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Management of Fractured Maxillary Incisors with Translucent Zirconia Crowns: A Case Report

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Abstract **Case Report**

Introduction: Traumatic dental injuries commonly occur to the maxillary incisors because of their position in the oral cavity. Depending on the event's intensity, the teeth may be frequently fractured at different levels. ***Observation*:** This case report describes the clinical procedures involved in the treatment of a complicated fracture in the right maxillary incisors in a 40-year-old male patient, due to road traffic accident. After clinical and radiograph examination, endodontic treatment was decided to restore the complicated crowns fracture with fiber posts and cores followed by all ceramic crowns. The teeth were satisfactory both aesthetically and functionally. ***Discussion*:** Fiber post has better homogeneous tension distribution when loaded and advantageous optical properties. Therefore, a combined use of fiber posts and translucent zirconia provides satisfying esthetic results and improved mechanical properties.

Keywords: Trauma, anterior teeth, fiber post, all ceramic crown, translucent zirconia, ferrule effect.

INTRODUCTION

The most common traumatic dental injury affecting permanent teeth is the uncomplicated and complicated crown fracture. Tooth fracture may cause emotional trauma to the patient. So, the main objective of such cases is the rehabilitation of both aesthetic and function [1].

Various treatment modalities are available for management of fractured anterior teeth; One of the options for managing coronal tooth fractures is the reattachment of the dental fragment if it is available; If the fracture is uncomplicated (i.e., not involving the pulp) and the pulpal health is uncompromised, it may be restored with composite resin or ceramic veneers and chips. If the pulp is involved, the tooth is treated endodontically and then restored with a full coverage restoration with or without post and core [2].

In cases where the tooth is severely fractured, endodontic treatment and placement of intracanal posts become necessary, before crown placement. The use of metal post and cores met with some resistance. As they were black in color, this will lead unfortunately to poor aesthetics under all-ceramic restorations. Subsequently, more aesthetic quartz and glass fiber reinforced composite posts were introduced as an aesthetic alternative [1].

The success of a dental restoration depends on a number of factors such as the material selection, its mechanical properties, anatomical form, surface texture, translucency and colour [3].

Due to their aesthetic quality and high success rate, metal-ceramic crowns have been the restoration of choice for decades. However, all-ceramic crowns have become more popular for aesthetic cases due to their biocompatibility [4].

This article outlines the successful management of fractured incisors teeth with translucent zirconia crowns.

CASE DESCRIPTION

A 40-year-old male patient reported to the department of Dental Medicine at Sahloul Hospital Sousse, Tunisia, with a complex crown fracture of his maxillary right incisors because of road traffic accident. His medical history was non-contributory. On extra oral examination, no TMJ dysfunction, muscle pain, or tenderness was found.

The intraoral examination revealed that the left central tooth was asymptomatic, with a coronal fracture limited at the incisal edge, the vitality test was positive, and the percussion and palpation tests were negative.

The right lateral and central teeth were severely damaged with a coronal destruction associated with pulp exposure. X-ray examination did not reveal any root damage or apical translucency.

The patient was not satisfied with his smile and was looking for an immediate solution (Figure 1).

Treatment options were presented and discussed with the patient. Considering the clinical situation, it was planned to carry out an endodontic treatment followed by fiber posts and cores build up on #12 and #11 teeth before the placement of definitive crowns while #21 needed a resin composite stratification.

At the first appointment, local anesthesia was administered and the access preparations to the root canals on #12 and #11 teeth were performed under rubber dam isolation. Pulps were extirpated. The cleaning and shaping of the root canals were done using rotary instruments (Revo S®, Micro Mega, France). Sodium hypochlorite solution (2.5%) was used as an irrigant. Final irrigation with normal saline was realized. The canals were dried with sterile paper points, obturated with gutta percha (ProTaper Universal Gutta Percha Points, Meta Biomed, South Korea) by cold lateral condensation technique.

Fig. 1: Labial and incisal view of the fractured teeth after root canal treatment

The trauma spared the middle and cervical thirds. Therefore, we had the minimum ferrule of 2.0 mm desired. To determine the ferrule, the teeth should usually be prepared before post selection.

In the following appointment,the intrasulcular preparation limit was performed as a shoulder with rounded inner angle, then fiber post spaces preparations were carried out using peeso reamers (#1,#2,#3) leaving the 5mm of apical gutta percha seal intact (Figure 2).

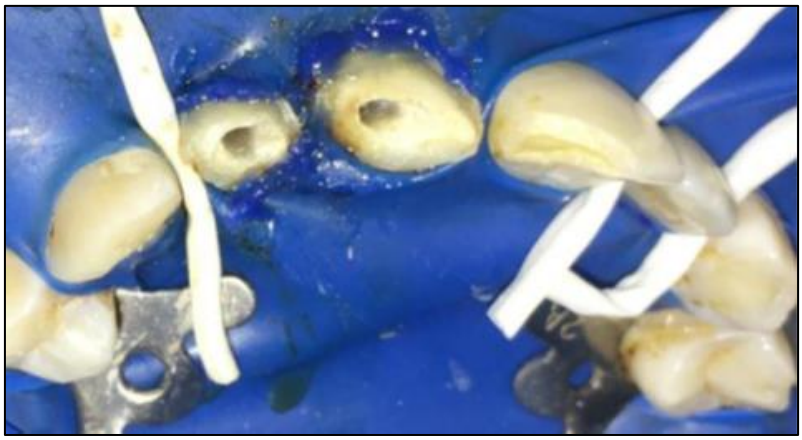

Fig. 2: The rubber dam is positioned to perfectly isolate the tooth from the biological fluids (saliva and blood)

The selected fiber posts (Fiber Post Refill Dentoclic, ITENA Clinical Dental Post, France) were demarcated (figure 3) reduced to an adequate length by a high-speed diamond disc under water-cooling (figure 4) and cleaned with alcohol.

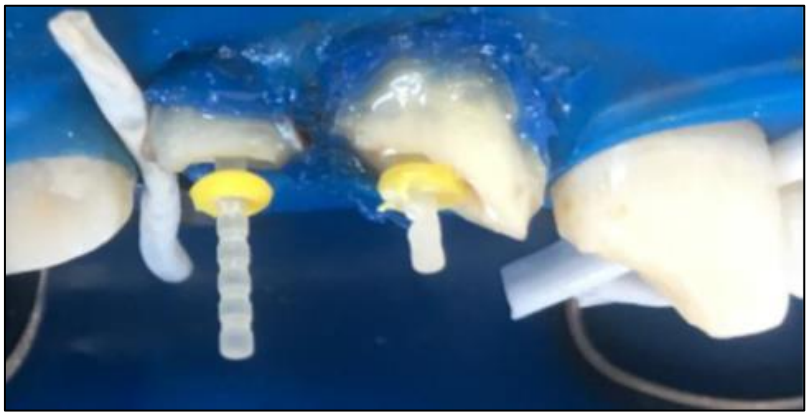

Fig. 3: Fiber posts were tried and adjusted at the adequate prepared root length

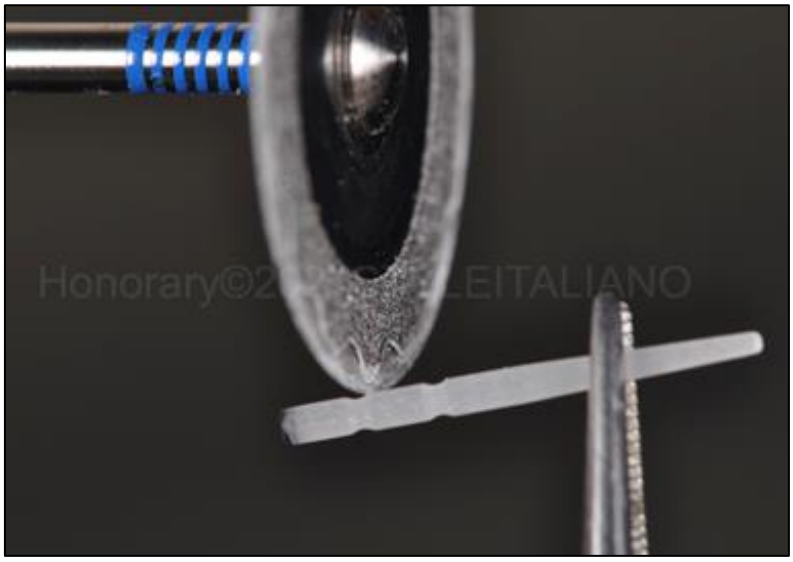

Fig. 4: In order not to damage the fiber when reducing the length of the post, a diamond disk is recommended. Diamond burs destroy the fibers

Dual cure cement (Nova resin, IMICRYL®) was used for post cementation. The posts were seated and excess material removed before light curing. Cores build up were done with composite (Composite Empress Direct - Ivoclar Vivadent).

Fig. 5: cores build up on #12 and #11 teeth

The teeth were subjected to dental preparation rectification after cores build up with rounded shoulder margin. The cutting depth at the preparation limit was ranging from 1 to 1.2 mm (Figure 6).

Fig. 6: tooth preparations on #12 and #11 teeth and composite resin stratification on #21

Before impression taking, retraction cords (Ultrapack knitted cord #0) were applied to achieve maximum soft tissue displacement. Then, the master impression using a two-step putty-wash technique with polyvinyl siloxane was performed. A master cast was fabricated from the final impression.

The zirconium abutments were generated by a computer-aided design/computer aided manufacturing (CAD/CAM) process (Dentsply Sirona). The combination of zirconium oxide and CAD/CAM gives strength and aesthetics.

The all-ceramic crowns were tried on the cores and checked for marginal fit, occlusion and esthetics. Gingival retraction was performed before cementation to enable the removal of the excess luting agent. Final cementation was carried out using self-adhesive dual cure composite resin (Nova Resin, IMICRYL®) (Figures 7 and 8).

The patient was satisfied with the shape and shade of the ceramic restorations.

Fig. 7: trying in of frameworks

Fig. 8: final result: aesthetic and functional integration of all ceramic crowns, patient was satisfied by the result

DISCUSSION

Dental trauma, and ensuing fracture of the permanent anterior teeth, may be one of the most stressful situations in a dental practice demanding a comprehensive treatment planning.

Treatment should be planned considering the advantages and disadvantages of available techniques and should be in conjunction with the desires and limitations of the patient [5].

The first step is pain management with well-executed root canals treatment on #21 and #11 teeth. This is the foundation upon which any reconstructive treatment on the tooth should be based.

In endodontically treated and fractured anterior tooth, the choice between fiber post and metal post reconstruction depends on many factors but we always prefer fiber post reconstruction if the situation allows. The Advantages of such approach can be summarized as follows [6]:

- Good aesthetics.
- Biological: adhesion allows more conservative preparation of the post space to achieve retention.
- Mechanical, due to the significant improvement regarding stress distribution along the root instead of being concentrated at the bottom of the metal post. This homogeneity created between the dentin, adhesive system, core build-up and fiber post can create «all-in-one» concept.

One of the most critical factors determining restoration success and longevity is the amount of remaining tooth structure above the gum line. The ferrule effect, described as a collar that surrounds the residual tooth perimeter, has a crucial influence on fracture resistance. A properly executed ferrule reduces the incidence of endodontically treated tooth fracture by reinforcing the outer tooth surface and dissipating the concentrated forces in the tooth's narrowest perimeter. Fracture resistance increases with ferrule length. The minimum length for sufficient ferrule should be between 1.5 and 2.0 mm of coronal dentin that extends beyond the preparation margin [7].

It has been stated that the ferrule can improve resistance to dynamic occlusal loading, maintain the integrity of the cement seal of the artificial crown retainer, and reduce the potential of concentration of stress at the junction of the post and core. Furthermore, "the ferrule effect" reduces the wedging of tapered posts or bending forces during post- insertion and helps to improve the marginal integrity [8].

To ensure the presence of ferrule effect in this case, the finish lines were placed in intrasulcular margins that may affect the quality of bonding of vitroceramic crowns.

Among the ceramics which can solve this problem, the use of zirconia has considerably increased due to the excellent mechanical properties and aesthetic results [9, 10].

Zirconia is made of polymorphic crystals, and it is commonly categorized into three forms: tetragonal, cubic, and monoclinic. Zirconia is monoclinic and stable at room temperature. Once the temperature reaches 1170°C and 2370°C, zirconia passes to tetragonal and cubic phases; respectively [11]. The conventional zirconia in dentistry contains 3% of yttria to stabilize the tetragonal phase at room temperature.

This 3 mol% yttria-stabilized tetragonal zirconia polycrystal (3Y-TZP) with tetragonal zirconia can form a transformation zone that will shield cracks [12]. This transformation toughening contributes to a high fracture resistance [13].

Although 3Y-TZP (1st generation zirconia) is still the most used by clinicians, the fact that it is white and opaque greatly reduces its clinical indications. In order to minimize such optical limitations, translucent and colored zirconia have been developed by means of microstructural modifications, such as decreased grain size, higher density, increased cubic phase and the addition of coloring oxides. Zirconia of the 2nd generation presents a reduction in the alumina concentration and modified sintering parameters, which discretely reduces its degree of opacity. However, an effective gain of translucency and a stable cubic phase are obtained when a higher concentration of yttria (approximately 9.3 wt% / 5mol%) is present, allowing an increment of cubic phase in zirconia composition, decreasing light scattering that occurs at grain boundaries. As a result, 3rd generation or high-translucent zirconia developed from this strategy have been used in the manufacture of monolithic crowns and ultrathin restorations, with acceptable aesthetic results. **[14]** The newest version of zirconia has been made with increased yttria content. It is fabricated with 5 mol% yttria that partially stabilizes the cubic phase. **[15]** This new zirconia (5Y-ZP) in the cubic phase is more translucent than 3Y-TZP because it is isotropic in different crystallographic directions. This novel translucent zirconia (5Y-ZP) has been called translucent zirconia due to its improved optical properties. The advent of the novel 5Y-ZP promises high translucency similar to that of glass-ceramics such as lithium disilicate [16].

Translucency of a ceramic material greatly affects the aesthetics of a restoration as well as its shade. It has an influence on the natural appearance of the restoration [17].

Translucency of zirconia is brand dependent and is greatly affected by yttria content, amount of impurities and grain size [18].

The shade match is another important factor for aesthetics. In order to match the shade, colored zirconia has been introduced to the market. The layering procedure of the veneering ceramic is simplified when the framework has a color match with the target shade. The veneer thickness required to mask the whiteness of the underlying zirconia framework can be reduced [17].

As 5Y-Z is intermediate in strength to lithium disilicate and 3Y-PSZ, the clinician is left with the challenging decision to choose which type of cement is more appropriate [19].

An important clinical consideration is the acceptability of luting 5Y-Z crowns with resin modified glass ionomer (RMGI) cement. Without particle abrasion, all 5Y-Z crowns luted with RMGI survived fatigue testing but recorded a lower fracture load than 5Y-Z or lithium disilicate crowns luted with resin cement. Five mol% yttria-stabilized zirconia and lithium disilicate performed similarly when used with resin cement; however, the 5Y-Z performed better than the lithium disilicate crowns when used with RMGI cement. A clinical advantage based on this observation is that 5Y-Z crowns may be less likely to fracture during the try-in and adjustment procedure, as they survived fatigue testing without adhesive bonding [19].

The crown was bonded with self-adhesive dual cure resin cement (Nova resin®), which provided better fit and retention, resulting in a more stable post-core-crown complex.

Until now, the mechanical and optical properties, as well as the abrasion and fatigue behavior of multilayer translucent zirconia materials, have been evaluated in several in vitro studies. However, reports on clinical experiences are limited to case studies and reports with labside-fabricated restorations with observational period up to 24 months. Clinical data for chairside fabricated restorations from multilayer translucent zirconia materials are still sparse [20].

In comparison with classic zirconia materials with an yttria content of 3 mol%, these materials show a reduced strength. Therefore, these zirconia materials do not offer a wider range of indication in comparison to high-strength glass-ceramics. They are suitable for single crown restorations and 3-unit FPDs up to the first premolar [20].

CONCLUSION

The functional and aesthetic restoration of severely compromised anterior teeth has always posed a challenge to clinicians. The success of such restorative treatment depends on the aesthetic integration between soft tissues and hard tissues. Excellent aesthetic and functional results can be achieved with the use of a fiber–reinforced root canal post and composite material for the treatment of anterior traumatized teeth. With the evolution in materials, translucent Zirconia can be a very useful choice in spite of the higher degree of care required in working with it. It eliminates the need for metal, and it gives excellent color matching.

DECLARATION OF CONFLICTING INTERESTS

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