Application of CAD/CAM in Esthetic Rehabilitation using High Translucent Zirconia: A Case Series

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ABSTRACT

Introduction: In recent years zirconia ceramics have undergone many changes in microstructure and composition to increase their translucency without significantly losing their fracture resistance, thereby expanding their clinical indication. With technological improvement and the evolution of dental restorative materials, it is currently possible to develop/produce ultrathin zirconia veneers with thicknesses of 0.1-0.3 mm and adhesively cement them on the tooth surface with minimal or no preparation and to modify color, shape and/or positioning of the teeth. In recent years,

Case report: This case series is to describes, two clinical cases, which have been rehabilitated with CAD/CAM fabricated zirconia with excellent esthetic results.

Conclusion: Digitalization in dentistry has already started replacing conventional techniques in fabrication of prosthesis and slowly it will replace all the conventional steps. To maintain pace with advancing technologies, we have to keep ourselves updated with new technologies, advancements and CAD/CAM is among one of those.

Keywords: CAD/CAM; Zirconia; Dental Fluorosis; Laminate Veneers; Esthetics.

INTRODUCTION

Porcelain veneers comprise a conservative and highly esthetic treatment that also offer high predictability and good clinical performance in the long term.[1] With technological improvement and the evolution of dental restorative materials, it is currently possible to develop/produce ultrathin veneers with thicknesses of 0.1-0.3 mm and adhesively cement them on the tooth surface with minimal or no preparation and to modify color, shape and/or positioning of the teeth.[2,3] Several ceramic materials currently indicated for veneers are lithium disilicate, feldspathic ceramic, feldspathic reinforced with leucite, Fluor apatite, and lithium silicate reinforced with zirconia.[4-7] On the other hand, high crystalline-content ceramics, such as tetragonal zirconia partially stabilized by yttria (Y-TZP), were originally considered only for the manufacturing of frameworks of crowns and fixed prostheses because of their high fracture resistance and ability to mask the dark substrate.[8] However, in recent years, zirconia ceramics have undergone many changes in microstructure and composition to increase their translucency without significantly losing their fracture resistance, thereby expanding their clinical indication.[9,10]

Thus, based on the promising results of surface treatments in zirconia and on the esthetic evolution of this material. This case series is to describes, two clinical cases, which have been rehabilitated with CAD/CAM fabricated zirconia with excellent esthetic results.

CASE 1

A 24 years old lady reported to the division of Prosthodontics, with the chief complaint of discolored and fractured upper front tooth. History of presenting illness revealed trauma due to fall from bicycle 3 years back and root canal treatment done wrt 11 two years back. Extra oral examination revealed symmetrical face, normal TMJ and competent lips. Intra Oral examination revealed discolored and root canal treated 11 and fractured 11, 21 (Fig 1a). IOPA and pulp vitality test were done and 21 was found to be vital. Based on the history, clinical and radiographical examination diagnosis of Ellis class 3 fracture wrt 11 and Ellis class 2 fracture wrt 21 was arrived at. Treatment plan was formulated to rehabilitate the case with full coverage CAD/CAM milled zirconia restoration wrt 11 and laminate veneer wrt 21. Treatment plan was explained to the patient and informed consent was obtained. Shade selection was done using Vita shade guide (VITA Classical shade guide) (Fig 1b).

11 was prepared to receive full coverage restoration and 21 to receive laminate veneer following guidelines of biomechanical tooth preparation (Fig 1c). Gingival tissue management was done using #00 gingival retraction cord (Ultrapak USA) and final impression was made with polyvinyl siloxane material using simultaneous double mixed impression technique (Dentsply Aquasil soft putty). Provisional restorations were prepared using bis-acryl (Protemp-4 3M ESPE; St. Paul, Minn) material and luted on the same appointment (Fig 1d). Master casts were poured with die stone (Kalabhai Ultrarock) and die preparation was done.

CAD/CAM procedures: Maxillary and mandibular casts

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were first scanned individually and then in occlusion using lab scanner Ceramill MAP (Amanngirrbach) (Fig 2a). Scanned data was transferred to CAD software, Ceramill mind where it was converted into three dimensional virtual models. Margins were marked manually and a suitable path of insertion was determined. A complete coverage restoration wrt 11 and laminate veneer restoration wrt 11 were designed using the CAD software and adjusted over virtual models. After designing, milling was done using 5 axis Computed aided manufacturing unit, Ceramill Motion (Fig 2b). Milled restorations were sintered using Ceramill Therm furnace at P2 program i.e. 1450 degree celsius for 5hrs 50 mins (Fig 2c, d). Sintered prosthesis were stained and glazing was done at 960 degree Celsius.

For cementation, inner surfaces of restorations were sandblasted with aluminum oxide (Al_2O_3) at 1 atm. Prepared tooth surface was cleaned with pumice, dried and isolated. It was then etched with 37% phosphoric acid for 30 seconds, rinsed thoroughly and air dried followed by bonding agent (Adper single bond 3M ESPE USA) application according to the manufacturer's instructions and was light cured. Dual cure resin luting cement (PANAVIA F 2.0) was applied to the inner surface of both restorations and placed gently onto the tooth in an inciso-gingival direction. Excess cement was removed and light-cure was done at gingival margins first for 10 seconds, followed by all other surfaces. Final cure for 60 seconds was done through the facial surface. Excess cement were removed using sharp hand instruments. A layer of glycerin gel (Liquid strip- IvoclarVivadent) was applied along the margins. Fine and extra fine diamond finishing burs were used to remove excess resin cement (Fig 3). Polishing was done to obtain a smooth surface. Occlusion was checked in all excursive movements and no occlusal interferences were found. The definitive prosthesis in relation to 11 and 21 produced the desired results in term of restoration of esthetics, function and improvement of overall health status of the patient (Fig 3c, 3d and Fig 4).

CASE 2

A 23 years old lady reported to the division of Prosthodontics and crown and bridge, with chief complaint of discolored upper front teeth, since childhood. Extra oral examination revealed symmetrical face, normal TMJ and competent lips. Intra Oral examination revealed generalized intrinsic brown stains wrt 13, 12, 11, 21, 22 and 23 (Fig 5a). Based on the history, clinical and radiographical examination, diagnosis of dental fluorosis was assured at. Treatment plan was formulated to rehabilitate the case with CAD/CAM milled zirconia veneers wrt 13, 12, 11, 21, 22, 23. Treatment plan was explained to the patient and informed consent was obtained. Shade selection was done using Vita shade guide (VITA Classical shade guide).

13, 12, 11, 21, 22 and 23 were prepared to receive laminate veneers following guidelines of biomechanical tooth preparation (Fig 5b). To maintain proper depth, preparation was started with horizontal depth grooves given by a diamond depth cutting bur on the labial surface of upper anterior teeth. Depth grooves were extended from mesial to distal without damaging the adjacent soft tissues and teeth that were not being prepared. Bur was angled in relation to the contour of the labial surface to achieve the appropriate depth for these guide cuts. Contacts were not broken while

Figure-1:

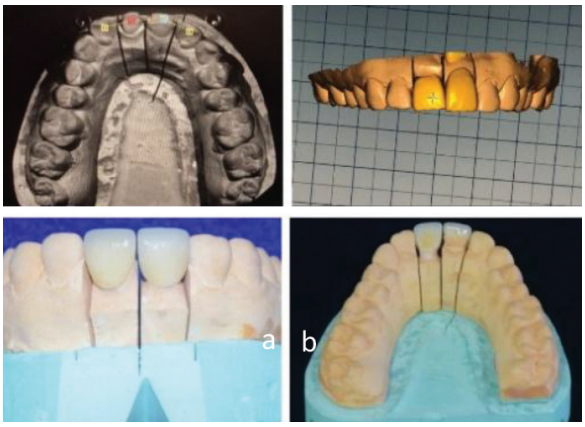

Figure-2:

Figure-3:


Figure-4:

Figure-5:

Figure-6:

Figure-7:

extending preparation on mesial and distal sides. The depth of preparation was 0.3 mm at cervical third, 0.5 mm at middle third and 0.7mm at incisal third. To achieve optimum bond strength, depth grooves were kept in enamel and not extended into dentin. Gingival tissue management was done using #00 gingival retraction cord (Ultrapak USA) and final impression was made with polyvinyl siloxane (PVS) material using simultaneous double mixed impression technique (Dentsply Aquasil soft putty). (Fig 5c). Master casts (Fig 5 d,e) were poured with die stone (Kalabhai Ultrarock). The zirconia laminate veneers were fabricated using the CAD/CAM (Fig 6) as described in the previous case. Finished restoration were luted and checked for any interferences in centric and eccentric excursive movements. Zirconia laminate veneers wrt maxillary anteriors produced a marked improvement in terms of esthetics and overall psychosocial status of the patient (Fig7).

DISCUSSION

Digitization has captured the world with its wide ranging applications, such that no field remains aloof. Now a days, anything and everything is just a click away. The future of dental practice is closely linked to the utilization of computer-based technology and virtual reality, which allows the dental surgeon to simulate true life situations in patients. CAD/CAM systems have three functional components: data capture unit or scanner, CAD to design the restoration and CAM to fabricate the restoration. The precision scanning technique, inbuilt design software and industrial manufacturing machines eliminate the laboratory deficiencies of the restoration and has made possible the use of zirconium based ceramics (which otherwise is difficult to machine), hence resulting in high quality metal free dental prosthesis. Advances in digital imaging, computer aided design, internet communication, digital manufacturing and new materials have undoubtedly simplified the diagnostic process and improved treatment outcomes. Since its introduction in dental practice, zirconia ceramic has become very popular material. Due to its better mechanical properties: in terms of strength, fracture toughness, flexural resistance, and its biological and

esthetic quality: in terms of opacity, translucency and ability to mask discolored underlying tooth structure, zirconia appears to be suitable for the fabrication of veneers, single crowns, FPDs, implants and implant abutments.[11] Its flexural strength of 900 to 1,100 MPa and fracture toughness of 8 to 10 MPa makes it a suitable material to create both single and multiple unit conservative esthetic restorations. It can be milled to a minimally invasive restoration with a thickness of 0.2 mm. However, in order to achieve a restoration of this description, we require the necessary chemistry to create adhesion between the zirconia and the tooth.

Cementation process of zirconia is much simpler as compared to its glass ceramic restorations. Common surface treatments (silanization, acid etching) are ineffective on zirconia because it has an inert surface without glassy component (on which this surface treatments act primarily), however sandblasting at 1atm with aluminium oxide (Al_2O_3) results in significant roughening that increases the surface energy and the wettability of the material. Resin cements have shown higher adhesion and stability values than the other cements. In particular, it has been seen that bond strength of zirconia copings on dentin using MDP-based resin cement is about 6, 9 MPa; this value is comparable to that obtained with gold copings cementation.[12]

One significant advantage of Zirconia is that the preparation can be more conservative than other all-ceramic or even metal-ceramic restorations, with a preparation design similar to that of a full coverage cast gold restoration. The amount of space required will vary slightly depending on the details of occlusal morphology expected in the outcome. For all ceramic restorations, minimum occlusal reduction of 1.5 mm to 2.0 mm at cusp tip/occlusal, 1.0 mm circumferential shoulder reduction (round internal line angle) and a 1.5 mm occlusal 1/3 reduction of the functional cusps required to achieve appropriate occlusal anatomy. For zirconia full contour crown- 1.0 to 1.5 mm occlusal reduction, 0.5 mm gingival chamfer reduction and a 1.0 mm occlusal 1/3 reduction of the functional cusp required to achieve appropriate occlusal anatomy, which is more conservative.

CONCLUSION

Combination of prudent time management, strength, conservative and esthetic properties make CAD/CAM fabricated Zirconia restorations, a treatment of choice these days. Digitalization in dentistry has already started replacing conventional techniques in fabrication of prosthesis and slowly it will replace all the conventional steps. To maintain pace with advancing technologies, we have to keep ourselves updated with new technologies, advancements and CAD/CAM is among one of those.

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