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Zirconia fixed partial denture : clinical requirements

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ABSTRACT In recent years, there have been promising results when zirconia frameworks were used as an alternative to metal based fixed partial dentures(FDPs). Yttrium-oxide partially stabilized zirconia(Y-TZP) exhibits exceptional fundamental properties of great interest to dental application, such as high strength, fracture toughness, opacity, and biocompatibility.This paper reports different clinical requirements of zirconia FDPs , illustrated by a clinical situation.

KEYWORDS : Zirconia, Fixed dental prostheses, connector, chipping, opacity

Introduction:

Over the last decade, zirconia technology has propelled a rapid development of metal-free dentistry that may provide material strength. The extensive knowledge gained regard to zirconia ceramic chemistry, crystallography, and the production of these engineered ceramics led to promising and advanced dental applications(1). Before the application of zirconia in fabrication of fixed dental prosthesis (FDP), it was found that the primary cause of failures of all-ceramic FDP was the fracture of the connector which differed from that reported for metal ceramic FDP(2). Since then, zirconia based ceramic has been developed and introduced as restorative materials for fabrication of FDP especially in posterior region because of its excellent mechanical properties. Also, since their introduction as FDP, the fracture of zirconia framework has been rarely reported.(3,4)

This article article aims to present the survival and success rate of zirconia FDPs and different clinical requirements of this clinical modality , illustrated by a clinical situation.

Case report

A 45 years old female patient with unremarkable medical history, presented to the department of fixed prosthodontics with esthetic and functional demands. Her chief complaint was to replace the first right maxillary premolar which was extracted since 6 months.(figure 1)

Figure 1 : Lateral view showing the missing of upper first premolar

A comprehensive clinical examination revealed good hygiene, and well developed alveolar crest favorable to implant placement, but this therapeutic decision was declined by the patient who refused any surgical and long lasting procedure. So after thorough examination(sufficient coronal length of abutments which were vital and aligned) and with the patient consent, a zirconia full coverage FDP was decided to replace the missing tooth .For that, abutments were prepared with respect of guidelines of all- ceramic restorations:

0.8 to 1 mm circumferential chamfer an axial reduction of 1.5mm with 10 degree taper, and occlusal reduction of 1.5 to 2 mm by using diamond rotary cutting instruments. On the buccal aspect of the restorations, the margins were located 0.5 mm subgingivally for esthetic reasons and supragingivally on the lingual aspect. All sharp edges were rounded and smoothed (figure 2)

Figure 2 : Teeth preparation

After a double gingival cord retractions, a simultaneous double mixed impression was made using light and heavy silicon A.Then working cast was performed, and scanned, the frameworks was designed, milled by CAD/CAM, and checked intraorally (figure 3).

After a color choice, the framework was veneered with feldspathic ceramic(VITA VM9). Zirconia FDP was checked to control the gingival margins adaptation, the restoration of contact point areas, gingival embrasure opening, static and dynamic occlusion especially the canine guidance, the occlusal scheme was identified using articulator paper. Then shade and esthetics are well checked.

After ceramic glazing, zirconia FDP was cemented with glass ionmer cement modified with adjunction of resin (figure 4)

Figure 3 :Intraoral checking of the zirconia framework (connector area of 9 mm2)

Figure 4: Esthetic and biological iintegration of the final restoration, the patient was instructed to clinical recalls every 6 months

Discussion:

The high-strength ceramic zirconia is the latest development with respect to ceramic framework materials (5, 6). Zirconia, or more precxisely yttria stabilized tetragonal zirconia polycrystals(Y-TZP), has the best mechanical properties of all other ceramics(7). Laboratory studies of zirconia-based FDPs indicated that zirconia frameworks might have the potential to withstand the occlusal forces both in anterior and in posterior regions.Hence, this ceramic was proposed as a valid alternative to metal for the fabrication of FDP frameworks also in cases of multiple-tooth gaps.(6)

The overall survival rate for zirconia FDPs was 94,29% according to the systemaeic review of Scley and al in 2010, this rate is comparable to the estimated 5-year survival rate of metal ceramic FDPs of 93,8%, reported by Pjetursson and all(8). A randomized controlled trial(RCT) comparing posterior FDPS with zirconia and metal Framework has been berformed, At 3 years of follow-up no differences were found between the two types FDPs.No fractures of ceramic or metal frameworks occurred, and the survival rate was 100% for both type.

(9).For a period of 10year, Sax and all(10) reported that the survival rate of FDPs was 67%, three framework fractures occurred, resulting in a 10-year survival rate for the zirconia frameworks of 91,5%. Chipping/fracture of the veneering ceramic, the most frequent technichnical complication, was detected in 16 FDPs over 10years(32%). A significant correlation of the span of the FDPs and the incidence of chipping was observed: 4- and 5-unit FDPs had a 4.9 times higher probability for chipping than 3-unit FDPs(10). A decrease of the success rate from 100% to 97.8% respectively from 3 to 5-year study was also remarked, thus due to the fracture of 5-units FPDs (4). Rinke and al showed that the span(three or four unit) of FDPs seemed to have no impact on the surd success rates within a 7-year observational period.(11)The span length has also, an effect on the fit of zirconia substructure that is fabricated using CAD/CAM technique especially at the occlusal area: the increase of span length of zirconia framework of 6 or more unit fixed partial denture may decrease the marginal and internal fit(2).

Also, very important is the size of connector that is definitely the weak point of the entire restorations and its size should be adjusted in height and width in order to allow log-term survival. One important study of Studart and al(12). based on the evaluation of some fatigue parameters of the prostheses, found that the size of the connector should be at least 5.7 mm2, 12,6mm2 and 18,8 mm2 for the fabrication of a 3,4 or 5 units FDP,respectively. Oh and Anusavice have suggested that fracture probability may be significantly minimized by using a connector with a curvature radius of 0.9 mm approximately.(13)

Other factors such as:framework thickness, minimum 0.5 mm is necessary for copings to support veneering material and avoid core deformation. The coefficient of thermal expansion of coping must be close to veneering ceramic to reduce stress in restorations(14). In fact with this limited core thickness and their heigh density and homogeneity, Zirconia ceramics can be very useful in cases of discolered abutments. Especially Yttiruim-stabilized zirconium is suitable for optical applications because of its high refraction index, its low absorption coffecient,and its hight opacity in the visible andinfrared spectra.(15)

Numerous investigations have focused on different factors that might influence the outcome of the zirconia veneering ceramic.For instance, different thermal expansion coefficients of core and veneering ceramic, different surface processing technique of zirconia and and various manufacturing conditions have been analysed. other investigations focused on the properties of the zirconia veneering ceramics, the support of the veneering ceramic by the framework, the influence of the thickness of veneering ceramic, the span of FDPs, and finally the aging of the veneering ceramic due to occlusal overload like . Unfortunately, the solution to these problem has not been found yet.(10)

However the use of monolithic zirconia(MZ) with no veneering porcelain has increased and the risk for fractures has diminished. MZ crowns can prepared just like conventional full coverage porcelain fused to metal restorations using either a butt shoulder, a chamfer, or a knife-edge finish line, MZ crowns may be fabricated with as little as 0.5 mm of occlusal reduction. The disadvantages of MZ crowns are mostly related to development of the final shade of the restorations. Although the restorations are fabricated using a color dip that is prepares to mimic the VITA shade guide selection system, some units can appear to be a higher value than the shade requested.(16)

Conclusion:

In conclusion, Zirconia appears to be suitable for the fabrication of FDPs, 3, 4 units in anterior or posterior regions, if clinicians respect sufficient mechanical and esthetic requirements. A part from the excellent mechanical properties of the framework, the long-term success of zirconia-based restoration can be influenced by many factors: connector dimensions, bridge geometry,marginal and internal fit, the span length, occlusion adjustment Further, long term prospective studies are necessary to establish the best surface treatment before cementation of zieconia based restoration.

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