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IP Annals of Prosthodontics and Restorative Dentistry

Journal homepage: https://www.aprd.in/

Original Research Article

Conventional all ceramic crowns versus CADCAM all ceramic laminates for esthetic rehabilitation of teeth with dental fluorosis: A 5 year follow-up study

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ARTICLE INFO

Article history:
Received 21-05-2024
Accepted 15-07-2024
Available online 16-08-2024

Keywords:
Dental Fluorosis
Laminate veneer ceramics
Aesthetic rehabilitation
CADCAM Crowns
Patient Satisfaction

ABSTRACT

Background: Every individual wants to look good and have a pleasing smile. In this era of social media where each and every phase of one's life is captured in camera, having an unpleasant smile makes a huge negative psychological impact on every individual. The foremost reason of an unesthetic smile commonly is dental fluorosis. Dental Fluorosis is an abnormality that causes enamel discolouration which may result when excess fluoride is consumed during the teeth forming stage i.e. 8 years and younger. The effect remains lifelong resulting in a huge esthetic insult. Treating such patients with aesthetic all ceramic crowns and veneers will definitely improve the patient's self-esteem.

Materials and Methods: In this retrospective study we clinically evaluated the aesthetics and patient satisfaction of 2 different treatment modalities for dental fluorosis namely Conventional all ceramic crowns and CADCAM all ceramic laminates in teeth with anterior fluorosis. Patients were divided in two groups. Both the groups included 35 patients each, Group 1 received conventional all ceramic crowns (156 in anterior maxilla and 24 in anterior mandible) using IPS e max fabricated in porcelain furnace and Group 2 received CADCAM porcelain laminate veneers (144 in the anterior maxilla and 36 in the mandible) fabricated with incisal overlap technique that covered the incisal edge and part of the palatal/lingual side of the tooth with a 1 mm high palatal bevel. The Orofacial Aesthetic Scale (OES) was used to assess the overall satisfaction level and White Aesthetic Score was used to assess the overall aesthetic improvement post treatment in both the groups.

Results: On the basis of the OES, it was found that CADCAM all ceramic laminates was more satisfying treatment for the patient rather than more extensive conventional all ceramic crown preparation. WES scores suggest that conventional all ceramic crown gives more aesthetic results as compared to CADCAM all ceramic laminates in moderate fluorosis.

Conclusions: The results of this clinical study should encourage clinicians to consider CADCAM all ceramic veneers over Conventional all ceramic crown restorations when restoring the smile of patients with moderate fluorosis.

1. Introduction

A pleasing facial profile is a symbol of self-endorsement. It has been envisaged since long time that the first impression an individual makes is because of his appearances which continues for many years. Social media promote ideal looks as a powerful influence on the conduct and thought process of our aesthetically driven community. Nowadays each and every phase of an individuals's life is expressed in photographs and frequently transmitted in public network. This has resulted to a heightened demand for beauty treatment from people.[1] So every individual wants to look

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https://doi.org/10.18231/j.aprd.2024.039

good and have a pleasing smile. The most common cause of having an unpleasant smile is dental fluorosis. Dental fluorosis is a disorder in which there is hypomineralised dental enamel and sometimes extending to dentin too due to prolonged consumption of fluoride in excess amount during formative years of tooth development phase especially eight years or younger but the consequences of discolouration lasts throughout a person's life if not treated.

Dental Fluorosis is a serious community health concern in India especially in Southern India, as majority of states are fluoride endemic.[2] In India, almost 25 million people are currently affected by fluorosis and 66 million are exposed to danger of developing fluorosis comprising of children of age 14 years.[3] The states which are more commonly affected with dental fluorosis is Gujarat, Andhra Pradesh, Rajasthan and Assam. The prevalence of dental flourosis among males is 49.49% and in females is 54.10%.[4] India is located in the geographical fluoride zone where fluoride is in excess in rocks or soil, resulting in excess fluoride in groundwater. Dean and McKay advocated that the ideal level of fluorine in water is below 0.9-1 PPM. This study was undertaken in Indian Naval Dental hospitals especially Visakhapatnam which covers the maximum brunt from Andhra Pradesh and Assam.

There are various indices used to categorise dental fluorosis amongst them the most common ones are Deans and Thylstrup and Fejerskov index.[5] Original criteria for Dean's fluorosis index given in 1934 had 7 criteria namely normal, questionable, very mild, mild, moderate, moderately severe and severe.[6] Later moderately severe and severe categories were combined to one category as severe in 1948. TF index have 10 categories and are given 9 scores namely questionable, very mild, mild, moderate and severe (Tables 1 and 2). These categories are based on the macroscopic appearance of teeth in relation to the underlying histologic condition of enamel.[7] The scores for the classification ranges from 0-9 as shown in Table 2. TF Index validates clinical appearance against histologic defect, most sensitive and more detailed especially utilised for research purposes in prosthodontics.

There are various treatment options of fluorosis which depends on individual cases. Fluoride benefits after tooth eruption but before that it's detrimental. Dental treatment of fluorosis comprises of micro-abrasion/macro-abrasion, bleaching, composites, veneers, and complete crowns.[8] Minimally invasive treatment of dental fluorosis includes composite or ceramic partial veneers or full crown, resin penetration and dental jewelry.

In mild level fluorosis in-office vital bleaching with McInnes solution is found to be successful. It is non-invasive compared to other techniques and requires less chair side time. It cannot be employed in patients with severe fluorosis as it causes postoperative sensitivity.[9] Vital bleaching is more promising in younger patients who have opaque to orange colour stain rather than older patients with dark brown stains.[10] Abrasion is found to be successful for single line or patchy type discoloration, but not successful in more diffuse discolouration. Both the bleaching and abrasion could be employed only for mild to moderate level fluorosis. Most often a combined treatment of bleaching and abrasion procedures is advocated to get the desired aesthetic outcome in patients with yellowish discoloration due to fluorosis.[11–13] Partial or Complete Veneers has shown success in managing moderate level fluorosis. All ceramic crowns as a treatment modality is restricted to severe fluorosis and lack of inter-occlusal space. Being extensive, the desired aesthetic and functional outcome is achieved. However it requires extensive lab procedure, operator skill and knowledge. The treatment options described above has its own advantages and disadvantages; a good clinician must have the knowledge of all the treatment modalities available and its advantages and disadvantages and choose the best option as per the individual patient needs.

2. Material and Methods

This research was carried out as a randomized controlled clinical trial to evaluated two different treatment options for dental fluorosis that is conventional all ceramic crowns and CADCAM all ceramic veneers. The study was endorsed by local institutional ethical fraternity (copy attached). All Patients signed an informed consent form. The recommendations issued by the Consolidated Standards of Reporting Trials (CONSORT) for reporting randomized and controlled clinical trials were followed. Study was performed in Visakhapatnam in Andhra Pradesh, an endemic zone for fluorosis since 2019-2023. Sample size selected for the study was based on the results of the therapy chosen (improved aesthetics). A minimum study sample of 30 patients per group was estimated to detect an aesthetic change of 10% between the groups with a power of 90%, alpha error of 5% and a one-tailed test. To take account of potential losses or refusal, 35 in each group were selected giving a total sample size of 70 participants.[14–16] Patients selected should have good oral and systemic health and have minimum four maxillary anterior teeth with dental fluorosis varying from 4 to 7 according to the Thylstrup and Fejerskov (TF) index.[16] Fractured, maligned or missing of some maxillary anterior teeth or with more than 1/6 of their buccal surfaces restored were excluded from this study. Patients under orthodontic treatment, with hypersensitivity or who had nonvital incisors or canines, smokers, pregnant or lactating women were also excluded. Dental fluorosis was diagnosed with the help of a trained examiner, using the TF index. Patients were divided into two groups based on the level of severity of fluorosis. Group I: Conventional all ceramic crowns (156 in anterior maxilla and 24 in anterior mandible) (Figure 1) and Group II: CADCAM all ceramic laminates (144 in anterior maxilla and 36 in the mandible)

(Figure 1)

2.1. Clinical evaluation

Cases selected were having TF Index of 4-7 range to avoid bias affecting at least 4 maxillary/mandibular anterior teeth. Sample were chosen to study the aesthetic and patient satisfaction level of CADCAM All Ceramic laminates / Conventional all ceramic crowns. Patient Satisfaction level was evaluated with Orofacial aesthetic scale (Table 3). OES is a eight elements tool to evaluate how patient distinguishes their dental and facial aesthetics. Patient is asked certain questionnaire regarding how they feel about the appearance of their face, mouth, gums and teeth. Their answers are rated from 0 being very dissatisfied to 10 being very satisfied. Aesthetic parameters are assessed based on White aesthetic score (Table 4).

2.2. Statistical analysis

The data on continuous variables is presented as mean and standard deviation (SD). The inter-group statistical comparison of means of normally distributed continuous variables is done using independent sample t test. The intra-group statistical comparisons of means of normally distributed continuous variables is done using Paired t test. The underlying normality assumption was tested before subjecting the study variables to t test. All results are shown in tabular as well as graphical format to visualize the statistically significant difference more clearly. Both the groups are tested for WES and OES preoperatively and postoperatively.

In the entire study, the p-values less than 0.05 are considered to be statistically significant. The entire data is statistically analyzed using Statistical Package for Social Sciences (SPSS ver 24.0, IBM Corporation, USA) for MS Windows.

Table 1: TFI Score

TFI	Enamel Appearance
0	Normal Creamy Surface After drying
1	Faint White Lines
2	Distinct White Lines with some merged
3	Cloudy opacities with white lines in between
4	Paper white opacities on entire surface
5	Pitted and opaque surface
6	Merged pits form rows < 2mm high
7	Irregular pattern of enamel loss < 50%
8	50% 0f enamel lost, remaining enamel opaque
9	Cervical rim of opaque enamel left

3. Discussion

The study utilised TFI rather than Deans Index since it is a 10 point scale rather than 6 point scale like Deans

Table 2: FIcriteria

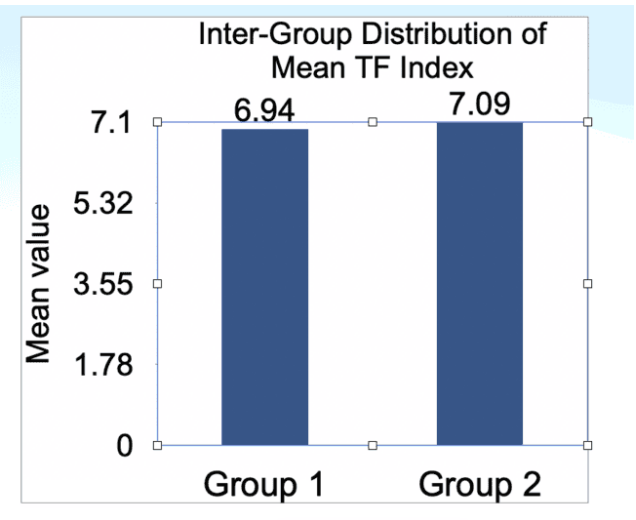
TFI score	
1	Questionable
2-3	Very Mild
3-4	Mild
4-7	Moderate
7-9	Severe

Table 3: Orofacial Esthetic Scale OES

Parameters	Major discrepancy	Minor discrepancy	No discrepancy
1. Tooth form	0	1	2
2. Tooth volume/outline	0	1	2
3. Color (hue/value)	0	1	2
4. Surface texture	0	1	2
5. Translucency	0	1	2

Table 4: White aesthetic score (WES)

How do you feel about the appearance of your face, your mouth, your teeth and your replacements
0 is 'Very dissatisfied' and 10 is 'Very satisfied'
1. Your facial appearance.
2. Appearance of your facial profile
3. Your mouth's appearance (smile, lips and visible teeth)
4. Appearance of your rows of teeth
5. Shape/form of your teeth
6. Colour of your teeth
7. Your gum's appearance
8. Overall, how do you feel about the appearance of your face, your mouth, and your teeth
1–7: summary score 8: overall impression score



Graph 1: Intergroup distribution of Mean TF Index

Figure 1: Group 1: Rehabilitation of dental fluorosis with conventional all ceramic crowns

Figure 2: Group 2: Rehabilitation of dental fluorosis with cadcam all ceramic laminates

index. The measurement error of TFI is 0.50 visa ve 0.53 of Dean's index. In Deans index there is difficulty in assessing questionable and very mild index. In TFI there is no difficulty and severe forms can be well discriminated.[17] In intergroup comparison of mean TF index (Graph 1) for both groups showed p value 0.670 NS. Group 1 showed the TF mean of 6.94 and Group 2 showed TF index of 7.09. This shows that there was no bias in case selection and both the groups shows almost similar TFI score in the range of moderate fluorosis.

Belser et al. have introduced the White Esthetic Score (WES) to explicitly focus on the visible part of the tooth itself.[18] WES is based on five parameters: tooth form, outline and volume, color (hue and value), surface texture and translucency and characterization. Each parameter is given a 2-1-0 score, with 2 being the best and 0 being the poorest score, thereby giving a maximum score of 10 for WES. WES, in intragroup comparison for both the groups post treatment shows higher results than pre treatment. Thus both the treatment modalities CADCAM all ceramic laminates and conventional all ceramic crowns definitely improves esthetics and overall patient satisfaction after treatment. In intergroup comparison WES scores were better in conventional all ceramic crowns group 1 cases which shows that all ceramic crowns provide better esthetics in terms of tooth form/volume, colour, surface texture and translucency. Samer used Modified USPHS criteria[19,20] and showed similar results.

Orofacial Esthetic Scale (OES) (Larsson et al., 2010) assesses orofacial esthetics and contains eight items. It was initially started in prosthodontic patients in Sweden. Later it was extended to all patients (John et al., 2012). Patients were asked how they perceive the appearance of their face, mouth, teeth, and prosthesis. There response was given on a 11-point scale (0 - "very dissatisfied", 10 - "very satisfied") or mark as "not applicable" if there is no response. OES componants refer to seven esthetic elements (face, facial profile, mouth, rows of teeth, tooth shape/form, tooth color, gum). These seven elements are integrated into a overall summary score ranging from 0 to 70 and higher scores implicate higher satisfaction. The eighth element of OES depicts an overall impact of orofacial looks and summarizes the patient's global evaluation of orofacial appearance. The OES is the most widely used instrument for self-evaluation in orofacial esthetics research (Mursid, Maharani & Kusdhany, 2020). It has also been validated in adult prosthodontic patients, in dental patients in general (Reissmann et al., 2019) or in the adult general population (eg. John et al., 2012).[21] OES Scale, In Intragroup comparison, post-operative results showed significantly higher results to pre-operative state except in gum appearance which is lower in CADCAM all ceramic laminates and showed not much difference in conventional all ceramic crowns. In Inter-group comparison, scores depict significantly higher values for all except facial profile, facial appearance and gum appearance. Only parameter which showed no difference in both the gps pre-operatively was mouth appearance. Overall Post-operatively Group 2 shows much higher values than group 1. Overall % change post operatively is higher for Group 2. Nikola used OHIP & OHR QoL and proved similar results.[22] They showed that Intra-group comparison of means of parameters of white aesthetic scores in patients participating in this randomized clinical trial and staying in a fluorosis zone represent a marked enhancement in quality of life, thereby depicting the advantages of the treatment protocol selected and, thus, validating the study hypothesis. It shows that patients' perception of oral health is an essential parameter in measuring the actual needs to evaluate the treatment protocol from oral healthcare. Recently, OHRQoL has been used as an gold standard to assess treatments in clinical trials and also to evaluate changes after treatment, since the response with aesthetics have improved in dentistry.

4. Conclusion

Conventional all ceramic crowns for treatment of dental fluorosis improved the aesthetics more than the CADCAM all ceramic veneers especially in moderate fluorosis. However overall patient satisfaction level is much higher in CADCAM all ceramic veneers owing to its conservation of tooth structure and almost equally good esthetics. This research is a randomized clinical trial, which is one of the most credited technique for assessing the efficacy or effectiveness of treatment procedures. Among the advantages, there is the high internal validity, due to minimal bias within the study, and the controlled exposures. Validated indices were used to measure dental fluorosis and the treatment outcome namely White esthetic scale and Orofacial aesthetic score. These scores are short high revealing and easy to use, have an appropriate scoring mechanism and is supported by a relevant theoretical model.

5. Source of Funding

None.

6. Conflict of Interest

None.

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Cite this article: Kapri A, Jacob O, Rana V, Reddy K, Kumari P, Rathi A. Conventional all ceramic crowns versus CADCAM all ceramic laminates for esthetic rehabilitation of teeth with dental fluorosis: A 5 year follow-up study. *IP Ann Prosthodont Restor Dent* 2024;10(3):203-207.