to dental students and professionals using snowball sampling method. The questionnaire consisted of demographics, perception of the respondents on the best and the worst esthetic outcomes among the 4 tooth shapes for each of the patients and knowledge about smile designing softwares. After the period of 15 days (January 1st - 15th January), a total of 72 responses were obtained. After data collection, it was compiled using Microsoft Excel and subjected to statistical analysis.

Figure 1- Smile simulation for a completely edentulous patient with various teeth form.

3. Statistical Analysis

The received responses to the questionnaire were analyzed. The compiled and coded data was transferred to IBM SPSS v23.0 software and statistical analysis was carried out using descriptive statistics and results were displayed as bar graphs and pie charts. Chi-square test was performed to find association between various parameters.

4. Results

A total of 192 responses were tabulated among which 54.2% (39) were females and 45.8% were male. Majority of the respondents (66.6%) were postgraduates, and the rest were undergraduates. Among the postgraduates 39 were prosthodontists. In terms of years of experience, the majority of the respondents had over 3 years of clinical experience (58.2%). A huge chunk of the respondents (48) had never used a digital smile designing software before but were mostly aware of the softwares globally available among which most common was 3 Shape TRIOS smile design (32%). 21% of clinicians felt that digital smile designing for completely edentulous patients is not justified. [Figure 2]

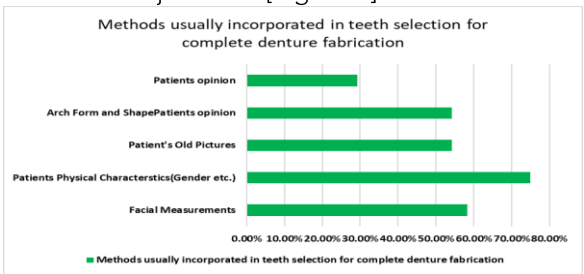

Figure 2- A bar graph depicting the methods incorporated by the respondents for teeth selection during complete denture fabrication.

75% of the respondents use patients' physical characteristics like gender, age etc. followed by facial measurements, patient's old pictures, arch form and shape and only 29.2% include patient's opinion in teeth selection for complete denture fabrication.[Figure 3] 87.5% of the clinicians feel that incorporating the patient's opinion for the aesthetic outcome of a complete denture may result in greater patient satisfaction (all the prosthodontists) but some still feel that it might complicate the treatment protocol and compromise function of the denture.

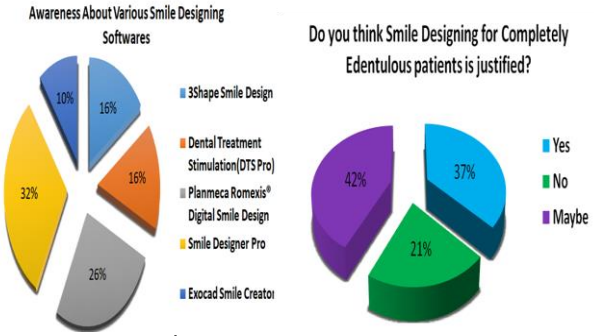

Figure 3- Pie charts representing awareness among professionals about smile designing and opinion on its use for use in completely edentulous patients.

There was a significant association between the qualification of the dental practitioner and the choice of aesthetic outcome for a particular patient. The result is displayed in the form of a clustered bar graph in Figure 4.

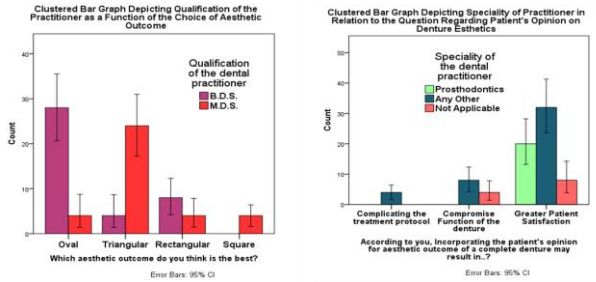

Figure 4- Clustered bar graphs based on the responses of the questionnaire

5. Discussion

The study showed lack of consensus between various dental professionals in perception of various esthetic concepts of complete denture. On one hand, most of the postgraduates thought a particular type of tooth form had the best aesthetics, while undergraduates deviated towards a different tooth form [Figure 2]. The fact that there was a significant difference ($p<0.05$) showed that as far as aesthetics is concerned, we cannot apply a strict set of rules for a practicing dentist since over a due course of time the preset ideas of dentists could change on exposure to patients who are not well educated. In a previous study about comparative evaluation of the perceptions of esthetics among dentists and patients regarding the final esthetic outcome [23] showed that the answers given by dentists and patients coincided only 68% of the time. This showed a tremendous gap between the concepts of understanding esthetics from a well-trained mind of a dentist to a layman. This could create problems for the dentist if he fails to educate the patient regarding the clinical procedures of complete denture. Considering all these factors, it appears that clinicians can reliably use dentulous preference findings in their treatment of edentulous patients. This supports the idea that patients maintain their preference with regards to dental esthetics despite the loss of their teeth. It therefore appears that the denture-look concept was indeed more a result of dentist-directed esthetics and focus on functional goals rather than denture patient preference.[24]

Although 79.2% of the respondents thought that digital smile designing for completely edentulous patients may be justified, 20.8% still felt that it was not and some still believe that incorporating the patient's opinion for the aesthetic outcome of a complete denture may might complicate the treatment protocol and compromise function of the denture.For the average restorative dentist who treats edentulous patients, utilization of dentate preference data is helpful in more efficiently arriving at an appearance the patient will prefer.

In 1914, Williams proposed the "law of harmony" in which he correlated the inverted shape of the face to the shape of the maxillary central incisor. The form at that time was classified into triangular, oval and square.[16] In 1956, Frush and Fisher linked gender and personality traits with the shape of the teeth. Till date, these approaches are little supported by recent studies. Farias et al[25] found a weak but significant correlation between facial measurements and the width and height of the central incisor. In the same study the shape of the central incisors was divided into triangular, oval or square; the agreement between the visual classification of the three examiners and the classification generated by measurements was unsatisfactory with low Kappa values even among examiners.

This disparity is reason enough to include the patient's opinion into the denture's esthetic outcome. In this modern day and age it's very taxing to do multiple teeth settings for the same patient, therefore digital smile designing is a time saving and practical solution for greater patient satisfaction and acceptance of complete denture treatment.

6. Conclusion

Majority of dental practitioners think that smile designing for complete denture aesthetics may be justified by the patient's satisfaction and inclusion in the treatment protocol. Digital smile designing can serve as an essential tool for completely edentulous patient's education and aid the clinician in treatment protocol.

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