Conservative Zirconia-Ceramic bridge in front teeth. Case report

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SUMMARY
Objective. This article discusses the clinical applications and techniques for zirconia restorations. The present case report describes a conservative zirconia bridge in front teeth and its retentive preparations.
Methods. A 51-year-old woman had a retained deciduous tooth 5.3 with a mesioangular impacted tooth 1.3. The accepted plan was for extraction of 5.3, a conservative zirconia framework/porcelain bridge to replace tooth 1.3. The lateral incisor was prepared with 1 to 1.5 mm reduction only on palatal surface and 1.5 mm deep seating grooves placed on the mesial and distal aspects of the preparation. A composite temporary restoration (Luxatemp [DMG America]) with an ovate type pontic was fabricated. The patient returned for definitive tooth preparation and impressions 3 months later and vinyl polysiloxane impressions were taken. After verification of fit a dual-cure DBA and luting material were used to fix the bridge.
Results. The soft-tissue response at 42 months was excellent with good papilla support and a natural emergence profile. After almost 5 years, there have been no clinical problems and the patient is very happy with the results.
Conclusions. The fixed bridge evaluated in the patient was found to be performing satisfactorily.

Key words: zirconia-ceramic bridge, impacted canine, conservative treatment, aesthetic in front teeth.

Introduction

The increasing aesthetic demand in dentistry has driven the development of a number of ceramics for their aesthetic capability, biocompatibility, colour stability, wear resistance and low thermal conductivity (1, 2). As far back as 1885, porcelain jacket crowns were first used for single crowns for the anterior teeth because of their aesthetic and natural appearance (3). However, ceramics cannot withstand deformation strain of more than 0,1-0,3% without fracturing and are susceptible to fatigue fracture. It is this brittleness, because of the ionic-covalent atomic bonding, which has limited their use in dentistry for decades (4).

The most recent introduction to the dental ceramics family is zirconia, which in its pure form is a polymorphic material that occurs in three temperature-dependant forms that are: monoclinic (room temperature to 1170°C), tetragonal (1170°C-2370°C) and cubic (2370°C - up to melting point) (5).

To date, there are three types of zirconia-containing ceramics which are used in dentistry: glass-infiltrated zirconia-toughened alumina ceramics, magnesium doped partially stabilized zirconia and 3 mol% yttria containing tetragonal zirconia polycrystalline (Y-TZP), with the latter being the most utilised form in dentistry because of its higher flexural strength reported torange from 900 to 1200 Mpa (6).

Y-TZPhas been used in root canal posts (7), frameworks for all-ceramic posterior crowns and fixed partial dentures (FPDs) (8-12), implant abutments (13, 14) and dental implants (15).

Advances in CAD/CAM technology has made it possible to more readily use zirconia in dentistry. This technology enables complex shapes

to be milled out of pre-made zirconia blanks or blocks (12), where the prepared abutment is first scanned, then using computer software, the desired frameworks designed prior to milling (16). Zirconia has been widely used within the last few years as a bridge framework because of its nonmetalic color, fracture resistance with flexural tests over 1,000 MPa, a good marginal discrepancy (17, 18) and a excellent long-term clinical success (12, 19, 20).

Conservative zirconia-fixed partial dentures can be a minimally invasive alternative for anterior tooth replacement and have proven to be very successful; particularly if retentive preparations are done (21).

Zirconia is an acid resistant, polycrystalline ceramic that does not contain amorphous silica, making it ineffective to traditional glass etching treatments such as hydrofluoric acid (HFl) followed by silane (21, 22). Bonding of zirconium based restorations cannot be done with the same methods as traditional glass-porcelain (5, 23, 24).

Bond strengths using differing methods including sand blasting with aluminium oxide, silane treatment, or other chemicals provided a weak bond at best that deteriorated significantly with time (25-28).

When preparation designs are retentive, as in the case of many full crowns and bridge abutments, bonding to the zirconia becomes less important, and more traditional cementation with dual-cure resin cements such as RelyX Unicem (3M ESPE) can be successfully accomplished.

Methods

A 51-year-old female patient presented with an unaesthetical appearance in anterior maxilla. She had a retained deciduous tooth 5.3 and a mesioangular impacted tooth 1.3 (Figure 1).

The patient reported that deciduous tooth had become mobile over the last year and reached the point of severe pain upon touch with grade 3 mobility. According to clinical and radiographic assessments the tooth was deemed hopeless and

Figure 1
The patient had been concerned with darkening of the retained deciduous tooth 5.3 for several years.

extraction was indicated (Figure 2). The patient requested an aesthetic replacement for her anterior region in the upper jaw. Surgical exposure of the impacted tooth with orthodontic ligation and traction was ruled out because of the unpredictability of forced eruption in adults and the patient was also not interested in orthodontic treatment. Also an oral surgeon declared that the extraction, bone grafting and implant placement would be unpredictable because of the position of the impacted tooth. After extraction of 5.3, the choice to restore this case with a veneered zirconia prosthesis was based on the desire to obtain

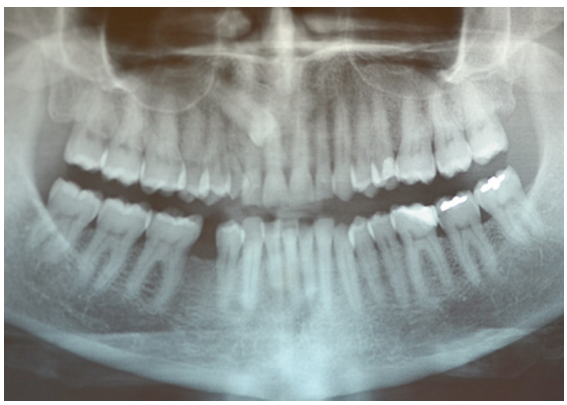

Figure 2
The Rx opt shows the position of the impacted canine 1.3.

the insizal translucency afforded by veneering porcelain and the high strength but white hue present in zirconia core to replace tooth 1.3, use of composite resin for tooth No.9 and the mesial of tooth No.10 to improve aesthetics and tooth No.6 to restore for the cusp tip.

After administration of local anesthetic, the deciduous tooth 5.3. was extracted (Figure 3), granulation tissue was removed and the abutment teeth were prepared using a medium grit tapered diamond bur. A chamfer margin was used for preparation. The lateral incisor was prepared with 1 to 1.5 mm reduction only on palatal surface and 1.5 mm deep seating grooves were placed on the mesial and the distal aspects of the preparation. The box on the distal side was 2 to 3 mm into the tooth and 3 to 4 mm in height from gingival to incisal line. The lingual cusp reduced at about 2 mm and interproximal box preparations were prepared with a width and height about 3 mm to provide a dovetail design with a definite path of insertion complimenting the preparation of the lateral incisor to avoid the risk of displacement.

A composite temporary restoration (Luxatemp [DMG America]) with an ovate type pontic was fabricated and cemented (Figure 4).

The tissue surface was smoothed and a small dome of composite was added to make a 100% convex surface to cover the extraction site and

Figure 4
After tooth preparation a temporary bridge was cemented.

obtain a slight pressure area so that minimal blanching would be seen when the restoration fully placed into the position. This slight pressure area is critical factor for papilla support and the maintenance of aesthetic gingival contours (Figure 6).

Besides, providing slight pressure area is needed to encourage the growth of soft tissue into an 'ovoid' form to have proper emergence profile of the final pontic.

The patient was invited for definitive tooth preparation and impressions 3 months later. The preparations were refined with a fine chamfer di-

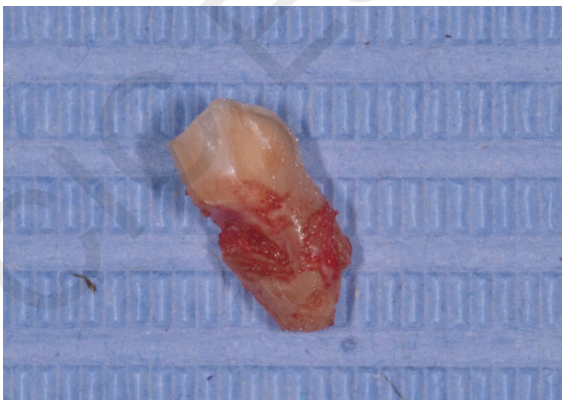

Figure 3
The retained deciduous tooth 5.3 after extraction.

Figure 5
The bridge framework of zirconia was covered with an add-on porcelain for aesthetics.

Figure 6
Soft-tissue tolerance at almost 5 years was excellent, and the integrity of the materials has been acceptable.

Figure 7
Assial view of Ceramic-Zirconia conservative bridge.

amond bur with boxes and channel providing a single path of insertion. Then, vinyl polysiloxane impressions were taken (Aquasil Ultra Monophase Dentsply-Konstanz Germany) and sent to laboratory with a full series of shade and character photos, bite registration and opposing model.

After verification of fit, the bridge (Figure 5) was cleaned with ethyl alcohol and an unhydrolyzed 2 part silane agent (Ultradent Products USA) was applied. A drop of zirconia primer (Z-Prime BISCO Dental Products) was placed on the internal surface of the porcelain abutments and dried for 60 seconds.

The teeth were etched 20 seconds with 37% orthophosphoric acid, rinsed and left moist onto the surface. The bonding agent (Optibond FL Kerr Scafati SA) was mixed and placed directly on both teeth and the bridge with air flowing to be thinned. The luting cement (Rely X Unicem 3M ESPE) was placed directly on the teeth and the bridge held into position with moderate digital pressure and cured with ultraviolet light. It is important to note that both a dual-cure DBA and luting material were used because of the opacity and low light transmission of zirconia. Patient's occlusion was checked with contacts minimal on the connectors and group function was maintained. Shaping procedure was completed with disks (SofLex 3M ESP) and polishing was performed with rubber cups.

Discussion and results

The follow-up period for the restoration were 42 months and 5 years. The soft tissue response at 42 months was excellent and with good papilla support and a natural emergence profile. Y-TZP framework was intact and no bridge retainers debonded. Any chipping fractures in the veneering ceramic were noted over the 5-year period. After almost 5 years there have been no clinical problems, with full clinician and patient satisfaction (Figures 6 and 7).

Conclusions

The demand for metal-free restorations coupled with the desire for conservation of tooth structure has put new demands on our profession. If properly designed – that is, with occlusion in zirconia and with use of long connectors and copings – partially veneered zirconia restorations have acceptable aesthetic and mechanical prop-

erties for anterior fixed partial dentures. The zirconia based restorations:

- are better aesthetically than typical porcelain fused to metal (PFM) restorations
- the long term colour stability probably will be the same as observed with PFM restorations
- the margins of the restoration have a more acceptable appearance than those of PFM restorations when gingiva recedes
- the long term wear characteristics on the opposing tooth for each material probably will be in similar behaviour, because the external ceramic materials are similar
- gingival sensitivity to metal will be reduced or eliminated with the use of zirconia-based restorations.

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