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Aesthetic Rehabilitation with Zirconia Based Restoration: A Case Report

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Abstract:*Tooth-coloured restorations has grown considerably during the last decade due to demand in aesthetics. All-ceramic systems became a viable treatment option with successful use in the anterior and posterior segments as result of advanced dental technology. The mechanical properties of brittle ceramics are characterized by fracture toughness and flexural strength. However, the conventional porcelain materials are not suitable for load-bearing restorations and are available only as single restorations due to reduced fracture toughness and flexural strength. Finally, industrial dense polycrystalline ceramics such as alumina, zirconia, and alumina-zirconia composites were introduced. In particular yttrium partially stabilized tetragonal zirconia polycrystalline (Y-TZP) showed better mechanical properties and superior resistance to fracture.*

Keywords:*Aesthetics, All-Ceramic systems, Zirconia*

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I. Introduction

Developments in routine dental treatments, are often by the introduction of new dental materials and processing technologies. Prosthodontic treatments have traditionally sought to restore lost function (chewing, speech, swallowing), while providing aesthetics that fulfil contemporary criteria for attractiveness. Dental prostheses such as crowns, fixed dental prostheses (FDPs), and removable dental prostheses are fabricated from a variety of dental materials using a range of dental laboratory processes. Because of the popularity of osseo-integrated implants, the application of fixed prostheses has expanded, even in the edentulous situation. Development of both casting gold alloys and precision dental casting technologies has contributed to the application of metallic prostheses. However, because of the recent demand from patients for aesthetics and biosafety which allowed simulation of natural dentition, metal-free prostheses have been desired. Both new dental materials and new processing technologies are required to meet these patient demands.The term 'In-Ceram' derives from "ceramic infiltration". In-Ceram system is classified as infiltrated ceramic indicated to obtain frameworks of crowns and fixed partial dentures with high strength—three more times than feldspathic ceramics to receive veneering ceramic.[1] In-Ceram technique was developed by a French scientist named DrM Sadoun and it was introduced in market by VITA in 1989. Initially, the system presented three different materials: Alumina, Spinnel and Zirconia. The flexural strength of Spinnel, Alumina & Zirconia are 350, 500 & 700 Mpa respectively.This case report presents the replacement of existing Metal- Ceramic restoration with a Zirconia Restoration.

II. Case Report

A 45 years old male patient reported to the Department of Prosthodontics with the chief complaint of improper crowns in the anterior tooth [Figure 1]. The patient gave a history of trauma to the front tooth 4 years ago. Dental treatment for the mentioned tooth had been carried out. On intraoral examination a fixed partial denture [Figure 2] with a loop connector [Figure 3] was observed. The abutment tooth did not show any signs of mobility, fracture, caries or periodontal disease. It was decided to include the canines also in the FPD to improve the aesthetics as a large spacing was observed interdentally between the lateral incisors [Figure 4]. Diagnostic impressions and study models were prepared. The diagnostic wax-up aided the patient in visualizing the outcome of the treatment. It was decided to fabricate Zirconia restoration in the maxillary anterior region. Patient was explained the treatment plan & consent was taken to go ahead with it.

III. Clinical Procedure

After the existing Fixed partial denture with loop connector was removed. Endodontic therapy was carried out for both the maxillary lateral incisor followed by a composite post- obturation restoration. Next, tooth preparation was done for a full- ceramic crown for the canines and some modifications for the lateral incisors. Shoulder-type margin was given extending subgingivally below the gingival margin. Prior to the

impression making, gingival retraction was done with gingival retraction cord (Ultrapack 000). Impressions were made with addition silicone (3M ESPE Express, United States). The impressions were poured in Type IV die stone (Kalrock, Kalabhai, Mumbai, India) and dies were obtained.

Meanwhile, a provisional Fixed partial denture was fabricated for the tooth using tooth colored self-cure acrylic (DPI, Mumbai, India). The provisional Fixed partial denture was cemented in place using a temporary cement (GC Freegenol, Europe) [Figure 5]. Shade matching was done with the help of the Vitapan 3D Classic shade guide. A bisque trial was done to inspect occlusion in static, protrusive & excursive movements, margins and seating of the crown

The Zirconia Fixed partial denture was cemented using a self- adhesive resin cement (RelyX U200, 3M, US). Initially the prepared teeth were cleaned by using a pumice paste. The cement was dispensed, hand mixed and applied to the FPD. It was later seated firmly on to the teeth with finger pressure. Tack cured for 1-2 seconds per surface to remove the excess cement while holding the FPD in place. Later, it was light cured for 20 seconds per surface. [Figure 6,7]. The patient was satisfied with the final outcome of the treatment. Printed and oral instructions for maintenance and use were duly given to the patient.

IV. Discussion

Traditionally, Porcelain-fused-to-metal (PFM) restorations were widely used full-coverage crown restoration systems, but the demand for tooth-coloured restorations has grown considerably during the last decade resulting in replacement of PFM with All-ceramic restorations [2]. These restorations have become a viable treatment option with successful use in the anterior and posterior segments[3,4] The mechanical properties of brittle ceramics are characterized by fracture toughness and flexural strength.[7] Conventional porcelain is a partially glassy material; its fracture toughness is approximately 1.0 MPa $m^{1/2}$ and flexural strength is approximately 100 MPa. This material is not suitable for load-bearing molar restorations. Initially, porcelain was reinforced by dispersing crystals within it like Aluminous porcelain. These materials have fracture toughness from 1.5 to 3.0 MPa $m^{1/2}$. However, these ceramics are still only available for single restorations.Another type of ceramic includes alumina that are sintered, then infiltrated with glass to give "glass-infiltrated ceramics," with fracture toughness from 3 to 5 MPa $m^{1/2}$. These materials have been applied to fixed partial dentures, but the prognosis was not satisfactory

Among various all ceramic systems, Zirconia was selected for the fabrication of all ceramic restoration in the present case.[8,9] Yttria partially stabilized tetragonal zirconia polycrystalline (Y-TZP) showed better mechanical properties and superior resistance to fracture than other conventional dental ceramics. Y-TZP has a high fracture toughness, from 5 to 10 MPa $m^{1/2}$, and a flexural strength of 900–1400 MPa.[10,11] When a crack initiates on the surface of Y-TZP, the stress concentration at the top of the crack causes the tetragonal crystal to transform into a monoclinic crystal, with associated volumetric expansion.In the vicinity of a propagating crack, the stress-induced transformation leads to compressive stress that shields the crack tip from the applied stress and enhances the fracture toughness.[12] These zirconia-based ceramics have been clinically available as an alternative to the metal framework for fixed dental prostheses (FDPs).

V. Figures

FIGURE 1: Pre-operative PhotoFIGURE 2: PFM Fixed Partial Denture

FIGURE 3: Loop ConnectorFIGURE 4: Tooth Preparation

FIGURE 5: Provisional Fixed Partial DentureFIGURE 6: Cementation of Zirconia Restoration

FIGURE 7: Post-operative Photo

VI. Conclusion

Zirconia restorations are a treatment of choice where aesthetics and strength are required. The improved characteristics of zirconia restorations are expected to expand the clinical application of dental ceramics to not only all-ceramic restorations, but also other fields such as the abutment of implants, implant bodies, and removable denture bases and parts.

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