Case Series

Restoring Esthetics in Traumatic Tooth Fractures with all Ceramic Restorations following Endodontic Therapy: A Series of Cases

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Abstract:

Earlier Metal ceramic crowns were the restorations of choice in the management of traumatic tooth fractures. However, the inherent drawbacks of metal ceramic restorations and the development of newer all ceramic alternatives have resulted in superior esthetic and functional management of these clinical situations. The following case series describes the management of traumatic tooth fractures with Zirconia based all ceramic restorations following endodontic therapy.

Key Words: Tooth fracture, Endodontic therapy, Zirconia all ceramic crown.

Introduction:

Oral injuries are the fourth most common area of bodily injuries among 7–30 years olds (Rajab, 2000). Traumatic dental injuries can become an important health problem not only because their prevalence is relatively high, they have a large impact on the individual's daily life (Traebert et al, 2003). They constitute one of the leading reasons for odontological emergencies.

The traumatic injury of a permanent tooth can lead to the loss of pulp vitality. The traditional endodontic management of such cases typically includes debriding the root canal, disinfecting the space, and obturation of the root canal system.

Ceramic is the material of choice for long term esthetic dental restorations because they mimic enamel in terms of translucency and light transmission. The role of ceramic in dentistry has increased with the development of its ability to fuse with alloys. Metal-ceramic restorations remain the most common application of ceramics in dentistry today. These restorations provide excellent fit, esthetics, minimal fracture and have proven ability to survive in different clinical environments for extended periods. However, the alloy substructure of these restorations can limit their esthetic potential. Depending on the colour of the alloy-oxide layer and the clinical situation, the alloy oxide may be difficult to mask with opaque porcelain. Because of this problem, the colour matching of the veneering ceramic may be compromised by the alloy oxide colour or an inadequate veneering thickness. The alloy substructure may be difficult to hide esthetically in anterior restorations, particularly at the facial-gingival margins. In addition, some patients may have an allergic reaction to certain metals, particularly nickel and cobalt. These disadvantages have led to the development of all ceramic restorations (Abraham et al, 2010).

All ceramic restorations provide excellent esthetics. However, the low flexural strength of these restorations results in their high incidence of fracture, even when the clinical use is restricted to anterior and non stress bearing regions (Kristallis & Phimmasone, 2006).

All-ceramic fixed partial denture (FPD) cores are being fabricated from Yttrium Tetragonal Zirconia poly crystals (Y-TZP). These materials have excellent mechanical properties and bio-compatibility. These Zirconia based ceramics are indicated for a wide variety of restorations from single units to long span bridges (Piconi & Maccauro, 1999). It is an optimal material of choice for metal-free restorations because of its biocompatibility, strength and durability (Filser et al, 2001). The Zirconia restorations are veneered with leucite-free porcelain systems for thermal expansion matching. These systems show excellent bond strengths to the Zirconia base, better clinical outcome and acceptable marginal fit (Kelly, 2004; Raigrodski, 2004; Yilmaz et al, 2007; Wolfort et al, 2009).

This case series highlights the use of Zirconia based ceramics as a viable alternative to lithium-di-silicate base ceramics and metal-ceramic restorations especially in restoring anterior dental esthetics.

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Case 1:

A 20 year old male suffered an accidental trauma involving the maxillary anterior region of the mouth. Clinical examination revealed Ellis Class III fracture of the maxillary right central and lateral incisors with pulpal involvement (Fig. I). Soft and hard tissue examination showed no signs of scarring or any other evidence indicating previous trauma. Radiographic examination revealed fracture of maxillary right central and lateral incisors involving the pulp with no periapical or peri-radicular pathology (Fig. II). The patient complained of pain in both the teeth and tenderness to apical palpation and percussion.

A decision was made to perform endodontic therapy on both, the central and the lateral incisors. The maxillary incisors were endodontically treated according to standard protocol (Fig. III). Once the teeth were asymptomatic, the prepared access cavities were filled with composite resin, and the preparation for all ceramic crowns (Cercon Zirconia, Dentsply) was done according to the accepted guidelines. Gingival retraction was done by double cord technique and impressions were made with polyvinyl siloxane impression material. Provisional restorations were fabricated with self-cured composite resin and cemented on to the prepared teeth with temporary cement. After fabrication of the definitive restorations, the provisional restorations were removed; the definitive preparations were cleaned with pumice slurry. The preparations were rinsed and lightly air dried. The prepared teeth were isolated, and the crowns were then cemented with resin luting cement following manufacturer's recommendations (Fig. IV).

Fig. I: Photograph showing fractured 11 & 12.

Fig. II: Photograph of preoperative radiograph.

Fig. III: Photograph showing post-obturation radiograph of 11 & 12.

Fig. IV: Photograph showing cemented crowns in 11 & 12.

Case 2:

A female patient aged 18 years reported with a traumatic injury to both the maxillary central incisors. Clinical examination revealed Ellis Class III fracture

of maxillary right central incisor, and Ellis Class II fracture of maxillary left central incisor (Fig. V). Radiological examination corroborated the clinical findings (Fig. VI). Based upon the clinical and radiographic findings, endodontic therapy followed by an all ceramic crown (Cercon Zirconia, Dentsply) was advised for the maxillary right central incisor and a composite resin restoration (Ceramex Duo, Dentsply) was advised for the left central incisor. The patient was informed of the treatment plan and consent was taken. The decided treatment was then performed according to the accepted protocols (Fig. VII, VIII, IX).

Case 3:

An 18 year old female patient reported with a traumatic injury to both the maxillary central incisors

Fig. V: Photograph of fractured 11 & 21.

Fig. VI: Photograph of preoperative radiograph.

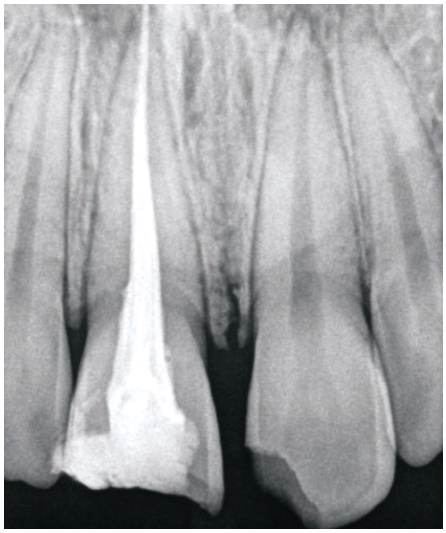

Fig. VII: Post obturation radiograph of 11.

Fig. VIII: Photgraph showing tooth preparation of 11.

Fig. IX: Photograph showing cemented crown in 11 & composite in 21.

(Fig. X). Clinical examination revealed Ellis Class III fracture of the maxillary right central incisor. Radiological examination corroborated the clinical findings (Fig XI). Although the maxillary left central incisor showed no apparent abnormality clinically, but

tested non-vital to pulp testing. The patient complained of pain in both the teeth and tenderness to apical palpation and percussion.

Based upon the clinical and radiological findings, endodontic therapy followed by an all ceramic crown (Cercon Zirconia, Dentsply) was advised for both the maxillary right and left central incisors. The patient was informed of the treatment plan and consent was taken. The decided treatment was then performed according to accepted protocols (Fig. XII, XIII, XIV).

Fig. X: Photograph showing fractured 11.

Fig. XI: Preoperative radiograph.

Fig. XII: Post obturation radiograph.

Fig. XIII: Photograph showing tooth preparations.

Fig. XIV: Photograph showing cemented crowns in 11 & 21.

Discussion:

Several restorative systems for fabricating all-ceramic crowns and bridges have been tested and are being tested in clinical studies for their long-term success. Yttrium tetragonal Zirconia polycrystals-based systems are the most recent version being tested with the emphasis on the use of computer-assisted design/ computer-assisted manufacturing (CAD /CAM) technology. These systems are being tested for their predictability as compared to metal-ceramic prostheses, which remain the gold standard in terms of their predictability (Yilmaz et al, 2007; Raigrodski, 2004). The recent ceramic systems that have received notable attention in peer-reviewed literature are: (1) a leucite-reinforced glass(Empress, Ivoclar), (2) a glass-infiltrated alumina (In-Ceram Vita), (3) a glass-infiltrated magnesium aluminate spinell (In-Ceram Spinell, Vita), (4) a poly-crystalline alumina (Procera, Nobel Biocare), (5) a glass-infiltrated alumina/Zirconia (In-Ceram Zirconia, Vita) and (6) transformation toughened polycrystalline Zirconia (Cercon, Dentsply Prosthetics: Lava, 3M-ESPE , Procera-Z, Nobel

Biocare). Amongst these systems, lowest fracture rates have been reported for the last two mentioned systems.

The esthetic advantages of all ceramic systems are real when the completely light- blocking metal is replaced even by an opaque ceramic. All ceramic systems can provide a better esthetic result for a wide range of patients than can metal-ceramics because a wide range of translucency opacity can be achieved with commercially available ceramic systems. Other advantages relate as much to the soft tissue health as to esthetics. Lesser amounts of plaque and adherence molecules are recovered from ceramic surfaces than from gold alloys or base-metal alloys. Secondly, intra-oral plaque of a qualitatively healthier composition can form on ceramic surfaces. It is often acceptable to leave the margins of all-ceramic prostheses supragingival or at the gingival margin, with the added benefit of more predictable and less traumatic impression making. Emergence profiles are less likely to be overcontoured, as it is often the result with metal-ceramic prostheses due to the efforts to provide a thicker layer of porcelain to mask the opaque-metal surface (Yilmaz et al, 2007).

The use of all ceramic restorations increases the depth of translucency and light transmission across the entire restoration. Some systems use a single white shade for the core. The core has masking ability and once milled, it can be coloured into one of the seven shades corresponding to the Vita-Lumin shade guide before the final sintering procedures. This allows the development of the shade of the restoration from its intaglio surface all the way to the outer aspect of the veneering porcelain. The ability to control the shade of the core may also eliminate the need to veneer the lingual and gingival aspects in cases where the inter-occlusal distance is limited. In addition, the palatal aspect of anterior crowns may be fabricated entirely of the core material in patients who lack space for lingual veneering porcelain. All ceramic systems also have reduced thermal conductivity resulting in less thermal sensitivity and potential irritation. Glass infiltrated leucite has always been the first choice for anterior restorations, especially in cases of highly translucent teeth. Glass infiltrated leucite reinforced ceramics provide better translucency but have very low flexural strength when compared to the newer generation yttrium based zirconia. Lithium based crowns also have the disadvantage of sub critical crack propagation due to stress corrosion caused by water in saliva reacting with glass resulting in decomposition of glass structure leading to increased crack propagation (Raigrodski, 2004).

The selection criteria according to Yilmaz et al (2007) & Raigrodski (2004) for all ceramic systems should be:-

1. Value of the dentition.
2. Cementation.
3. Clinical indications.
4. Strength.

In highly opaque teeth, where translucency is not required an opaque substructure will impart the desired and accompanying strength. When translucency is required in lithium-di-silicate based ceramics, the primary requirement for cementation is the formation of a micro mechanical bond which can be achieved by etching and bonding protocol of cementation. Zirconia based ceramics provide very little micro mechanical retention even after etching. The zirconium based crowns can be cemented by using glass ionomer cement or resin based cements, giving an option to the dentist.

Clinical situations like deep bite, class II div 2, or in teeth with already existing metal post or amalgam core where lithium-based crowns cannot be used, Zirconia based crowns provide a viable alternative to metal-ceramic and lithium based crowns (Raigrodski, 2004). Therefore, it is of utmost importance that during diagnosis and treatment planning, careful examination of the available edentulous space and inter occlusal distance be carried out. A 4mm clinical measurement with a periodontal probe from the inter dental papilla to the marginal ridge of the prospective abutment indicates adequate connector height for most all ceramic FPDs (Raigrodski, 2004). Even short clinical crown height may restrict the height of the connector.

Zirconia based all ceramic FPDs exhibits better fracture resistance of 1457 N when cemented with glass ionomer cement, which is well beyond 1000N. It also provide excellent esthetics if used in the appropriate clinical situation (Raigrodski, 2004). In all the cases reported above, Zirconia based restorations provided good mechanical and esthetic results.

Conclusion:

This article describes the restoration of function and esthetics following traumatic fracture of anterior teeth by endodontic treatment and Zirconia based all ceramic crowns. If proper clinical protocol is

followed, this system can provide optimal esthetics and function in routine as well as in unusual clinical situations.

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