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Geriatric Dental Aesthetics-A genuine concern

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Abstract

The confidence that is exhibited with a healthy and bold smile has made the aging population also seek dental care to uphold their dental aesthetics. Senior citizens experience loss of self-esteem when the tonicity of perioral muscles decrease, inclination of anterior teeth changes and gingiva recedes. Geriatric oral care is a genuine concern across the globe today. Various dental treatment options like bleaching, bonding, direct/indirect restorations, periodontal aesthetics and preplanning prosthetic care should be tailor made for geriatric cases because age changes of soft tissue and hard tissue with systemic illness demands slight modification in selection of dental materials and also adopted technique. This review highlights the changes in macro and micro-aesthetic parameters with aging and the treatment considerations preferred with the aim to provide a functionally stable and aesthetically acceptable healthy smile.

Keywords: Geriatric dentistry, Aesthetics, Tooth wear, Root caries

Introduction

It's a known fact that with advances made in medicine and public health measures in the last half of the 20th century, there is a substantial increase in the life span of an individual. Elders have health problems as a result of aging process, which calls for special consideration. This demographic change will have a major impact on the delivery of general and oral health care, as well as on the providers of these services [(1)]. In geriatric dental care it's not only the oral conditions that have to be concentrated on but also the systemic and psychological condition that has to be skillfully managed. However, age should not be considered as a bar for any kind of treatment.

Elderly are respectfully termed as “Young Elderly”- 65 to 75 years of age when they are healthy and active, “Mild Old” - 75 to 85 years when they are managing an array of symptoms and “Oldest Old” - 85 years and above when they are physically frail [(2)]. In general, ill health, functional limitation and financial constraint poses a problem in providing ideal dental care. Objectives of Geriatric Dentistry may be maintaining oral and general health, recognizing and relieving chief complaint, aiding in restoration and preservation of function for maintaining normal life in elderly patients.

Gradual changes in the smile line, changing color of the teeth, migration of front teeth, development of spaces, observation of regressive alterations and changes in the gum line are the anterior aesthetic concerns of the elderly. As there are various changes occurring in the tooth tissues and also soft tissues of the oral cavity as a part of the aging process, treatment planning needs special consideration for geriatric cases.

Importance of natural Dentition

The benefits of retaining the natural dentition until late in life is incomparable. The mechanoreceptors in the periodontal ligament gets stimulated by the occlusal load and this in turn enhances tactile sensitivity. Masticatory muscles are kept active by the chewing process and this activity pumps oxygenated blood to the brain. There is natural cleansing activity of the oral cavity by ‘Active chewing’. Lastly, natural teeth provide an age-adequate confidence with dental appearance, hence favouring social interaction and active participation in society [(3)].

Influence of Systemic illness

Origin of this cycle which includes Friality- Sarcopenia-Malnutrition-poor oral Health-Systemic Perturbation and again Friality is unknown. Bidirectional relationship is appreciated in oral and general health. Diabetes, hypertension, rheumatoid arthritis, Alzheimer’s disease, Parkinson’s disease and depression are common diseases that become more prevalent with age [(4)]. Periodontal disease, dental caries and even oral precancerous and cancerous lesions may be commonly observed due to these systemic diseases and their related medications. This makes the older adults more vulnerable leading to certain

degenerative changes that become more severe with age. Reduction of salivary flow, mouth dryness is physiological due to atrophy of the salivary parenchyma or hormonal as well as lack of stimulation. Hypoptyalism changes the composition of saliva by decreasing the levels of immunoglobulin, lysozyme and mucin levels compromising the moisturizing, lubricating, immunological and antibacterial role of the salivary flow [(10)].

Aging and Dental Aesthetics

It's obvious that there is an inexorable increase in the proportion of older people. Better standard of health has led to a "dental transition", whereby the proportion of that group who are edentulous has also been steadily falling. A substantial proportion of the older people present with chronic dry mouth, affecting their speaking, enjoyment, ingestion of food and denture wearing [(5)]. Elderly individuals appear tired and dull because the orofacial muscles lose their tonicity over aging process. If there is anterior tooth loss along with reduced tonicity the nasio-labial fold looks enhanced. The young and bright smile gradually changes because of the wear, size, position, and colour of the teeth. Most important phenomenon today is the regressive alteration of teeth in elderly which results in loss of vertical dimension and shorter appearance of visible teeth in the smile window. "Reverse Smile" is considered un-aesthetic which results from the tips of the canines or premolars being longer than those of the central incisors [(6)]. Parafunctional habits create a visible change in the occlusion for which the masticatory muscles get adapted. Reversal and reconstruction of all the lost parameters demands a skill full treatment planning in the elderly.

Aging and Micro-Aesthetics

Incisal Embrasures are lost due to wear of the anterior teeth. Gradual loss of incisal edge alters width-to-height ratio of teeth. The **connector space** is the zone in which two adjacent teeth appear to touch. The ''50%-40%-30%'' connector rule of youthful, harmonious smile changes to more flat contact between the teeth making it un-aesthetic and difficult to maintain oral hygiene. **Buccal corridor** or the negative space appears wide as regressive alterations of maxillary posterior teeth appear to disappear failing to fill up the

space resulting in lack of youthful smile**. Tooth color** is a major concern in geriatric aesthetics. Naturally with aging, enamel thins down and the dentin colour becomes more prominent, resulting in darker teeth. Other reasons for tooth discolorations may be medications, coffee, soft drinks, tea, or cigarettes [(6)]. Therefore, the greater Chroma saturation results in a lower value of teeth resulting in a poor contrast with the lips and perioral skin. Change in **axial inclination** of anterior teeth leading to poor smile or incompetent lips may be observed due to long standing underlying periodontal pathology.

Cosmetic contouring

Tooth contouring or shaping in terms of enameloplasty is a very conservative approach done for chipped or partially fractured incisal edges. In elderly due to erosion and attrition sharp enamel edges abrade the tongue and the mucosa leading to a graver clinical condition. This procedure must always be done with the principles of proper occlusion in mind. Cosmetic contouring is also done to achieve illusions in the smile window, angle correction, length reduction, altering tooth form and arch irregularity [(7)].

Tooth Whitening

Well-groomed older people consider teeth stains and discolorations as being capable of being interpreted by others, like grandchildren, as reflecting poor maintenance of oral cavity. Bleaching represents a proven, sensible, pragmatic, affordable and practical approach to treat the aesthetic issues of older patients [(8)]. The benefits are achievable without destroying their residual sound tooth tissue. In-office vital bleaching is very effective and night guard vital bleaching can be practised at senior citizens own pace. However, reminerelizing agents post bleaching will help protect enamel surface alterations.

Bonding and aged teeth

Direct or indirect composite restorations help improve the shape of worn, un-aesthetic teeth without damaging the structure or health of the residual tooth tissue. As a rule of thumb while treating the elderly patients **ADDITIVE RESTORATIONS** should be considered with minimal preparation of the

remaining tooth structure. However, tooth adhesion may be a challenge in aged tooth tissues.

Gradual enlargement of the peritubular dentin and intra-tubular mineral deposits, resulting in narrowed or completely occluded tubules interferes in bonding. More sclerotic dentin demands modification of the etching time or roughening of the surface [(9)].

Senile Caries

WHO has mentioned that dental caries is the third global scourge affecting all ages of life. As the word meaning goes for Senility, Senile caries is no excuse. Clinically recurring decay around the necks of the teeth can produce a 'chipmunking' effect which can be extremely difficult to control with a conventional 'drill and fill' approach [(10)]. Root caries is primarily because of acid attack by bacteria directly on the exposed root surface or micro leakage around previously treated caries at the cervical margins of teeth around dentures or fixed prosthesis. Cemental caries propagate twice as fast as enamel caries as cementum demineralizes at a pH of 6.7. Application of 0.4% stannous fluoride in mouth guard is suggested as "Active Prevention" of Root caries creating a biologic balance in the favour of remineralisation.

As age advances there is anatomical and physiological change in the oral environment. Due to generalized attrition cuspal inclination is reduced and grooves /fissures become non-retentive. Thus coronal fissure caries is rarer, compared to other age groups. Physiological wear and tear blunts the coronal relief and modifies the points of interdental contact. Therefore, biofilm, food debris, is no longer retained at the coronal level but accumulates in interdental spaces leading to multiple proximal decay. Restorative materials with chemical adhesion like Glass ionomers with fluoride releasing property, reasonable aesthetics, biocompatibility and less technique sensitivity are considered [(11)] Resin composite with minimal tooth preparation reinforces the remaining tooth structure.

Tooth wear

Manifestation of some degree of tooth wear in all dentate older patients is common. The degree of tooth wear decides the clinical consequence and

required intervention. Patient complaint may include tooth sensitivity, sharp edges of teeth, soft tissue trauma or pulpitis. Aesthetic concerns can manifest as shortened teeth, altered tooth shape or reduced lower face height whereas functional concern is reduced masticatory function or altered diet selection [(12)] Long standing chronicity and slow paced progress of attrition, abrasion and erosion lesions tend to deposit thick secondary dentin and also promotes pulp chamber regression.

Restoring cervical lesions is a challenge in elderly with sclerotic dentin and cementum in the cervical margin. Attrition with shortened teeth and vertical height loss can be well managed with the introduction of the 'Dahl Concept'. This clinical procedure deals with selective provision of adhesive restorations in supra-occlusion with the remaining teeth out of occlusion. Over a period of time, the teeth which are out of occlusion will erupt into occlusion, thus creating space for the restoration of anterior teeth.

Loss of vertical Dimension

Cases of the elderly losing several teeth will often show a decrease in the vertical dimension, causing dysfunctionality, discomfort, and visual displeasure. Decreased VD causes saliva to drip on the corners of the mouth and the possibility of angular cheilitis. Lack of lip and cheek support with protrusion of chin during jaw closure makes an individual aesthetically displeasing [(13)]. Unclear phonetics can be judged by the pronunciation of the letters F and V with malposition of upper anterior teeth and with the letter S with malposition of lower teeth. Pre-prosthetic workup is mandatory to decide the amount VD increase. Full coverage crowns, onlays, overlays and fixed prosthesis can be bonded to increase the VD which maintains the harmonious stomatognathic system.

Periodontal concerns

As discussed earlier, longer lifespan means teeth and supporting structures continue to be used and exposed to bacteria for much longer. The impact of systemic health, poly pharmacy usage and local oral factors lead to swollen gums, sore gums, receding gums, loose teeth, teeth that have drifted and bad breath [(14)]. These conditions lead to dark triangles, spacing and change in inclination of teeth expressing an un-aesthetic smile. Conservative adhesive composite restorations with minimal tooth preparation on the gingival embrasure area helps in reconstruction of the lost smile. Ceramic laminates or

full crowns to re-establish the lost arch form is another option in smile designing. However, with cognitive or motor impairment in elderly, periodontal aesthetic treatment planning should aim at minimal tooth preparation and easy maintenance of the restorations.

Prosthetic Planning

While considering the “mild old” and “oldest old” category of geriatrics, loss of few teeth in the dental arch is inevitable. For multidimensional and multidisciplinary geriatric oral care assessment, there are certain observations noted which is termed as “Oral Functional Capacity”. OFC consists of four resilience capacity levels (RCL 1—RCL 4) and three parameters namely therapeutic capability, oral hygiene ability and self-responsibility [(15)]. It is recommended to design prosthetic constructions in a manner that they can be easily modified in case of one more tooth loss or other biological complications. After OFC assessment removable or fixed prosthesis is designed. The Shortened Dental Arch - “SDA” concept is a frequently discussed treatment option for geriatric dental treatment planning which designs and fabricates typically ten occluding antagonistic pairs usually ranging up to the second premolar meeting the functional requirement. While age is not regarded as a contraindication for the insertion of implants per se, placement of implants is an alternative treatment option.

Treatment Planning in elderly

For older adults’ special considerations should be given during treatment planning. Informed consent, discussion with family members, involvement of care givers is very important before decision making. It is suggested in the literature, that a systematic approach to planning oral care for older adults, is called “OSCAR”. OSCAR explains Oral Condition, Systemic illness, Capability, Autonomy and Reality [(16)]. A perpetual dilemma may exist during treatment planning for senior citizens which can be solved on identification of “key Teeth”. Key teeth are those teeth which is crucial in the arch for function, it can support itself and also support other teeth in the arch.

Geriatric satisfaction

On aging, even small imperfections in dental aesthetics might lead to a fear of negative public reactions and cause appearance-based insecurity leading to psychological stress. There are innumerable questionnaires and scoring scales

mentioned in literature to assess the geriatric and adult health status. One such questionnaire, titled the **"Smile Aesthetics Satisfaction Scale"** (SASS), showed good psychometric properties and its use can be recommended [(17)]. Simple clinical predictors of greater satisfaction with smile aesthetics like tooth display when smiling, Tooth colour, absence of gingivitis, as well as absence of crowded, fractured and restored teeth in the anterior segment are evaluated. Understanding patient's satisfaction and willingness to improve helps therapist to assess the patient's desires and increase the likelihood of treatment success.

Conclusion

In future, more and more of the aged population will seek dental care to reverse the signs of the aging smile. "One size fits all" approach of smile designing does not work in geriatric aesthetics. Treating the elderly should have the touch of care which includes strong, sensitive, dynamic and peaceful expressions in our treatment. "Visagism" applies the principles of visual art to the composition of a customized smile which upholds overall health of the elderly [(18)]. With dentistry's many advances, patients have choices that can help plan and execute a more creative, customized and biomimetic smile which can express their emotions and uphold their personality. Aesthetic dentistry offers an opportunity for the aged population to have a more youthful, harmonious smile with function and optimum oral health.

References

1. P Abdul Razak, K M Jose Richard. Geriatric Oral Health: A Review Article. Journal of International Oral Health 2014; 6(6):110-116
2. Priyadarshini Karthikeyan, Dr.Ramesh Kumaresan. Geriatric Dentistry- A Review. European Journal of Molecular & Clinical Medicine. Volume 07, Issue 11, 2020.5158-5162
3. Frauke Muller, Yoshihiro Shimazaki. Oral health for an ageing population: the importance of a natural dentition in older adults. International Dental Journal 2017; 67: 7–13
4. Alice Kit Ying Chan, Manisha Tamrakar. Common Medical and Dental Problems of Older Adults-A Narrative Review. Geriatrics 2021, 6, 76 (mdpi)
5. William Murray, Sunyoung ma. An ageing population poses dental challenges. Singapore Dental Journal 35 (2014) 3–8

6. Betsy K. Davis. Dental Aesthetics and the Aging Patient. Facial plastic Surgery/Vol 22, Number 2 2006
7. Ronald E. Goldstein. Cosmetic Contouring. Text Book of Esthetic Dentistry.
8. Martin GD Kelleher, Serpil Djemal. Bleaching and Bonding for the Older Patient. Dental Update. June 2011, 294 -303
9. Marcelo Giannini, Patrícia chaves. Effect of tooth age on bond strength to dentin. J Appl Oral Sci 2003; 11(4): 342-7
10. Rapp L, Maret D. Dental Caries in Geriatric Dentistry: An Update for Clinicians. International Journal of Oral and Dental Health. 2019, Vol 5 Issue 1.1-6
11. Roopa R Nadig, Usha, Vinod Kumar. Geriatric restorative care - the need, the demand and the challenges. J Conserv Dent. 2011 Jul-Sep; 14(3): 208–214
12. Francis M Burke, Gerald McKenna. Tooth-wear and the Older Patient. Dental Update · April 2011.165-168
13. Nova Adrian. Rehabilitation of Vertical Dimension Decreased Case in Elderly Patient. Journal of Indonesian Dental Association 2019 2(2), 81-85
14. I Darby. Periodontal considerations in older individuals. Australian Dental Journal 2015; 60:(1 Suppl): 14–19
15. Ina Nitschke, Anja Wendland. Considerations for the Prosthetic Dental Treatment of Geriatric Patients in Germany. J. Clin. Med. 2021, 10, 304
16. RL Ettinger. Treatment planning concepts for the ageing patient. Australian Dental Journal 2015; 60:(1 Suppl): 71–85
17. Vlatka Lajnert, Daniela Kovacevic Pavicic. Smile Aesthetics Satisfaction Scale: development and validation of a new brief five-item measure of satisfaction with smile aesthetics in adults and the elderly. International Dental Journal 2018; 68: 162–170
18. Dibyendu Majumder, Mithra N. Hegde. Recommended clinical practice guidelines of aesthetic dentistry for Indians: An expert consensus. Journal of Conservative Dentistry | Volume 25 | Issue 2 | March-April 2022

SMILE ENHANCEMENT BY LASER RECONTOURING AND ZIRCONIA POST AND CORE – A CASE REPORT

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ABSTRACT

An unesthetic smile is a condition that affects the confidence of many young people. It is caused by a variety of factors from excessive display of gingival tissue to old discoloured restorations. Also The success of a restoration in endodontically treated teeth is dependent upon many factors including treatment with an artificial crown as well as the condition and size of the remaining natural crown or root.

Cast metal post-core systems have a long history of successful use because of their superior physical properties. However, their high elastic modulus can cause stress concentrations within the surrounding radicular dentin, resulting in root fractures. Moreover, the increasing demand for more esthetically appealing and biocompatible restorations has led to the development of tooth-colored,

translucent, metal-free post-core systems. Notably, zirconia ceramic post systems have been introduced to satisfy this trend toward a heightened awareness of esthetics, whereby the translucency of all-ceramic crowns can be successfully maintained with the use of ceramic post-core materials. Owing to the keen interest in and widespread use of zirconia ceramic post systems, many in vitro studies on zirconia posts have been published in the last 15 years. This case report presents a prefabricated metal post which was replaced with CAD- CAM manufactured custom-made zirconia post which was completed with the placement of an E.max crown.

KEY WORDS : Zirconia post, Metal free post, laser recontouring, all ceramic post, esthetic post.

INTRODUCTION

Beautification of smiles is becoming an everyday requirement in dental practice. Beautiful smiles are produced by three main parameters that are the teeth, the gums, and the lips, respectively. There are few instances where gum recontouring is necessary. First in cases of altered passive eruption, while other is clinical crown height of the tooth is less than anatomic crown height producing short teeth which are square and wide.[1] This may result in high smile line, with resulting appearance of “gummy smile.” Dentists can easily modify the shape of the tooth, the interdental papilla, and contour of the gums while it may be difficult to correct discrepancies of the lip and

position of lip in speech. In all corrections of gingival particular attention has to be given in preserving the biologic width.[2]

When an endodontically treated tooth has a significant loss of coronal structure, a post-and-core is used to provide retention and support for a subsequent crown. As a cast post-and-core provides intimate adaptability in a canal wall and resists torsion force, it has been considered the gold standard, especially in the situation of an insufficient ferrule and an irregularly shaped canal.

However, when all-ceramic restorations are preferred, metal posts may negatively affect the esthetic results. Besides, corrosion reactions can cause metallic taste, oral burning, oral pain, sensitization, and other allergic reactions.[3,4]

With regard to both esthetic and health concerns, non-metal posts not only render esthetic superiority over metallic posts, but also preclude the possibility of corrosion and reduce the risk of toxicity. For these advantageous reasons, a wide range of esthetic posts have become commercially available, such as fibre reinforced composite resin posts (FRC) and yttrium stabilized zirconia-based ceramic posts.[5]

With the development of computer-aided design and computer-aided manufacturing (CAD-CAM) technology, a zirconia post-and-core has been used as an alternative to a cast post-and-core in the esthetic zone. The mean load-bearing capacity of a zirconia post-and-core is comparable with that of a cast post-and-core.

Zirconia posts were first introduced by Meyenberg et al., who reported that the flexural strengths (900−1200 MPa) of these posts were comparable to cast gold or titanium, and that it is possible to have the same post dimensions as high gold alloys or titanium.

Currently in prosthodontics, zirconia is a widely used material because of its good chemical stability, high mechanical strength, high toughness, and a Young's modulus similar to that of stainless steel

alloy. The high initial strength and fracture toughness of partially stabilized zirconia stems from a physical property known as transformation toughening.[6,7]

Apart from its favourable chemical and physical properties, zirconia also wields the esthetic advantage of having a colour similar to that of natural teeth.

Many techniques are available for post and core reconstruction. With zirconia posts, these core restoration techniques have been applied: direct composite resin curing, direct ceramic core heat pressing, and indirect ceramic core processing.[8]

For example, IPS Empress Cosmo Ingot (Ivoclar Vivadent) is a glass-ceramic containing zirconia and used as a core material that is heat-pressed onto zirconia posts. For indirect ceramic core processing, an example is Ceracap (Komet Brasseler) —which is a prefabricated glass-ceramic core cemented onto CeraPost with resin cement. To date, many research articles on zirconia posts have been published. However, there is little consensus with regard to their mechanical behaviour and reliability, and the factors which would contribute to their optimal application performance.

CASE REPORT

PRETREATMENT PLANNING

As in any case of esthetic dental treatments, certain parameters have to be critically assessed prior to performing gingival recontouring. This will help in proper treatment planning for the patient.

1. Patients expectations, systemic health, and habits;
2. Height, symmetry of face and smile line;

3. Lip thickness, size, and profile
4. Size and shape of the teeth
5. Gingival biotype and width of keratinized gingiva;
6. Thickness and contour of the alveolar bone.

A study cast and radiographs obtained will help in preparation of a surgical template which can help in precisely planning the amount of gingival tissue removal and also plan to provide ideal gingival shape and contour.

The gingival countouring can be performed by many means including scalpel surgery, electrocautery, and lasers. In most of the cosmetic dentistry cases, cosmetic gingival contouring can be successfully performed by the soft tissue diode laser. The soft tissue diode laser helps to establish a state of hemostasis and facilitate gingival recontouring. In some cases of minor corrections laser gum contouring can be done even without local anesthetics.

TREATMENT PLAN

A female patient aged 25 years reported with the chief complaint of a discoloured restoration on her maxillary right central incisor and an excessive show of gums while smiling. After assessing the case and presenting her with various treatment options it was decided to go with gingival recontouring with diode laser for her gummy smile. On examination of her discoloured restoration it was revealed that a post and core treatment was required for her right maxillary central incisor for which she opted to go for a zirconia post system which would then be restored with an Emax crown, in adherence to her esthetic requirements.

TREATMENT PROCEDURE

PART 1: LASER RECONTOURING

A stent was prepared preoperatively assessing the amount of gingiva that can be excised after ensuring that sufficient biologic width remains. The diode laser excision was performed at 1.5 watts continuous mode with an activated tip. Post-operative healing was uneventful with an acceptable smile for the patient

Figure 1: Pre Operative extraoral photograph

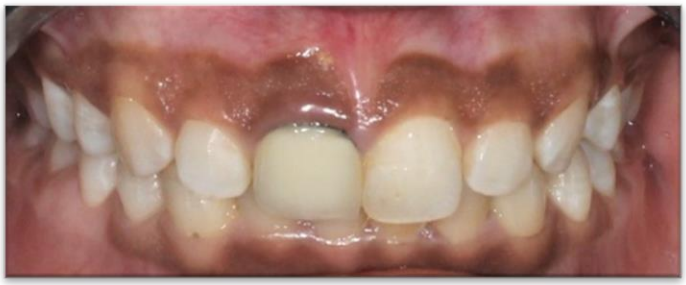


Figure 2: Pre Operative intraoral photograph

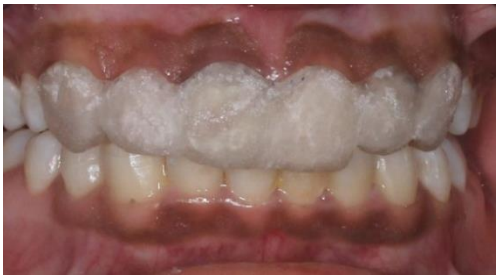


Figure 3: Fabrication of stent

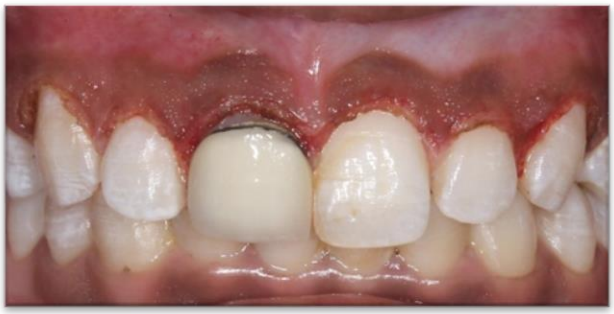


Figure 4: Intraoral photograph immediately post laser recontouring

PART 2: ZIRCONIA POST AND CORE SYSTEM

On removal of the discoloured crown it was revealed that the upper right central incisor had fractured. Probing depths around the tooth were in physiological range and there was no pathological mobility. According to radiographic evaluation, 6 mm of gutta-percha was observed in the apical region. Based on these findings, the treatment plan indicated removing the prefabricated metal post and applying a custom-made zirconia post-core, chiefly due to the higher fracture strength of zirconia ceramic and esthetic.

Zirconia post-and-core fabrication

First step of the treatment plan was to remove the previous metal post with a round tungsten carbide bur under ×2.5 magnification. Then, the post space was reshaped with Peeso reamers. Consequently, owing to the compromised vertical post space, a custom made zirconia post-core was constructed in order to improve adaptation and retention. However, the upside was that the milled ceramic post-core would be stronger due to its one-piece construction.

An impression was taken with addition silicone (Aquasil). In the laboratory, impression was scanned using laboratory scanner. By means of a dental CAD/CAM (Computer Aided Design/Computer Aided Manufacturing) system, the zirconia post-core was fabricated using zirconia ceramic. During the trial appointment, post adaptation was verified in the mouth and a control radiograph was taken.

Post-core buildup with crown restoration

Post surface was air-abraded with 50-µm Al2O3 particles prior to cementation. The cementation procedure was then performed using a dual-cured resin cement (Calibra, Dentsply) according to manufacturer's instructions. The temporary restoration was removed, and dentin was cleaned and conditioned with 37% phosphoric acid for 15 seconds. After etching with phosphoric acid, a primer (Syntac Primer, Ivoclar Vivadent) was applied for 15 seconds and then dried. This was followed by applying a dentinal adhesive (Syntac Adhesive, Ivoclar Vivadent) for 10 seconds and then dried. The

base and catalyst of the resin cement were mixed manually and applied on the post surface. After inserting the post into the canal, excess cement was removed, and polymerization was initiated using a polymerization lamp for 40 seconds.

After final preparation of the tooth, an impression was taken using the same addition silicone (Aquasil). After giving her various options for her prosthesis and based on the indications of the case it was decided to restore with an E.max crown.

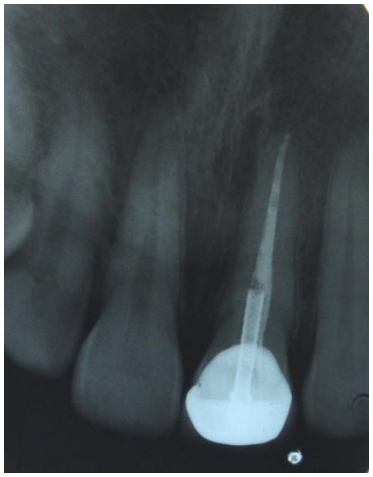


Figure 5: Pre-treatment Radiograph

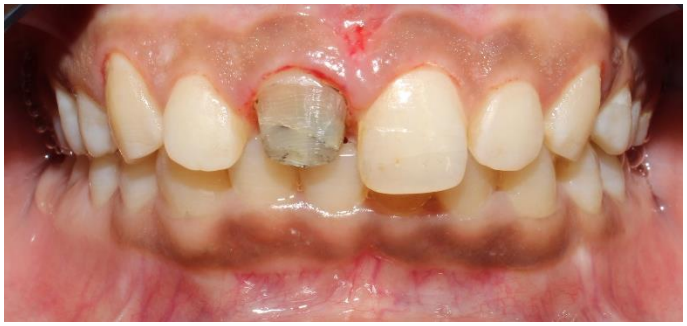


Figure 6: Tooth after removal of old prosthesis

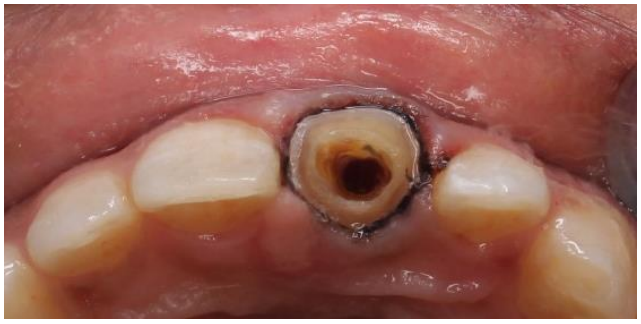


Figure 7: Removal of metal post and preparation of post space.

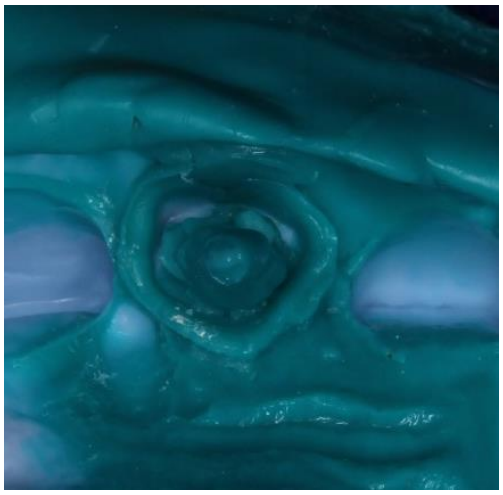


Figure 8: Impression of post space.

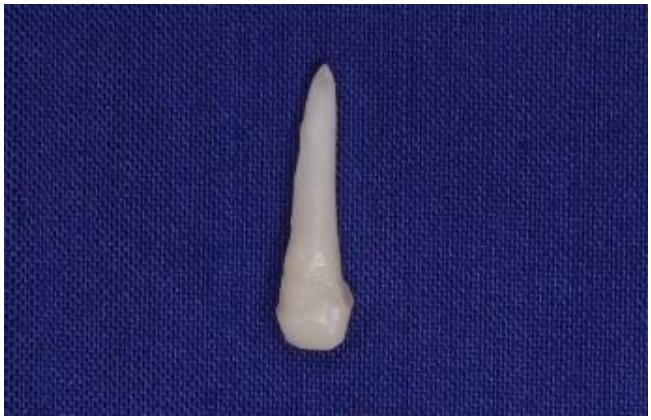


Figure 9: CAD- CAM manufactured custom zirconia post

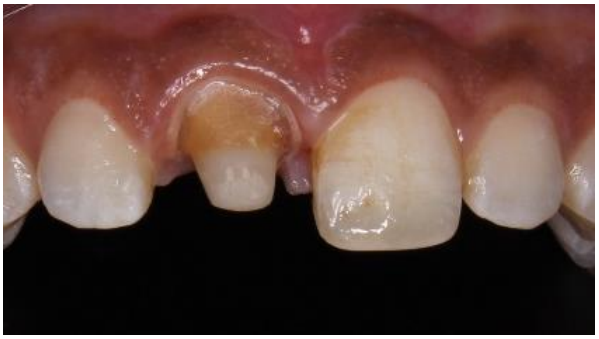


Figure 10: Cementation of zirconia post

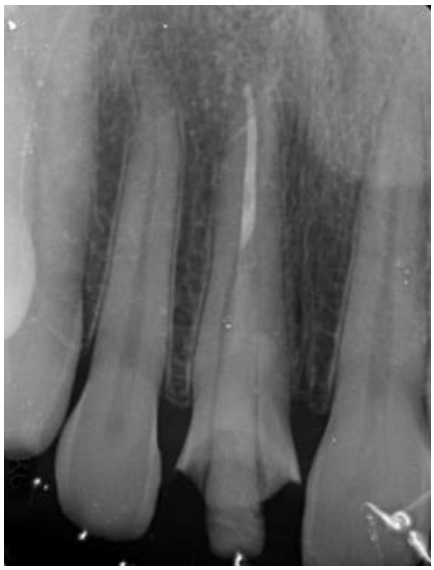


Figure 11: Post Operative Radiograph

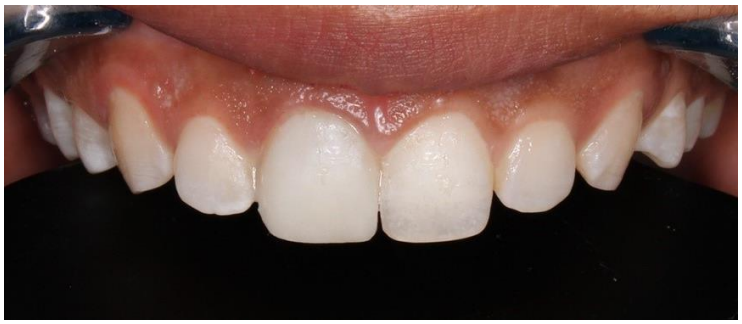
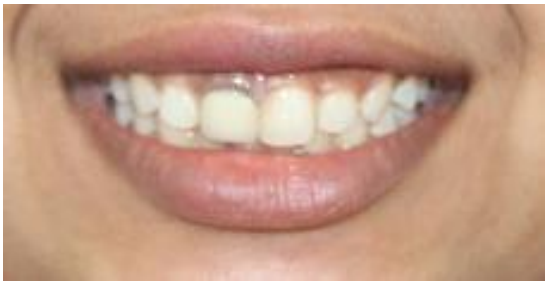


Figure 12: Cementation of E.max crown.



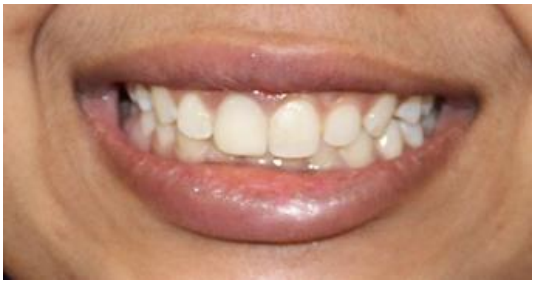


Figure 13: Pre-operative and Post-operative smile.

DISCUSSION

The increased use of all-porcelain crowns provides a rationale for tooth-colored cores.[1,3] Prefabricated allceramic posts offer an excellent esthetic solution for specific clinical situations. When used with ceramic post and core materials, the translucency of all-ceramic crowns is maintained because a dark post does not show through. Auto- or dual-curing luting composites are used to bond zirconia posts to the root canal. The strength and integrity of the bond between the zirconia post and the pressed ceramic core is of possible concern with this system. However, push-out tests have demonstrated a reliable bond strength between the zirconia post and pressable ceramic.[6,7] Glass ceramic material has a slightly lower coefficient of thermal expansion than that of the zirconia ceramic and a stress- and crack-free bond between the 2 materials can be achieved. [4]

The indirect fabrication technique of the CosmoPost post and core has several advantages. Chair time is reduced because the core fabrication is accomplished in the dental laboratory, and mounted casts allow evaluation of the core pattern. The cast post and core can also be fitted to the master cast, thereby reducing chair time at the insertion appointment. This procedure combines the advantages of customized direct post fabrication with indirect core patterns. Indirect fabrication of the CosmoPost IPS Empress post and core has an advantage over the direct method in that it does not use a composite core. Even with the application of dentin bonding agents, shrinkage gaps form between the tooth structure and the core material, and leakage at the crown margin may occur.

The best esthetic results are achieved with teeth that are free of discoloration or only slightly discolored. A ferrule or encircling band of restorative material around the coronal surface of the tooth has been reported to improve the integrity of the endodontically treated tooth.[9] If 1 mm of the dentin is preserved above the shoulder of the tooth preparation, a significant increase in the failure threshold will occur.[9] The potential for failure may increase when the finish line of the ceramic core is at the same cervical level as the finish line of the crown because there will be no ferrule effect. When an all-ceramic crown is used, bonding properties of the cementation system

may substitute for the ferrule effect. However, this has not been substantiated and needs to be investigated. The clinical results are promising and a favourable prognosis can be expected. However, clinical use of this method should be considered experimental and further research in this area is recommended.

1. **Advantages of zirconia as a post material**

With the zirconia material, its main advantages lie in its translucency and tooth-colored shade, thereby rendering the material usable with all-ceramic crowns in the anterior region. In particular, a patient who has a high lip line and thin gingival tissue would require the use of a zirconia post with an all-ceramic crown to optimize the esthetic effect at the root, while maintaining an adequate level of strength. In addition, zirconia is indicated for teeth with severe coronal destruction, because composite materials lack the strength to resist deformation when used to support crowns.

2. **Disadvantages of zirconia as a post material**

The rigidity of zirconia posts, can be a predisposing factor for vertical root fractures. Therefore, zirconia is not indicated for patients with bruxism. Besides, it is almost impossible to retreat teeth restored with zirconia posts because it is too difficult to grind away the zirconia post and remove it from the root canal.

3. **Post space preparation**

Post space preparation principles for zirconia posts are similar to other post systems. The clinician must have the fundamental knowledge of root canal configuration to avoid excessive shaping. Drills should be used in low speed to reduce the risk of perforation. Length of the post should be two-third of the root canal length, and post space preparation should not disrupt the integrity of the remaining root canal filling. If a small diameter post had to be used, a more rigid post system such as zirconia would be advantageous.

CONCLUSION

All-ceramic systems (posts and cores and crowns) offer a promising alternative to the restoration of anterior teeth with metallic cast posts and porcelain fused to metal crowns. The esthetic results obtained by the use of all-ceramic systems are exceptional. High success rates could be achieved in this study over a period of 4 years; a final judgment would definitely require a long term study.

REFERENCES

1. Dolt AH, 3rd, Robbins JW. Altered passive eruption: An etiology of short clinical crowns. Quintessence Int. 1997;28(6):363–72.
2. Ingber JS, Rose LF, Coslet JG. The “biologic width” – A concept in periodontics and restorative dentistry. Alpha Omegan. 1977;70(3):62–5.
3. Meyenberg KH, Luthy H, Schaerer P. Zirconia posts: a new all-ceramic concept for nonvital abutment teeth. J Esthet Dent 1995; 7: 73-80.
4. ÖZKURT, Z., ISERI, U., & KAZAZOGLU, E. (2010). Zirconia ceramic post systems: a literature review and a case report. Dental Materials Journal, 29(3), 233–245. doi:10.4012/dmj.2009-128
5. Kedici SP, Aksut AA, Kilicarslan MA, Bayramoglu G, Gokdemir K. Corrosion behaviour of dental metals and alloys in different media. J Oral Rehabil 1998; 25: 800-808
6. Piconi C, Maccauro G. Zirconia as a ceramic biomaterial. Biomaterials 1999; 20: 1-25. 31)
7. Garvie RC, Hannink RHJ, Pascoe RT. Ceramic steel? Nature 1975; 258: 703-704.
8. Paul SJ, Werder P. Clinical success of zirconium oxide posts with resin composite or glass-ceramic cores in endodontically treated teeth: a 4-year retrospective study. Int J Prosthodont 2004; 17: 524-528.
9. Robbins JW, Earnest LA, Schumann SD. Fracture resistance of endodontically-treated cuspids. Am J Dent 1993; 3: 159-161.

RESTORING SMILES, THE SMART WAY

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Abstract

Over the past three decades, dentistry is seeing a shift from reactive treatment of dental disease to a preventive and aesthetic model with bioactive technologies. Bioactive materials are “smart,” moisture-friendly and dynamic. By responding to ambient conditions in the mouth, these materials knit the restoration and tooth together. These materials remineralize dentin, maintain long-term bonded restorations, guard against recurrent caries and prevent the staining associated with microleakage and failure.

ACTIVA KIDS is the first dental resin with a bioactive ionic resin matrix, shock-absorbing rubberized resin component and reactive ionomer glass fillers that mimic the physical and chemical properties of natural teeth. It is a two-part, light and self-cure material, available in an opaque, light B shade suited for pediatric dentistry. This paper highlights one of the currently available “smart materials” in pediatric dentistry which may over the course of years help us move towards a new era of aesthetic bio-smart dentistry.

Key words: Bioactive material, primary teeth, anterior teeth, aesthetics, Activa Kids, anterior restoration

Introduction

Early childhood caries (ECC) is one of the most prevalent diseases in children worldwide.[1] By definition, early childhood caries is the presence of one or more decayed, missing or filled tooth surfaces in any primary tooth in a child 71 months of age or younger. It mainly affects the primary maxillary incisors followed by maxillary and mandibular first molars and mandibular cuspids.[2] The early loss of primary teeth may result in reduced masticatory efficiency, loss of vertical dimension and development of parafunctional habits. Esthetic-functional problems such as malocclusion and space loss, and psychologic problems that can interfere in the personality and behavioral development of the child.[3] Dentofacial aesthetics is an important determinant of overall physical esthetics. From the standpoint of child psychology, a healthy smile is conducive in building up interpersonal relationships and self-esteem.[4]

ACTIVA KIDS was reported by the manufacturer, Pulpdent, to be the first bioactive dental material with an ionic resin matrix, shock-absorbing resin component, and bioactive glass fillers that display similar chemical and physical properties to natural teeth.[5] They are durable, wear and fracture resistant. ACTIVA KIDS chemically bonds to teeth and seal against bacterial microleakage. It also releases and recharges with calcium, phosphate, and more fluoride ions as compared to glass ionomer cement. In addition, ACTIVA KIDS contains no bisphenol A (BPA), bisphenol A glycidyl methacrylate (bis-GMA), or BPA derivatives.[6] This case report describes esthetic restoration of primary anterior teeth using bioactive material – Activa Kids in a 4 1/2-year-old female patient.

CASE REPORT

A healthy 4 1/2-year-old girl child reported to Department of Paedodontics and Preventive Dentistry, Terna Dental College with the chief complaint of decayed upper front teeth. Intra oral examination in relation to the area of chief complaint revealed smooth surface caries with respect to 51, 52, 61 and 62 (*Fig 1*). Radiographic examination using intraoral periapical radiograph of 51, 52, 61 and 62 showed no pulpal involvement and there were no pathologic findings in the surrounding area.

Local anesthesia was achieved by infiltration of 2% lignocaine with 1:80,000 adrenaline (Lignox 2%) and rubber dam isolation was carried out (*Fig 2*). Caries debridement was performed using a slow-speed round bur (*Fig 3*). After complete caries excavation, the prepared surface was etched with 37% phosphoric acid for 20 seconds, followed by rinsing with water (*Fig 4*). The surface was later air dried. ACTIVA KIDS was applied slowly, from the bottom of the preparation to the top, taking great care to cover every surface with the cement while avoiding air incorporation (*Fig 5*). The proximal surfaces were contoured using matrix with wedges. After a delay of 20 seconds to allow for the acid component to react with the tooth surface, it was light cured for 20 seconds (*Fig 6*). The restoration was then finished and polished using Shofu's Super Snap kit (*Fig 7,8*). After a follow up period of six months, the teeth showed no detectable wear, all margins were clinically sound, and no fracture lines could be detected in the filling material or associated enamel margins (*Fig 9*).

Discussion

ACTIVA™ KIDS is an esthetic, bioactive resin restorative material that stimulates apatite formation and the natural remineralization process with discharge and recharge of calcium, phosphate and fluoride. It is an opaque white shade ideally suited for pediatric dentistry. ACTIVA is the first bioactive restorative with an ionic resin matrix, a shock-absorbing resin component, and bioactive fillers that mimic the physical and chemical properties of natural teeth.[7]

It is a two-part, light- and self-cure material loaded in double-barrel automix syringes. It eliminates safety concerns for children and does not contain bisphenol A (BPA) and its derivatives. ACTIVA KIDS delivers all the benefits of glass ionomers and has the esthetics, strength and durability of composites.[8]

Various studies have been conducted on Activa restorative material over the past several years.[9] In summary, those test results show that Activa has physical characteristics closely resembling the strengths and wear resistance of composites. Physical properties for ACTIVA listed by the manufacturer are shown in Table below.

Physical properties	**ACTIVA™ KIDS**
Light-cure setting time	20 sec

Depth of light-cure	4 mm
Self-cure setting time at 37°C	2 min
% filler by weight	56%
% reactive glass by weight	21.8%
Fluoride release, 1 day	230 ppm
Fluoride release, 28 days (cumulative)	940 ppm
Flexural strength	102 MPa/14,790 psi
Flexural modulus	4.3 GPa
Compressive strength	280 MPa/40,600 psi
Diametral tensile strength	42 MPa/6,090 psi
Water sorption, 1 week	1.65%
polymerization shrinkage	1.7%

A study conducted by Theodore P Croll using ACTIVA-RESTORATIVE, observed that the material handles like most injectable resin-based composites. Also, no bonding agent was needed while repairing primary teeth. Although in most cavity preparations, mechanical undercutting augments retention achieved with adhesive bonding. He also stated that the chemical cure of the ACTIVA products was reassuring to the dentist, if in some cases the light-beam penetration is not ideal. In such cases the material hardening is completed by chemical curing reaction and the acid/base neutralization hardening reaction of the glass ionomer components.[6]

Two common pediatric restorative techniques are interim therapeutic restorations (ITR) and atraumatic restorative technique (ART). Although the techniques of these procedures are similar, their therapeutic goals are quite different. ITR is primarily for patients who are very young and uncooperative, or who require special care. ITR is also used for caries control (prior to restoration) in children with multiple open carious lesions. The purpose of ART is to restore and prevent caries specifically in populations with little access to dental care.[5]

A case report by Ewoldsen described a modified ART technique using ACTIVA in the management of caries. The author concluded that the bioactive materials exceed the service of the previously classified interim or temporary materials owing to their ionic properties and remineralization potential. Thus, these materials provide long-term therapeutic restorations with aesthetics and durability comparable to composite restoratives which are technique sensitive.[10]

Activa kids has an unparalleled combination of physical and chemical properties which delivers bioactivity, toughness, resilience, durability and marginal integrity. The other key properties include:[11]

- Provides natural esthetics as it is highly polishable
- Resists fracture, wear, chipping and crumbling
- Moisture tolerant, thus making it a pediatric dentistry friendly material
- Automix syringe allows unique precise placement of material
- No bonding agents required when retention form is adequate
- Ideal for bulk filling
- Light cure and self-cure

Conclusion

Activa is a moisture-friendly, flowable material applied directly from the syringe using an injection technique. Because of its low surface tension and intimate adaption to tooth structure, Activa penetrates and flows into every nook, which is unusual for a resin-based material. We can now quickly deliver esthetic restorative solutions with materials that have a great affinity for tooth structure, provide the ionic exchange and full benefits of bioactivity and rival the physical properties of composites on the market today.

The judicious use of Activa may offer certain clinical advantages in restorative procedures, although further evidence is needed to substantiate any benefits in these indications. The mechanisms of adhesion, integration, and sealing of dentin for these new bioactive materials are still not proven and require more research before we can fully understand and prove whether bioactive materials are able to restore the form and function of the natural tooth.

References

1. Meyer F, Enax J. Early Childhood Caries: Epidemiology, Aetiology, and Prevention. Int J Dent. 2018;2018:1-7.
2. American Academy of Pediatrics. Policy on early childhood caries (ECC): classifications, consequences, and preventive strategies. Pediatr Dent. 2008;30(7 Suppl):40.
3. Verma L, Passi S. Glass fibre-reinforced composite post and core used in decayed primary anterior teeth: a case report. Case Rep Dent. 2011;2011:1-4.
4. Bönecker M, Abanto J, Tello G, Oliveira LB. Impact of dental caries on preschool children's quality of life: an update. Braz Oral Res. 2012;26(SPE1):103-7.
5. Dworkin O, Kugel G, Cheen Loo BD. What is Bioactive Dentistry? A Review. 2018 [cited 2018 Jan]:1-6. Available from:

https://www.dentalcetoday.com/courses/301%2FPDF%2FDTCE_Dworkin_Jan_217_fnl1.pdf

6. Croll TP, Berg JH, Donly KJ. Dental repair material: a resin-modified glass-ionomer bioactive ionic resin-based composite. Compend Contin Educ Dent. 2015 Jan;36(1):60-5.
7. The Future of Dentistry Now in Your Hands. PULPDENT® publication XF-VWP REV: 05/2014. Watertown, MA: Pulpdent Corporation; 2014.
8. ACTIVA™ BioACTIVE Instruction Manual. PULPDENT® publication XPV-01w REV: 12/2013. Watertown, MA: Pulpdent Corporation; 2013.
9. Zmener O, Pameijer CH, Hernández S. Resistance against bacterial leakage of four luting agents used for cementation of complete cast crowns. Am J Dent. 2014;27(1):51-55.
10. Ewoldsen N. Management of advanced caries. Inside Dentistry. 2015;11:90-93.
11. ACTIVA™ BioACTIVE Products for ProACTIVE Dentistry. ACTIVA™ Overview – Physical Properties. PULPDENT® website, Accessed November 5, 2014.

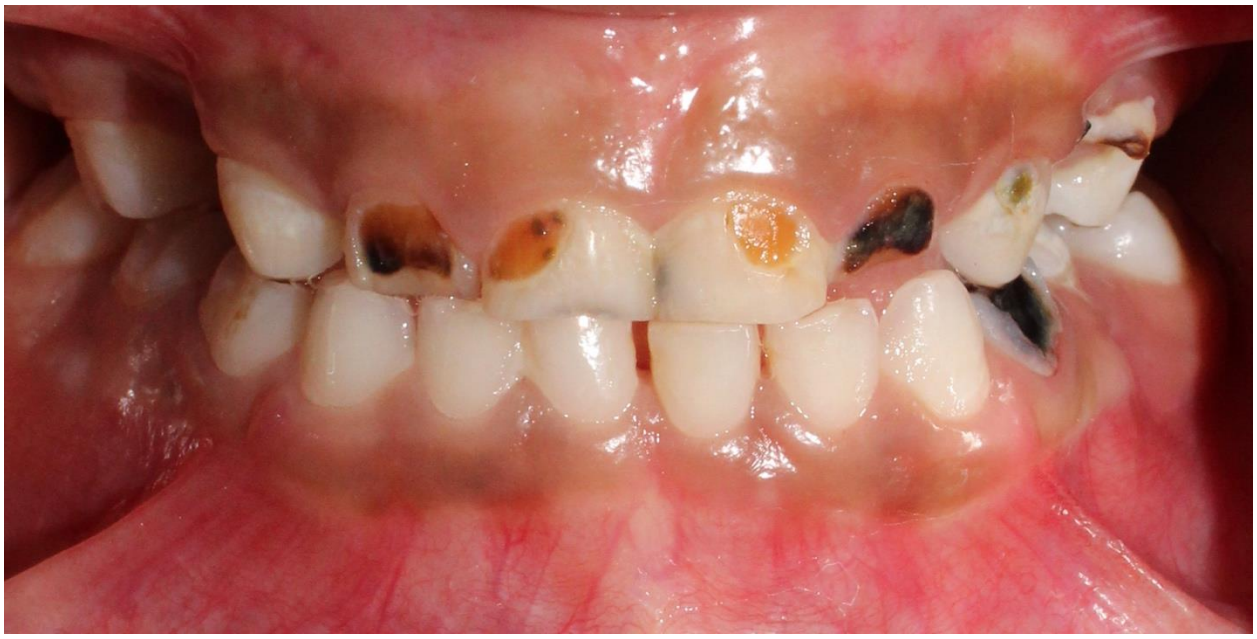

Fig 1: Pre-operative photograph

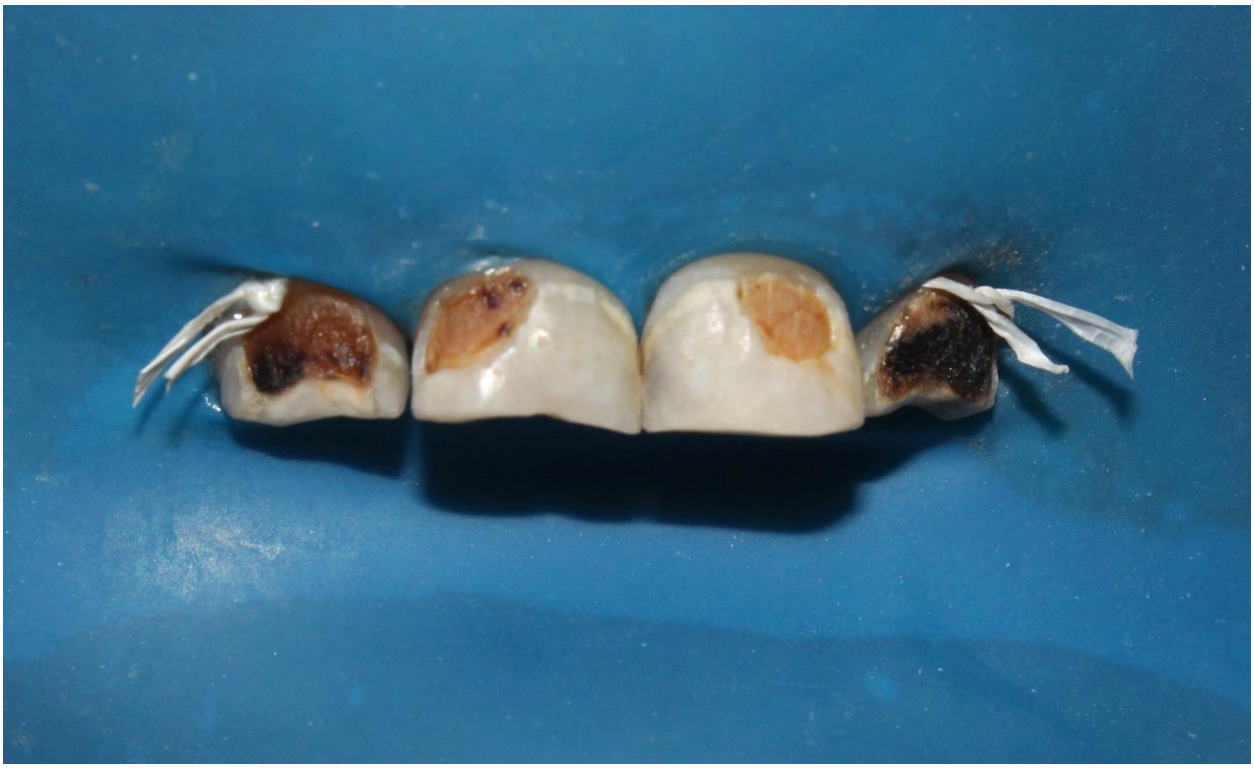

Fig 2: Rubber dam isolation

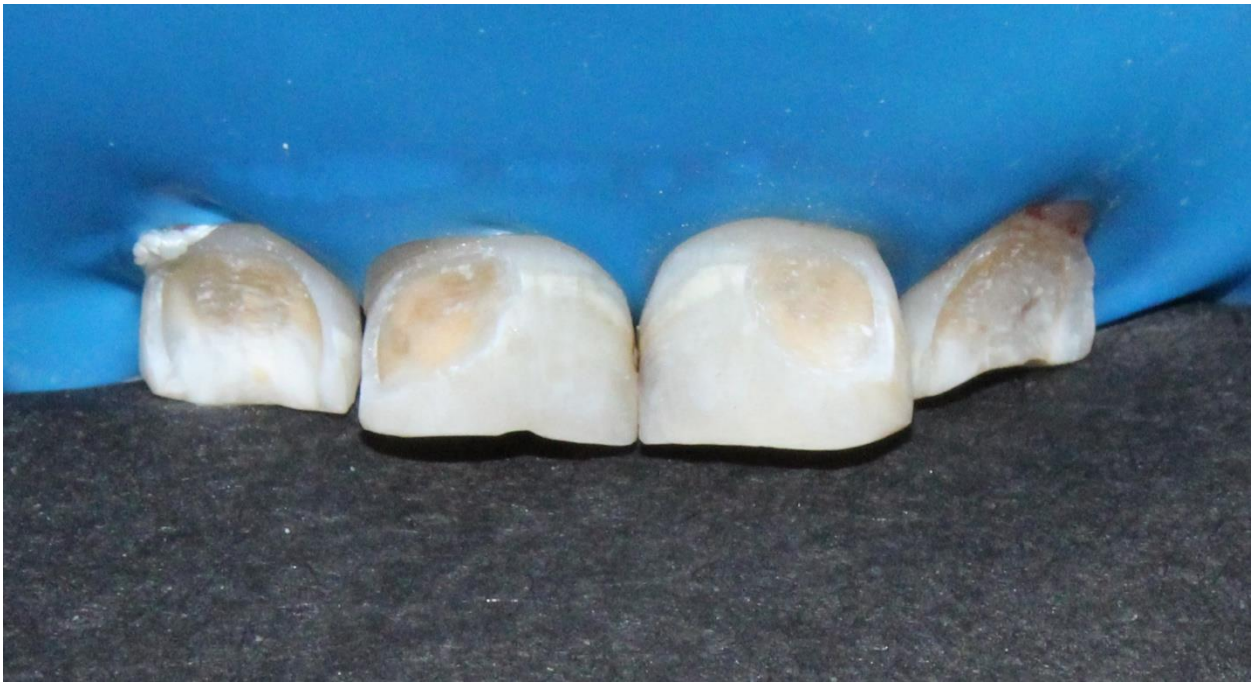

Fig 3: Caries excavation

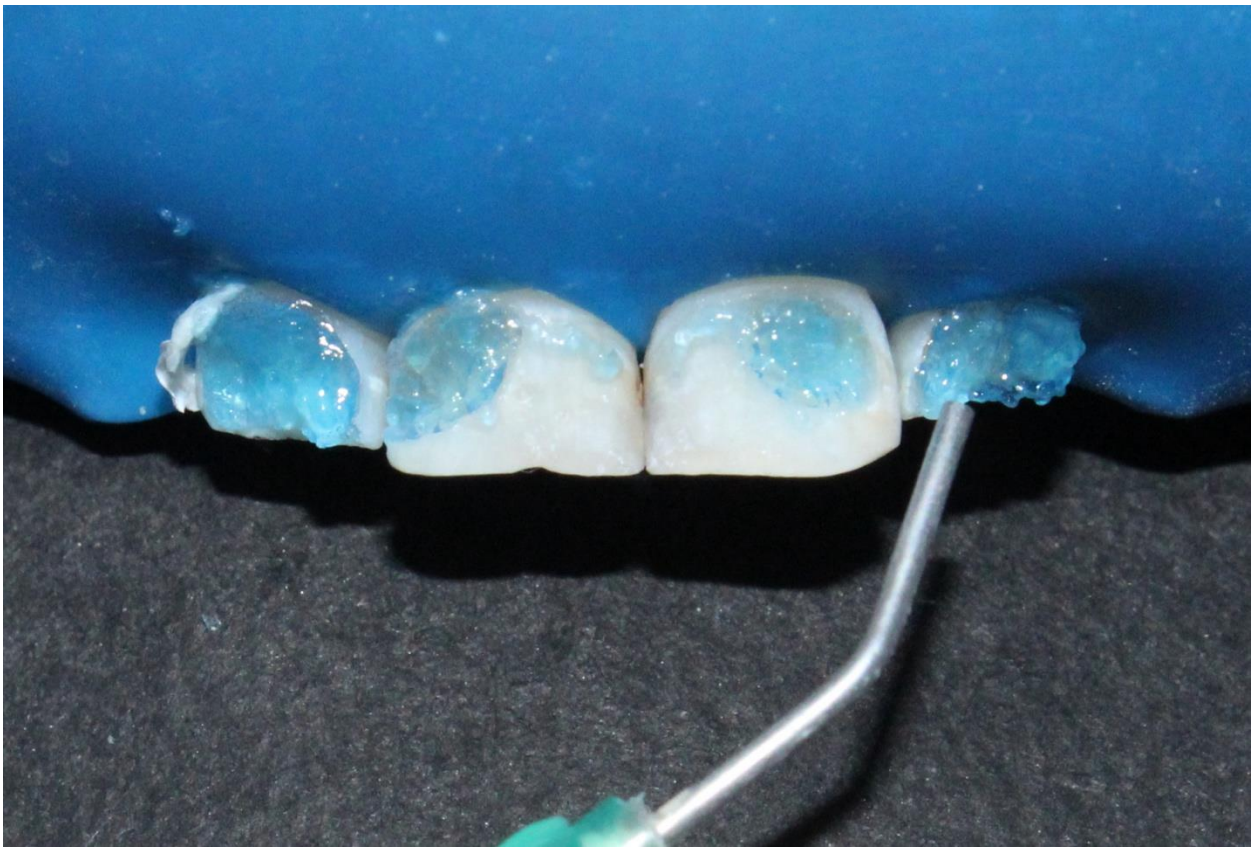

Fig 4: Etching with 37% phosphoric acid

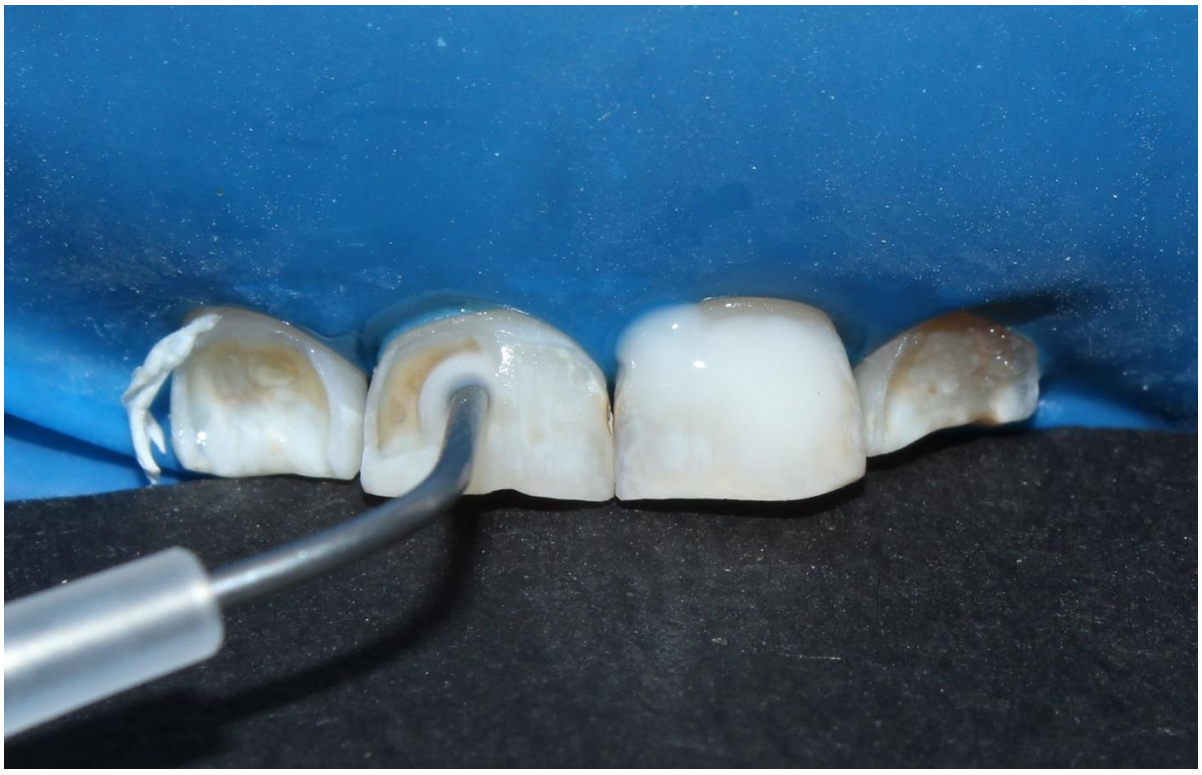

Fig 5: Application of activa kids-restorative

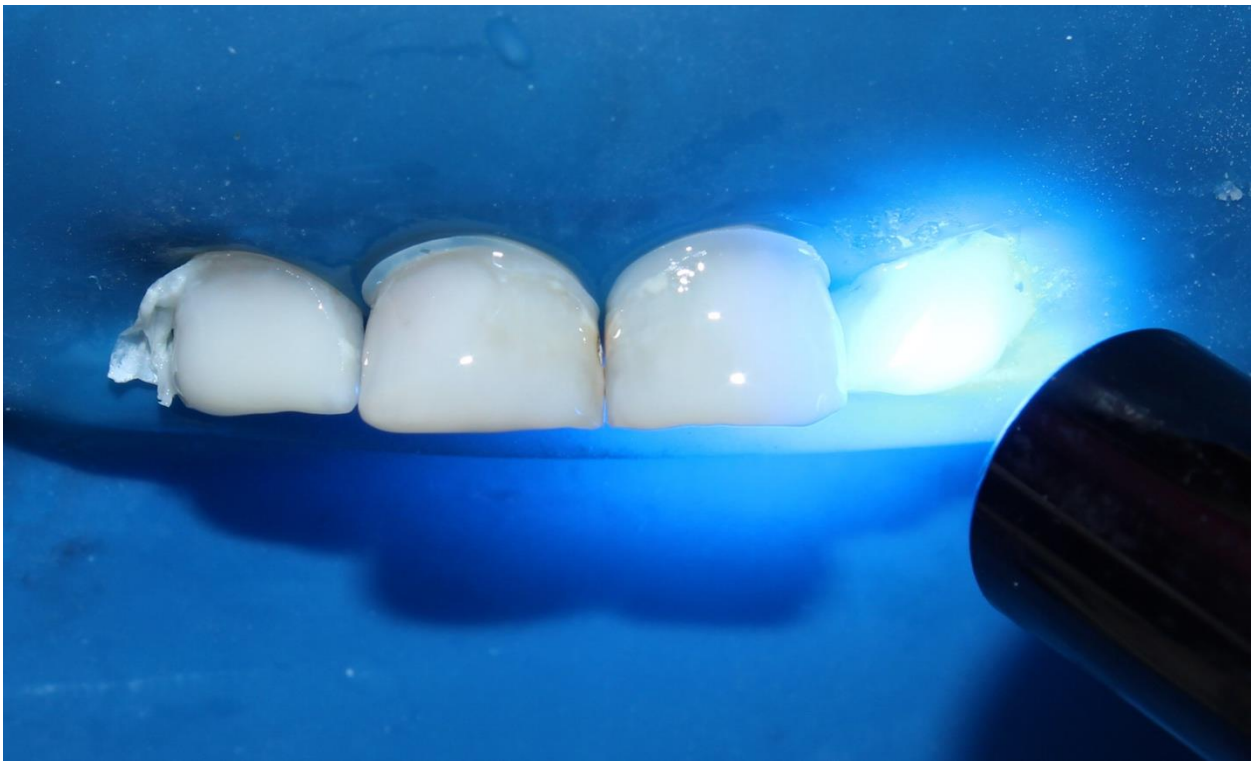

Fig 6: Curing for 20 seconds

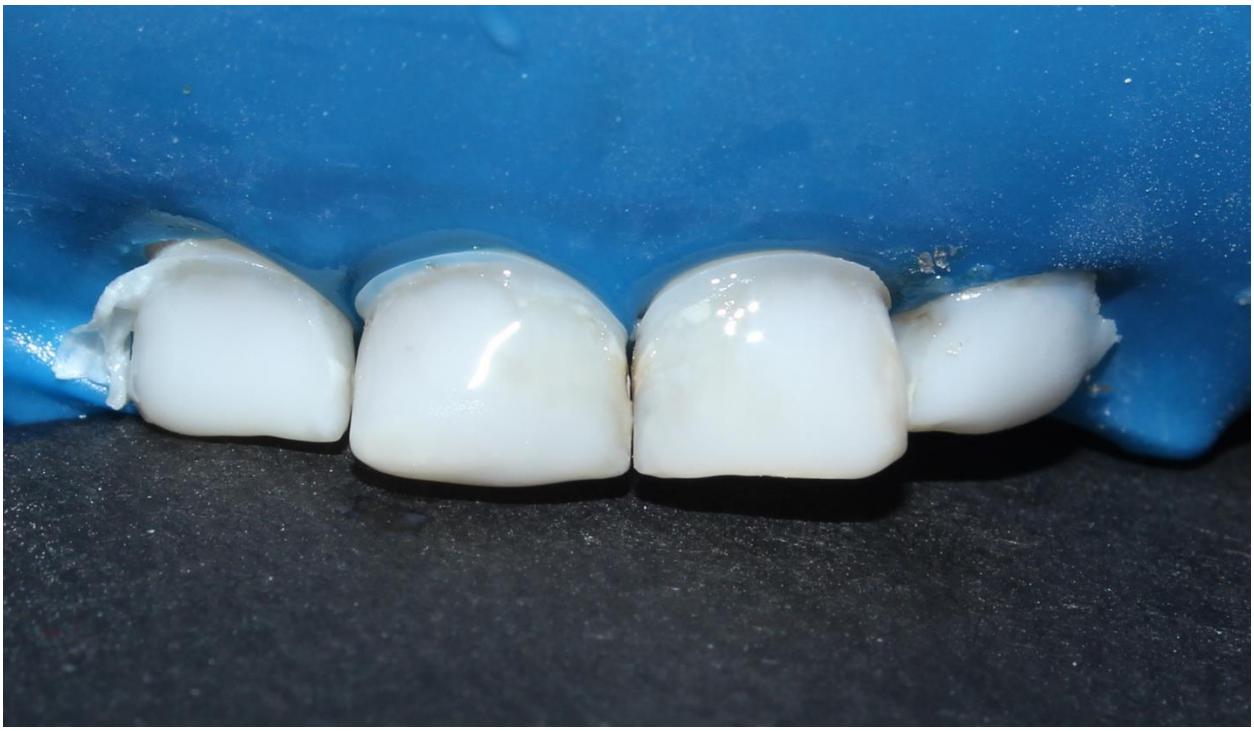

Fig 7: Finishing and polishing

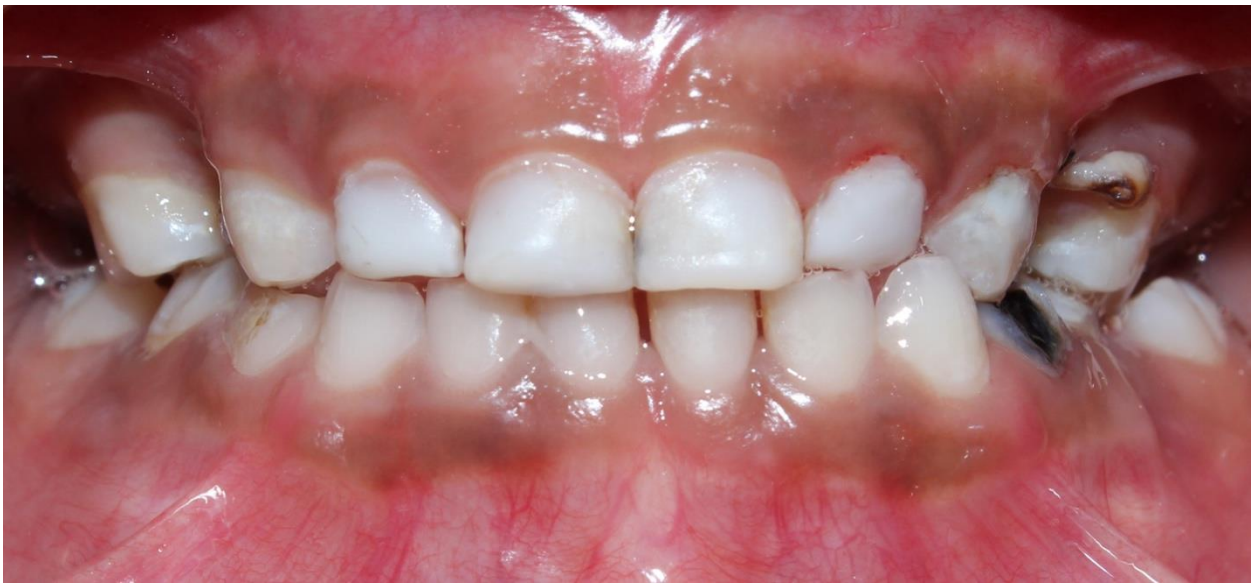

Fig 8: Post-operative photograph

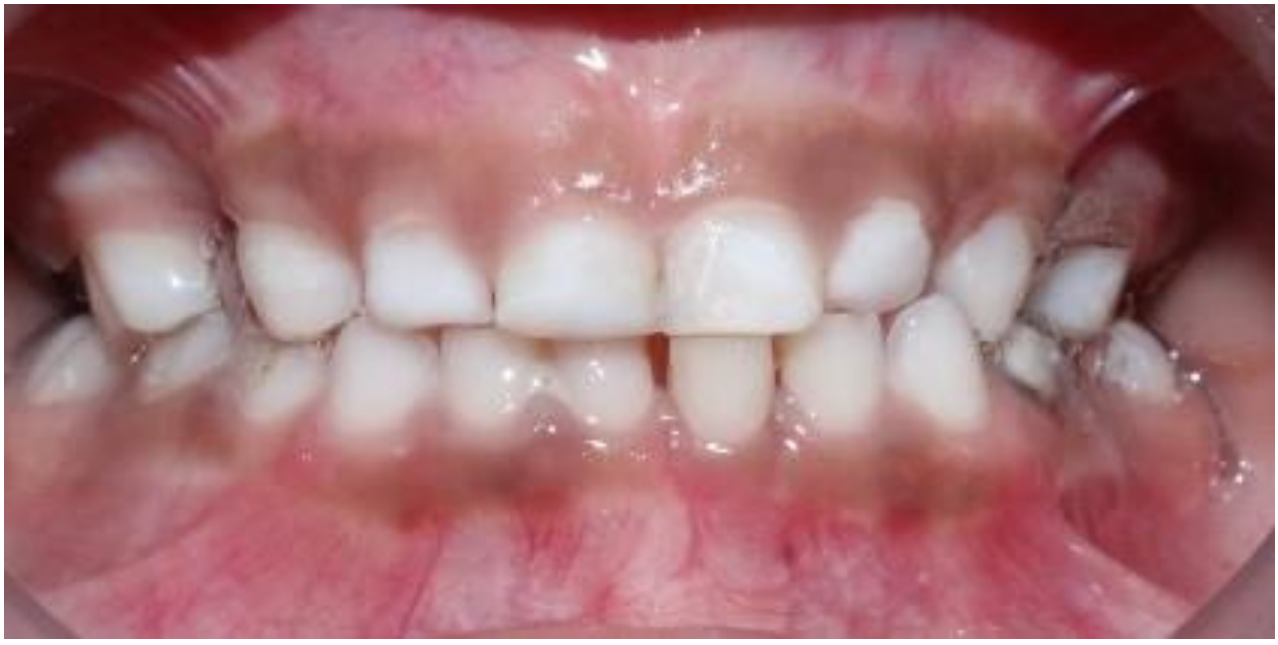

Fig 9: 6 months follow-up

CLINICAL EVALUATION OF CONCENTRATED GROWTH FACTOR (CGF) MEMBRANE BANDAGE AFTER GINGIVAL DEPIGMENTATION: A RANDOMIZED CONTROLLED TRIAL

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ABSTRACT:

CGF is described as a new form of a autologous platelet concentrate which has an extra fibrin matrix and more growth factors than those observed with PRF due to its differential centrifugation process. This study describes clinically and histologically, wound healing with CGF membrane as a periodontal bandage after depigmentation. Eight individuals were selected for a split mouth study with sites as test and control group. After surgical depigmentation,, the test site received CGF membrane and the control group was untouched, both groups were covered by a periodontal pack. The individuals were evaluated for visual analog scale and healing index on the 3rd and 5th day. Epithelization test was done with toluidine blue on the 5th day. Data was evaluated by using visual analog scale, healing index, and by the epithelisation test, which showed that the application of CGF membrane is a successful approach to protect the raw wound area of depigmented sites with better patient comfort and faster healing.

Key words:

Gingival hyperpigmentation, non-eugenol periodontal dressing, concentrated growth factor, CGF membrane, CGF bandage, wound healing.

INTRODUCTION:

The overall makeover of your look and enhancement of facial beauty is one of the primary elective goals of cosmetic dentistry. The broad black zone of pigmentation on the gingiva has been described as one of the serious patient esthetic concerns, it has been said to be very unsightly and its removal recommended.[1]

One of the oldest and reliable technique involving surgical removal by a scalpel blade of the gingival epithelium along with layer of connective tissue creating a connective tissue bed healing by secondary intention.[2] This study aims at evaluating wound healing clinically with CGF membrane as periodontal bandage after depigmentation.

MATERIALS AND METHODS:

Eight systemically and periodontally healthy patients with chief complaint of hyperpigmented gingiva [Figure:1] reported to the Department of Periodontology. A detailed medical history including smoking habit, systemic diseases associated or not associated with gingival melanin pigmentation, any malignancy, and medications was taken and was non-contributory.

All the relevant blood work was done and found satisfactorily within physiological limit.

After taking the ethical clearance and patients consent, an infiltration anesthesia with 2% lignocaine with adrenaline 1:200,000 was administered. A split thickness flap was raised and excised maintaining the gingival architecture. [Figure:2] Any bleeding was controlled using a saline soaked gauge. The entire visible pigmentation was removed, exposing the underlying connective tissue. CGF was first developed by Sacco (Sohn et al. 2011). CGF is produced by the centrifugation of venous blood and platelets are concentrated in a gel layer containing fibrin matrix as same as PRF (Rodella et al. 2011).[3] [Figure:3]

A split-mouth design was carried out and the gingiva of one quadrant was covered with CGF membrane bandage and sutured with 5-0 resorbable sutures [Figure:4] and covered with tin foil [Figure:5] so that it does not come contact with periodontal dressing and both quadrant was covered with a non- eugenol periodontal dressing(NEPD) Coe-Pak.[Figure:6]

Patients were prescribed amoxicillin 500 mg tid for 3 days and analgesic ibuprofen 400 mg bd for 3 days. They were refrained from brushing for 3 days and were instructed to rinse with 0.2% chlorhexidine digluconate. Postoperative instructions were given. On the 3rd postoperative day, patients were recalled and non-eugenol periodontal dressing was removed for evaluation. The visual analog scale (VAS) and healing index (HI) were assessed at 3rd and 5th day. Epithelization test by toluidine blue was carried out on 5th day.[4,5,6]

RESULTS:

Visual analog scale:

The VAS was assessed at 3rd and 5th day postoperatively. On the 3rd day, patients complained of moderate pain in the NEPD sites whereas in NEPD plus CGF sites patients reported of mild pain. On the 5th day, all patients in the NEPD sites reported of mild pain, while on the other hand, no pain was seen in patients in NEPD plus CGF sites. (Table 1)

Healing index:

HI was evaluated according to Landry et al. In NEPD sites, patients had poor healing score on the 3rd day after surgery. On the 3rd postoperative day in all the individuals NEPD plus CGF sites showed good healing, [Figure: 7] and it was very good on 5th postoperative day in the same sites. [Figure: 8] (Table 2)

Epithelization test:

All surgically depigmented sites were stained with toluidine blue on 5th day postoperatively. The amount of staining a site picks up tells about the inflammatory concentrate underneath. NEPD sites picked up moderate staining as compared to sites with NEPD plus CGF sites picked up mild staining. The toluidine blue score

clearly indicates the presence of more inflammatory cells in the NEPD sites. [Figure: 9] (Table 3).

The use of CGF bandage on the scalpel treated depigmented sites showed encouraging results with respect to clinical parameters compared to moderate healing sites which received the application of periodontal dressing only.

DISCUSSION:

Pigmentation of the gingiva though not a medical issue of serious concern but definitely has an impact on esthetic and also creates physiological negativity. Although a wide range of depigmentation techniques have been employed to manage this condition there is scarcity of literature that guides clinicians to manage inflammation, healing procedure and pain control after these procedure.

The aim of these procedures should be to make them simple, cost effective and comfortable. There should be minimum pain and tissue loss and no gingival recession, damage to attachment apparatus and underlying bone.

Depigmentation done by using scalpel technique, is also called as split thickness epithelial excision and surgical stripping. Conventional scalpel method involves the surgical excision of gingival epithelium using a scalpel and allowing the denuded connective tissue to heal by secondary intention.[2] It is simple, most economical and convenient to perform with minimum time and efforts. Healing with this technique is faster in comparison to other surgical techniques. Although lower cost and lower rate of recurrence favor the surgical stripping of gingiva, it is associated with some pain, post-operative discomfort, intra- and post-operative bleeding and requires placement of periodontal dressing. Thinner gingival biotype and narrow papillary areas contraindicate the use of this technique.[7]

After depigmentation, as suggested by Soheilifar S et al., it has been traditionally believed that periodontal dressing reduces the risk of wound infection, bleeding and granulation tissue formation and improves tissue healing and reduce patients pain and discomfort immediately post surgery.[8] However, these advantages were later questioned by some researchers. Bose et al., suggested that periodontal dressing

leads to more inflammation immediately post-surgery; which may in turn delay the wound healing response.[9]

Periodontal dressing induces allergic reactions, difficulties in manipulation and rough surface after setting. Histological evidence shows inflammatory cell infiltration after application of periodontal dressing as suggest by (Kreth et al 1966).[10]

The 2nd generation PRF has been utilized and investigated in various forms in the field of periodontology. The PRF membrane has been used as palatal bandage following free gingival graft procedure where satisfactory patient comfort was achieved. The distinguishable results from various treatment modalities could be attributed to its fibrin structure and the release of various growth factors for a prolong period.[11]

The latest in platelet concentrates, concentrated growth factor (CGF) is an innovative method for producing a fibrin matrix with concentrated growth factor and its clinical applications are being currently investigated (sohn et al.,2009)[12] CGF does not dissolve rapidly following application. Instead, the strong fibrin gel in the matrix addition is slowly remolded in a similar manner to a natural blood clot. Dohan et al., in their study stated that CGF has a complex tridimensional architecture which makes it a real platelet, leukocyte and growth factor rich fibrin biomaterial. The platelets and the dense fibrin network make large clusters of coagulation in the initial millimetres of the membrane beyond the red blood cell base, also confirmed by SEM analysis.[13]

Hence as seen in this study the benefits of using CGF membrane as a bandage for coverage was provided to the exposed gingival surface exhibiting less pain and discomfort to the patient and also visibly lesser inflammation at the surgical site. The presence of growth factors, such as TGF-b1 and VEGF, is important for stimulating cell proliferation, matrix remodeling, and angiogenesis during healing processes (Grainger et al.,2000)[14] CGF membrane as a bandage would be used as a three dimensional scaffold for autologous in vitro culture in combination with adipose derived stem cells and CGF(such as PDGFs,bFGF,VEGF,IGF-1and TGF-B) released by PRP collected from autologous blood samples and thereby promote its application in the different fields of autologous regenerative medicine.[15]

Hence it was concluded that the application of CGF membrane as a bandage in this study has shown a successful approach to protect the raw wound area of

depigmented sites with better patient comfort and faster healing, excellent handling rather than the use of periodontal pack alone.

REFERENCES:

1. Ginwalla TM, Gomes BC, Varma BR. Surgical removal of gingival pigmentation. J Indian Dent Assoc 1966;38:147-50.

2. Dahiya R, Blaggana A, Panwar V, Kumar S, Kathuria A, Malik S, et al. Clinical and histological comparison of platelet-rich fibrin versus non-eugenol periodontal dressing in the treatment of gingival hyperpigmentation. J Indian Soc Periodontol 2019;23:345-50.

3. Rodella LF, Favero G, Boninsegna R, Buffoli B, Labanca M, Scarì G, et al.Growth factors, CD34 positive cells, and fibrin network analysis in concentrated growth factors fraction. Microscopy research and technique 2011;74:772-7.

4. Dexter F, Chestnut DH. Analysis of statistical tests to compare visual analog scale measurements among groups. Anesthesiology: J ASA 1995 ;82:896-902.

5. Lingamaneni S, Mandadi LR, Pathakota KR. Assessment of healing following low-level laser irradiation after gingivectomy operations using a novel soft tissue healing index: A randomized, double-blind, split-mouth clinical pilot study. J Indian Soc Periodontol 2019;23:53.

6. Sridharan G, Shankar AA. Toluidine blue: A review of its chemistry and clinical utility. J. Oral Maxillofac Pathol 2012;16:251.

7. Kon S, Bergamaschi 0, Dome Al. Ruben MP. Melanin Repigmentation after Gingivectomy: A 5-Year Clinical and Transmission Electron Microscopic Study in Humans. Int J. Periodont Rest Dent 1993;13:85-92.

8. Soheilifar S, Bidgoli M, Faradmal J, Soheilifar S. Effect of periodontal dressing on wound healing and patient satisfaction following periodontal flap surgery. J Dent 2015;12:151.

9. Bose S, Gundannavar G, Chatterjee A, Mohan RR, Viswanath RA, Shetty S, et al. Comparison Of The Early Wound Healing Following Periodontal Flap Surgery In Periodontitis Patients With And Without Periodontal Dressing. Indian J Dent Sci 2013;1:5.

10. Kreth KK, Zimmermann ER, Collings CK. Effect of periodontal dressings on tissue culture cells. J Indian Soc Periodontol 1966;37:48-53.

11.Debnath K, Chatterjee A. Clinical and histological evaluation on application of platelet concentrates on depigmented gingival epithelium. J Indian Soc Periodontol 2018;22:150.

12. Sohn DS, Moon JW, Moon YS, Park JS, Jung HS. The use of concentrated growth factors for sinus augmentation. Int J Oral Implantol 2009;38:25-38.

13. Dohan DM, Choukroun J, Diss A, Dohan SL, Dohan AJ, Mouhyi J, et al. Platelet-rich fibrin: A second-generation platelet concentrate. Part I: Technological concepts and evolution. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2006;101:37-44.

14. Grainger DJ, Mosedale DE, Metcalfe JC. TGF-β in blood: a complex problem. Cytokine & growth factor reviews 2000;11:133-45.

15. Qian Y, Han Q, Chen W, Song J, Zhao X, Ouyang Y, et al. Platelet-rich plasma derived growth factors contribute to stem cell differentiation in musculoskeletal regeneration. Front. Chem 2017;5:89.

TABLE 1

Table1: Visual analog scale rating obtained on 3rd and 5th postoperative day.

VAS				
	GROUP A (CONTROL)		GROUP B (TEST)	
CASE ID	3RD DAY	5TH DAY	3RD DAY	5THDAY
1	4	2	2	0
2	4	2	2	0

3	4	2	2	0
4	5	3	3	1
5	4	2	2	0
6	5	3	3	1
7	4	2	2	0
8	5	3	3	1

Table 2:

Healing index score obtained on 3rd and 5th postoperative day.

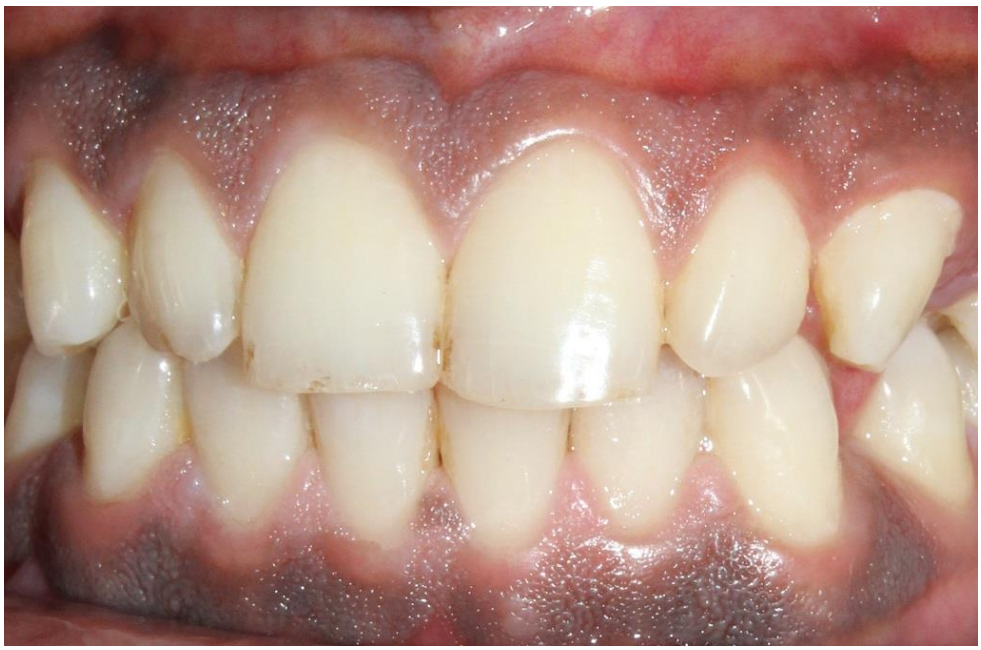
HEALING INDEX BY LANDRY ET AL					
	GROUP A(CONTROL)		GROUP B(TEST)		
CASE ID	3RD DAY	5TH DAY	3RD DAY	5TH DAY	
1	2	3	3	4	
2	2	3	3	4	
3	2	3	3	4	
4	2	3	3	4	
5	2	3	3	4	
6	2	3	3	4	
7	2	3	3	4	
8	2	3	3	4	

Table 3: Epithelization test score obtained on 5th postoperative day.

EPITHILIZATION TEST 5TH DAY			

CASE ID	GROUP A	GROUP B	
1	3	1	
2	3	1	
3	3	1	
4	2	1	
5	3	1	
6	3	1	
7	2	1	
8	2	1	

Figure 1:



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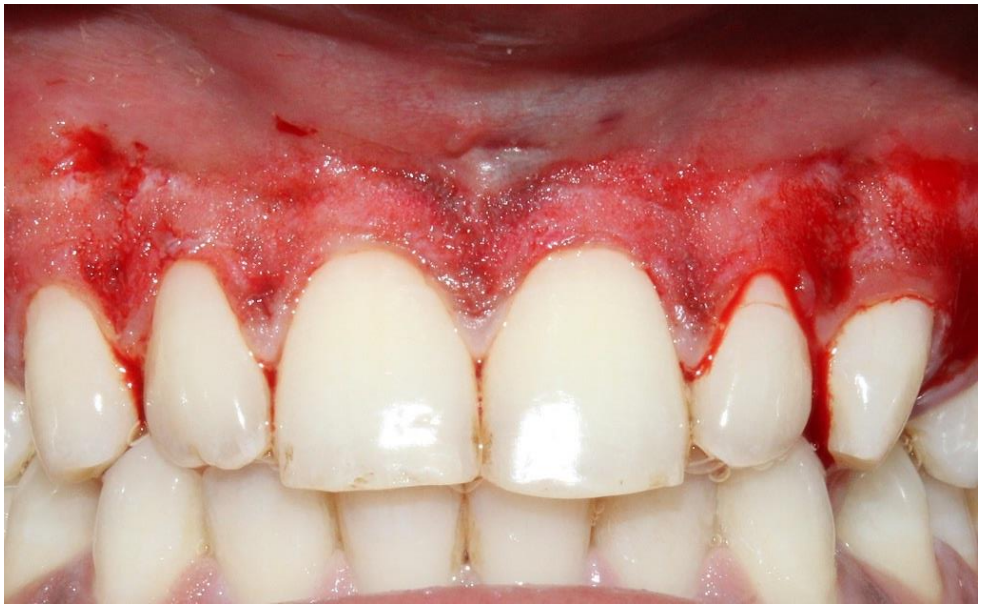
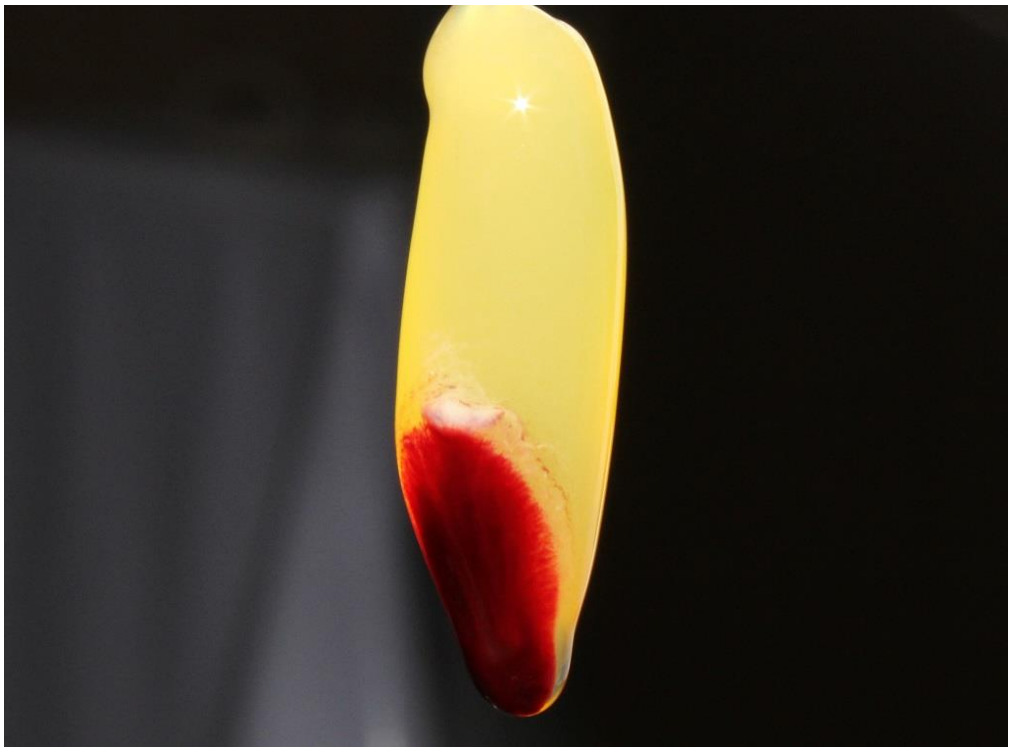


Figure 3



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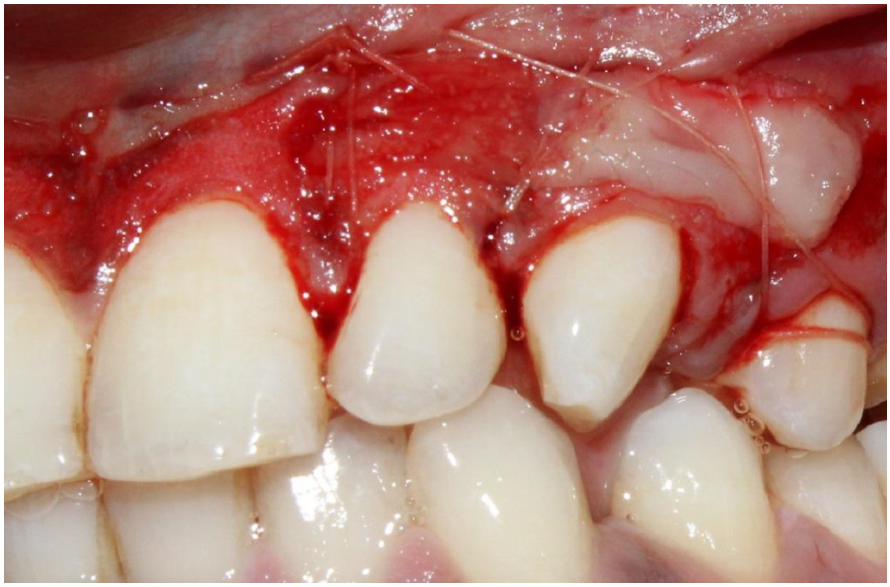

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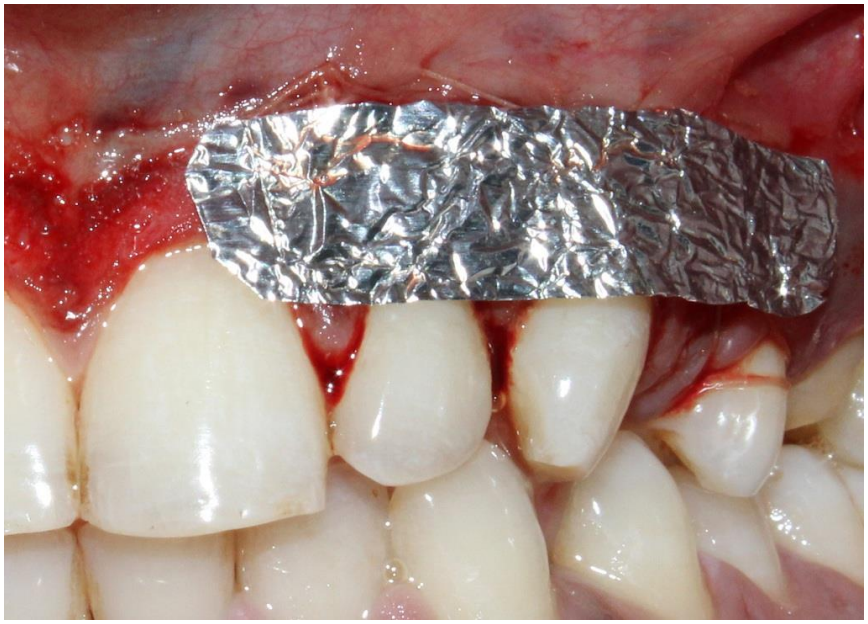

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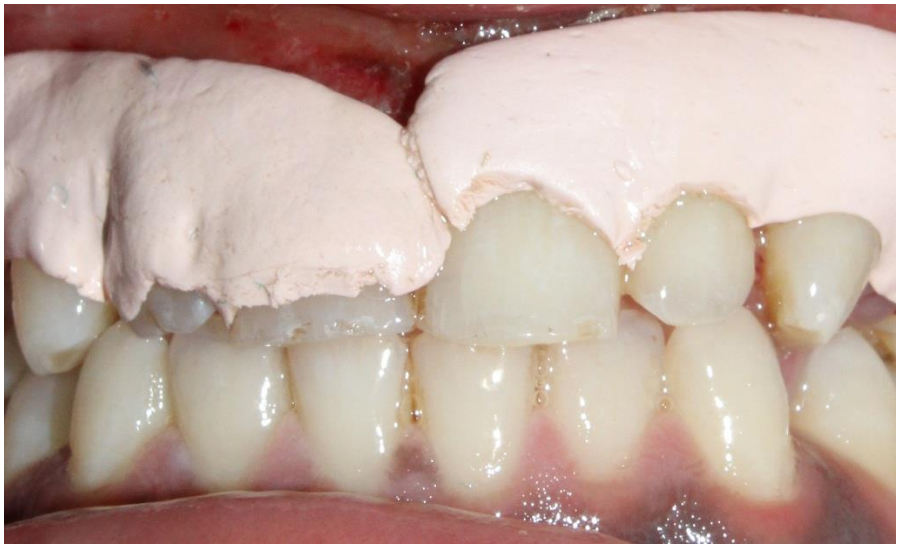
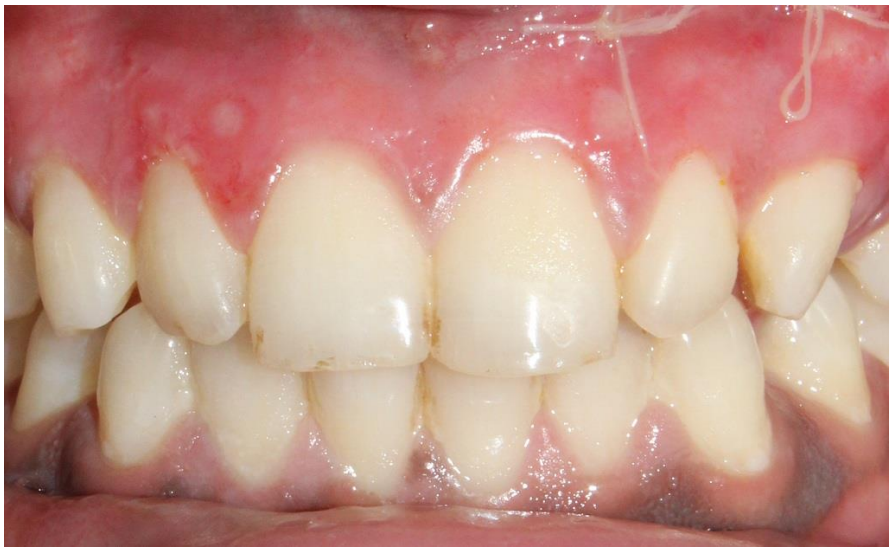


Figure 7



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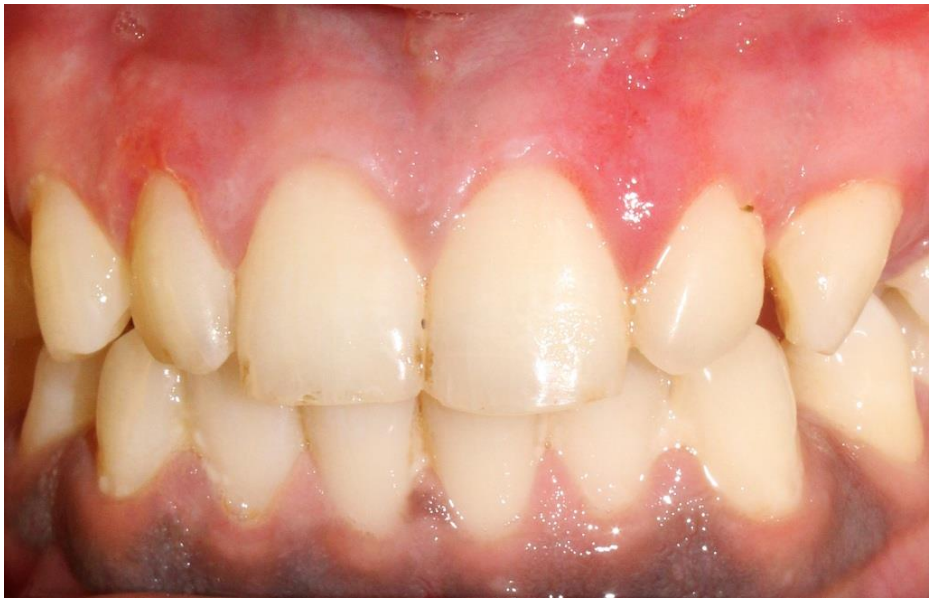

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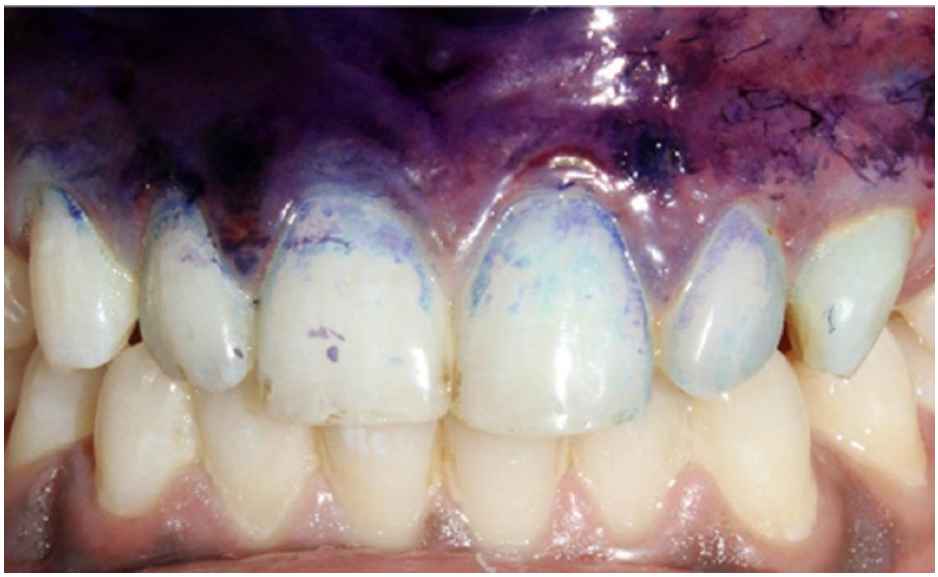

Recent Advances in Dental Ceramics: A Review of Literature

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Introduction

Dental ceramics are inorganic, non-metallic, structures, primarily containing compounds of oxygen with one or more metallic or semi metallic elements (aluminium, calcium, lithium, magnesium, phosphorous, potassium, silicon, sodium, titanium and Zirconium). Dental ceramics are superior because of their biocompatibility, long term color stability, wear resistance, and their ability to be formed into precise shapes**.**

Methods:

A comprehensive search of PubMed journals was conducted to retrieve clinical and experimental studies, case reports and review articles by using keywords. After studying a series of related articles and publications we have reviewed and compared the various properties, applications and advances in dental ceramics.

History

In approximately 700 B.C., the Etruscans made artificial teeth of ivory and bone, human teeth and animal teeth that were held in place by gold wires or flat bands and rivets (Fig.1). Animal bone and ivory from hippopotami and elephants were used for many years thereafter[1].

THE JOURNEY FROM METAL CERAMICS TO ALL CERAMIC PROSTHESIS

METAL CERAMICS RESTORATIONS

Weinstein et al. first described the production of metal ceramic restoration by using porcelain powders containing 11% to 15% K_2O frit.

METAL REINFORCED SYSTEMS (CAPTEK SYSTEM)

THE CAPTEK SYSTEM**:** In the Captek system the coping is produced from two metal impregnated wax sheets that are adapted to a die and fired. The first sheet forms a porous gold platinum palladium layer that is impregnated with 97% gold when the second is fired. Advantages of the system include excellent esthetics and marginal adaptation[2].

ALUMINOUS PORCELAIN CROWNS

The porcelain jacket restoration has been in use since Land introduced it in 1903. Testing by Seghi et al found strength of the core to be up to four times greater than other ceramics materials[3].

CASTABLE AND MACHINABLE GLASS CERAMICS (DICOR AND DICOR MGC)

Dicor is a polycrystalline glass-ceramic material, initially formed as a glass and subsequently heat treated under controlled crystallization conditions to produce a glass-ceramic material[4].

PRESSABLE GLASS CERAMICS

IPS empress, a new addition to the metal free ceramic restorations uses a wax-up lost wax technique (Fig.2). The ceramic is leucite reinforced and comes in precerammed cylinders (Fig.3) in various shades[3].

CERESTORE: A SHRINK FREE CERAMIC CROWN

Sozio and Riley in 1903[3] introduced the Cerestore system. It employs a heat stable epoxy die and an aluminous core porcelain which is injection molded.

CEROMERS

Ceromers are more viscous than typical composite resin, have greater filler components and different handling characteristics.

ORMOCERS

Acronym: - Organically modified ceramic.

It is composed of inorganic-organic hybrid prepolymerized matrix with chemically attached polymerizable group. It contains multifunctional Urethane and Thioether (meth) acrylate alkoxy silane sol-gel precurssors.

COMPUTER ASSISTED RESTORATIONS

Today's world is not a mere electronic or computer world but it is a world of automation. CAD-CAM is the one of the important milestone in the world of automation.

Tuntiprawon M. and Wilson P.R. (1995)[5] stated that long term success of all ceramic crowms and fixed partial dentures depends on accuracy of fit between restoration and prepared tooth structure which can influence the strength of restoration.

Acoording to **Tinscert J. et al. (2000)[6]** advantages of using CAD/CAM are:

- Room temperature milling of ceramic materials processed under high quality processes will yield homogenous materials where voids, cracks and flaws are reduced to minimum.
- This technology is able to produce highly accurate restorations.
- It yields restorations with higher strength, accuracy and marginal fit.

SYSTEMS OF CAD-CAM

Some popular systems that are in current use to accomplish CAD-CAM restorations:

a) The CEREC system manufactured by Siemens Dental Corp. This compact chairsided system consists of an optical data aquisition camera, CAD CAM software and micromilling machine.

b) The DUX or Titan system consists of a miniature contact digitizer, a central computer and a milling machine.

c) The DURET system is produced by Sopha. It consists of three discrete units: a camera module for data acquisition, the CAD module used to design the restoration and the milling module.

d) The CELAY system is a very small unit consisting of contact digitizer that “reads” the shape of an acrylic inlay and directly transfers the shapes to a miniature milling machine.

e) **The PROCERA system** is a coping and fabrication system using a pantograph and an electric discharge machining. The shape of the die and the wax pattern of the restorations transmits these shapes to a milling machine to produce electrodes in these shapes. These electrodes are used to produce a restoration.

f) The DENTI-CAD system consists of miniature robot arm digitizer, CAD-CAM software with an export for fully automated design and a milling machine. It is completely automated[7].

THE CEREC SYSTEM

The CEREC 3 (Fig.4) all ceramic, chair side computer aided design/computer aided machining restorations system was introduced in January of 2000. Chair-side fabrication of ceramic inlays, veneers partial and full posterior crown and anterior full crown was simplified and accelerated (Fig.5).

The newest model known as CEREC AC (powered by BlueCam) also has the ability to take half-arch or full arch impressions and create crowns, veneers and bridges. The entire tooth preparation scanned is coated with a layer of titanium dioxide powder, which makes translucent areas of teeth opaque and permits the camera to register all of the tissues[8].

DCS PRECIDENT CAD/CAM SYSTEM:

The DCS (Digitizing Computer System) Precident system, called the DUX or Titan system in the United States, was developed in 1988 and introduced to the market in 1990.

J.Tinschert et al. (2001)[9] studied marginal fit of alumina and zirconia based finer partial dentures produced by DSC precident system. It was concluded from the results of the study that the level of accuracy found for investigated All-ceramic Fixed partial dentures meet the clinical requirements.

THE PROCERA ALL-CERAMIC SYSTEM

Application of the Procera system for manufacturing individual crowns made of aluminum oxide ceramics for the first time joins computer controlled technology with the increasing demands for improved esthetics (Fig.6).

CAD/CAM GLASS CERAMICS

CAD/CAM-compatible feldspathic ceramics

The conventional dental porcelain is based on feldspar, comprises a tectosilicate mineral feldspar, quartz, or kaolin and have excellent aesthetic properties and have been recommended for use in fabricating veneers, inlays/onlays and single anterior and posterior crowns. The clinical performance of these CAD/CAM inlays and onlays was evaluated in a 10-year prospective study and a success rate of 90.4% was achieved (Otto T, et al. 2002)[10]. However, a much higher breakage rate of up to 36% after 2 years was also reported.

Clinical studies of Vita Mark II inlays showed survival rates of 94.7% after 5 years, 90.6% after 8 years and 85.7–89% after 10 years (Pallesan U, et al.2000)[11].

CAD/CAM with leucite-reinforced ceramics

ProCAD was introduced in 1998 to be used with the CEREC. It is a leucite reinforced ceramic, similar in structure to the heat pressed ceramic Empress.

CAD/CAM milling lithium disilicate reinforced ceramics

Lithium disilicate glasses have their flexure strength between 350 MPa and 450 MPa. This is higher than that of leucite-reinforced dental ceramics. Lithium disilicate

CAD/CAM ceramic IPS E.max CAD was introduced in 2006 and is a chair-side monolithic restorative material. They are available in A–D and Bleach shades as well as in 3 translucencies and are supplied in a pre-crystallized so-called blue state.

CAD/CAM and glass infiltrated alumina and zirconia ceramics

The Vita In-Ceram Classic group of ceramics are slip cast, glass infiltrated ceramics that have at least two interpenetrating phases intertwined throughout the material. Acid etchants have no appreciative effects on aluminium trioxide and conventional cements such as glass ionomer cement has been suggested for luting. Air particle abrasion with 50 mm aluminium trioxide with the use of tribochemical silica- coating for bonding to a silane coupling agent have also been suggested to be effective CAD/CAM[10].

RECENT ADVANCES IN DENTAL CERAMIC MATERIALS

The evolution of computerized systems for the production of dental restorations associated to the development of novel microstructures for ceramic materials has caused an important change in the clinical workflow for dentists and technicians, as well as in the treatment options offered to patients[12].

Monolithic Zirconia restorations

The better translucency of the new zirconia materials has been achieved by means of microstructural modifications, like decrease in alumina content, increase in density, decrease in grain size, addition of cubic zirconia and decrease in the amount of impurities and structural defects[13,14]. Laboratory studies have shown that monolithic zirconia usually causes a rather comparable wear of the antagonists in comparison to other restorative ceramics, and this wear rate is within the physiological range reported in the literature. Some of these studies[15,16] compared different surface finishing techniques for monolithic zirconia restorations, such as polishing versus glazing, and found that polished surfaces resulted in less enamel wear of the antagonist.

New Glass Ceramics

These new glass-ceramics were designed to contain lithium silicate as the main crystalline phase in a vitreous matrix reinforced with zirconium dioxide crystals[17]. Suprinity and Celtra duo are two new glass ceramics containing smaller and finer crystalline phase occurs due to the presence of zirconia particles in the material, which acts as an additive influencing the crystallization by hindering crystal growth[18]. The main advantage of these materials is their time saving ability for the production of dental restorations, since they are faster to be milled in CAD-CAM machines than lithium disilicate glass-ceramics[19] and are already offered in their fully crystallized state (CELTRA Duo) or need a very short crystallization cycle (Suprinity).

Polymer infiltrated ceramic networks (PICNs)

Recently, a new material has been developed by Vita which is marketed as a polymer infiltrated in a porous ceramic, generating an interpenetrating network (polymer infiltrated ceramic network, PICN). This new material was developed based on the glass infiltrated ceramic technology, which was originally released by Vita in the 90's[19]. This PICN is based on initial sintering of a porcelain powder to approximately 70% of its full density, followed by infiltration with a monomer mixture[20]. A study evaluated the damage tolerance of different dental materials and showed that the damage tolerance of PICN was higher when compared to other ceramics for CAD-CAM, like veneering ceramics[21].

RECENT ADVANCES IN PROCESSING TECHNOLOGIES

Addition to CAD-CAM systems, the following techniques have stood out recently:

Selective Laser Sintering or Melting

SLS was invented by Deckard and Beaman at the University of Texas at Austin, with the very first patent filed in 1986. In this technique, the laser beam sinters thin layers of a ceramic from a container filled with powder to create a single coping or framework, in

which each layer represents a cross section of the CAD mode[22]. An additional advantage is that these materials are also more tolerant to temperature gradients. Like its counterparts, ceramic SLS has also become increasingly popular in biomedical applications, particularly in the fabrication of customized complex and highly cellular biocompatible scaffolds for tissue engineering.

Direct 3D Printing

Direct 3D printing (Fig.7) is similar to a traditional inkjet printer, performing the direct printing of a ceramic suspension, allowing the generation of dense green bodies with high resolution, and producing complex shapes[23]. In 2009, using a modified inkjet printer, a zirconia crown was manufactured with sufficient mechanical properties to be used in the oral cavity[24]. The impression of the posterior dental crown was performed using a cartridge filled with a 27 vol% solid content of zirconia-based ceramic suspension. Slurry-based ceramic 3D printing technologies generally involve liquid or semi-liquid systems dispersed with fine ceramic particles as feedstock, either in the form of inks or pastes, depending on the solid loading and viscosity of the system. The slurry content can be 3D printed by either photopolymerisation, inkjet printing or extrusion. Advances in materials science have also made it possible to photopolymerise pre-ceramic polymers (PCPs) for transformation into polymer-derived ceramic (PDC) components via heat treatment[25].

Stereolithography

Stereolithography is frequently used nowadays, and has already evolved enough to allow production of more complex ceramic pieces, whereas the previously mentioned techniques are in the early development stage for dental applications. It is a process in which a light source of a certain wavelength (usually in the ultraviolet range) is used to selectively cure a liquid surface in a vat containing mainly photopolymerisable monomer along with other additives in very small amounts, particularly photoinitiators[26]. The light-activated polymerization process (i.e. liquid monomer turns into solid resin) generally proceeds point-to-line, line-to-layer, and then layer-by-layer, along with the light scans

on the liquid surface. When polymerisation is finished for one layer, the vat or platform supporting the part being produced is lifted or lowered by the thickness of a layer, depending on whether the building process is being operated in a top-down or bottom-up mode.

Conclusion

Dental ceramics and processing technologies have evolved significantly in the past years, with most of the evolution being related to new microstructures and CAD-CAM methods. Also, a trend towards the use of monolithic restorations has changed the way clinicians produce all-ceramic dental prostheses, since the more aesthetic multi-layered restorations unfortunately are more prone to chipping or delamination. These new generations of all ceramic materials present interesting options, both in terms of material selection and fabrication techniques. The various materials have different properties that specify their use in specific clinical situations.

References

1. Petrauskas A, Olivieri KA, Pupo YM, Berger G, Betiol EÁ.Influence of different resin cements and surface treatments on microshear bond strength of zirconia-based ceramics. J Conserv Dent: 2018 Mar;21(2):198.

2. Rosensteil. Land. Fujimoto: Contemporary fixed prosthodontics, 3rd edition. Pg - 433-435.

3. J. Gregery Wall and Dale L. Cipra: Alternative crown system: Is the metal–ceramic crown always the restoration of choice. Dent. Clin. N. Am,1992; 36(3):765-781.

4. Gordan J. Christensen: why all ceramic crowns? JADA,1997;128:1453-1455.

5. Tuntiprawon M, Wilson PR.The effect of cement thickness on the fracture strength of all-ceramic crowns. J Aust Dent.1995; 40(1):17-21.

6. Tinschert J, Zwez D, Marx R, Anusavice KJ.Structural reliability of alumina-, feldspar-, leucite-, mica-and zirconia-based ceramics.J Dent. 2000; 28(7):529-35.

7. Vivek K. Pakhmo, de Suchitra R. Gosavi: Dental CAD-CAM: A new state of Art, JADA 1994; 65: 236-238.

8. Textbook of operative dentistry by Vimal sikri; 4th Edition; Pg-472.

9. Tinschert J, Natt G, Mautsch W, Spiekermann H, Anusavice KJ.Marginal fit of alumina-and zirconia-based fixed partial dentures produced by a CAD/CAM system. Oper Dent. 2001;26(4):367-74.

10. Otto T, De Nisco S.Computer-aided direct ceramic restorations: a 10-year prospective clinical study of Cerec CAD/CAM inlays and onlays.International J Prosthodont. 2002;15(2):122-28.

11. Pallesen U, Van Dijken JW.An 8-year evaluation of sintered ceramic and glass ceramic inlays processed by the Cerec CAD/CAM system. Eur J Oral Sci. 2000;108(3):239-46.

12. Silva L, Miranda R, Favero S, Lohbauer U, Cesar P.Dental ceramics: a review of new materials and processing methods.Braz. oral res. 2017;31.

13. Zhang H, Li Z, Kim B-N, Morita K, Yoshida H, Hiraga K et al.Effect of alumina dopant on transparency of tetragonal zirconia. J Nanomater. 2012; 37.

14. Zhang Y. Making yttria-stabilized tetragonal zirconia translucent.Dent Mater. 2014;30(10):1195-203.

15. Stawarczyk B, Frevert K, Ender A, Roos M, Sener B, Wimmer T. Comparison of four monolithic zirconia materials with conventional ones: contrast ratio, grain size, four-point flexural strength and two-body wear.J Mech Behav Biomed Mater. 2016;59:128(5)-38.

16. Alqutaibi AY, Ghulam O, Krsoum M, Binmahmoud S, Taher H, Elmalky W, Zafar MS. Revolution of Current Dental Zirconia: A Comprehensive Review. Molecules. 2022 Mar 4;27(5):1699.

17. Rinke S, Pabel A-K, diger M, Ziebolz D. Chairside Fabrication of an all-ceramic partial crown using a zirconia-reinforced lithium silicate ceramic. Case Rep Dent. 2016;12-14.

18. Apel E, van't Hoen C, Rheinberger V, Höland W. Influence of ZrO2 on the crystallization and properties of lithium disilicate glass-ceramics derived from a multi-component system. J Eur Ceram Soc. 2007;27(2):1571-77.

19. He LH & Swain M.A novel polymer infiltrated ceramic dental material. Dent Mater. 2011;27(6):527-34.

20. Denry I, Kelly JR. Emerging ceramic-based materials for dentistry. J Dent Res. 2014;93(12):1235-42.

21. Coldea A, Fischer J, Swain MV, Thiel N. Damage tolerance of indirect restorative materials (including PICN) after simulated bur adjustments. Dent Mater. 2015;31(6):684-94.

22. Strub JR, Rekow ED, Witkowski S. Computer-aided design and fabrication of dental restorations: current systems and future possibilities. J Am Dent Assoc. 2006;137(9):1289-96.

23. Özkol E, Zhang W, Ebert J, Telle R. Potentials of the "Direct inkjet printing" method for manufacturing 3Y-TZP based dental restorations. J Eur Ceram Soc. 2012;32(10):2193-201.

24. Ebert J, Ozkol E, Zeichner A, Uibel K, Weiss O, Koops U et al. Direct inkjet printing of dental prostheses made of zirconia. J Dent Res. 2009;88(7):673-6.

25. Yang Z, Hu J, Li K, Liu A, Liu S. 3D printing of diamond tools for dental ceramics processing. Advanced Engineering Materials. 2018 Mar; 20(3):1700747.

26. Chen Z, Li Z, Li J, Liu C, Lao C, Fu Y, Liu C, Li Y, Wang P, He Y. 3D printing of ceramics: A review. Journal of the European Ceramic Society. 2019 Apr 1; 39(4):661-87.

FIGURES

Figure 1:
Copy of Etruscan denture recovered from a tomb in Etruria, Italy, circa 700 B.C. Gold bands of this type held human or animal teeth that were fastened by means of gold rivets.

Figure 2:
IPS Empress Furnace

Figure 3:

Impress Pellets

Figure 4:

Cerec 3 with Monitor

Figure 5:

CEREC Milling Unit

Figure 6:

PROCERA CAD CAM SYSTEM

Figure 7:

3-D Printing Technology