The era of monolithic translucent zirconia

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Monolithic translucent zirconia restorations offer improved aesthetics, minimal tooth reduction and elimination of ceramic chipping compared to traditional zirconia cores with veneered ceramic, but the scientific evidence on the survival of this type of restoration is scarce.

This article presents two case reports demonstrating rehabilitation with monolithic translucent zirconia restorations and discusses the clinical challenges of this treatment modality.

A patient with history of trauma to her maxillary anterior teeth and a patient with amelogenesis imperfecta were rehabilitated with monolithic translucent zirconia restorations. After 16 and nine months respectively, the patients were satisfied with function and aesthetics and no complications were noticed in the restorations or the opposing teeth.

Introduction

Yttria-stabilised zirconia polycrystalline (Y-TZP) ceramics were introduced as a biomaterial in restorative dentistry to eliminate the incidence of bulk fracture in all-ceramic restorations (Conrad et al, 2007). They attracted the interests of clinicians due to their high flexural strength and fracture toughness (Guazzato et al, 2004a; Guazzato et al, 2004b).

Their five-year survival rate ranges from 93.5% to 97.8% for tooth-supported prostheses and from 97.1% to 100% for implant-supported prostheses (Le, 2015; Larsson and Wennerberg, 2014; Sailer et al, 2007).

Chipping of the veneering ceramic with incidence of 15.7% has been reported as the most common complication both for tooth- and implant-supported prostheses (Sailer et al, 2007; Sailer et al, 2015; Pjetursson et al, 2015). Also, this type of prosthesis requires heavy tooth reduction and the reduced translucency of the core compromises the aesthetic outcome; factors that limit their use (Goodacre et al, 2001; Heffernan et al, 2002).

Figure 1: Preoperative labial view showing the traumatised maxillary anterior teeth

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Recently, monolithic translucent zirconia restorations were introduced in an effort to eliminate chipping of the veneering material, allowing minimal occlusal and axial tooth reduction of 0.5mm – compared to conventional zirconia restorations, which require reduction of 1.5-2mm (Nakamura et al, 2015).

The fracture resistance of monolithic translucent zirconia restorations is considerably higher than that of veneered zirconia cores and glass ceramics (Johansson et al, 2014), but a minimal thickness of 0.5mm is essential for optimal mechanical properties (Nakamura et al, 2015).

Monolithic translucent zirconia restorations show less wear to the antagonist tooth compared to traditional zirconia cores and glass ceramics (Mundhe et al, 2015; Rosentritt et al, 2012; Cardelli et al, 2015), irrespective of whether they are polished or glazed (Jung et al, 2010). Careful polishing is recommended after adjusting the prosthesis to keep surface roughness and phase transformation low (Preis, 2015).

Furthermore, the increased translucency of monolithic translucent zirconia restorations results in improved aesthetic outcomes compared to traditional zirconia cores (Harianawala, 2014).

The introduction of a variety of shades, application of colouring liquids to the core and staining of the occlusal surface improves the aesthetic properties of monolithic zirconia restorations (Rinke and Fischer, 2013). Besides, they are claimed to be cost-effective restorations as ceramic veneering is not required.

Preliminary outcomes show high survival rates both for full-arch and single-unit tooth- and implant-supported prosthesis (Carames et al, 2015; Venezia et al, 2015; Moscovitch, 2015).

Carames et al (2015) followed 14 patients with full-arch implant-supported prostheses for 24 months and showed a 96% survival rate. Other studies (Venezia et al, 2015; Moscovitch, 2015) have shown 100% survival over a 36- and 68-month follow-up period.

The aim of this article is to present two case reports of patients who were rehabilitated with monolithic translucent zirconia restorations and discuss the clinical challenges of this treatment modality.

Clinical report one

A 25-year-old female patient with a history of trauma to her maxillary anterior teeth presented requiring restoration of the traumatised teeth.

The fractured maxillary central incisors were provisionally restored with composite restorations and the maxillary lateral incisors had fractured at the cervical margin.

Figure 2: Preoperative occlusal view showing the traumatised maxillary anterior teeth

Intraoral and radiographic examination confirmed the diagnoses of failing restorations in the maxillary central incisors, intruded maxillary right central incisor and chronic apical periodontitis in the two maxillary incisors. The maxillary lateral incisors were retained as roots (Figures 1 and 2).

The treatment plan included full-coverage crowns to restore the maxillary central incisors and single-tooth implant-supported crowns to replace the maxillary lateral incisors. A high lip line and the patient's high aesthetic expectations indicated the use of all-ceramic restorations to restore the traumatised teeth.

The preoperative treatment planning was based on the SAC assessment tool (Dawson et al, 2009) and involved diagnostic wax-ups, cone beam computed tomography (CBCT) and use of radiographic and surgical stents (Mericske-Stern et al, 2000). Root canal treatment was performed in the maxillary central incisors prior to implant placement to eliminate any active infection (Martin et al, 2009).

Type II (early-delayed) implant placement surgery with simultaneous guided bone regeneration was performed in the maxillary lateral incisor sites to augment ridge contour with deproteinised bovine bone and porcine collagen membrane (Geistlich Biooss and Biogide) (Buser et al, 2009; Hämmerle et al, 2004; Chen et al, 2009).

Crown lengthening surgery was performed in the upper left central incisor at the time of implant placement to correct the irregular gingival contour.

After an uneventful healing period of three months, provisional restorations were placed in the maxillary lateral incisors to create an optimal emergence profile.

Figure 3: Postoperative labial view showing the monolithic translucent zirconia restorations

Figure 4: Postoperative occlusal view showing the monolithic translucent zirconia restorations

Provisional crowns were also placed on the two central incisors based on the diagnostic wax-up aiming to assess function and aesthetics (Jemt, 1999; Moscovitch and Saba, 1996; Lewis et al, 1995).

Lithium disilicate cement-retained crowns (IPS E.max, Ivoclar Vivadent) on zirconia abutments (Straumann Cares abutment, zirconium dioxide) were planned as definitive restorations for the lateral incisors and the monolithic translucent zirconia crowns (Straumann Cares monolithic restorations) for the central incisors (Stawarczyk et al, 2011).

As a result of trauma the remaining tooth structure in the central incisors was limited and mainly presented palatally. The use of monolithic translucent zirconia crowns allowed minimal tooth reduction of 0.5mm palatally and 1mm labially.

The zirconia abutments and cores were scanned with a CS2 scanner and the Cares visual software (Straumann Cares System 8.0) (Kapos and Evan, 2014). The monolithic translucent zirconia crowns for the central incisors were stained to optimise the aesthetic outcome (Rinke and Fischer, 2013).

The zirconia abutments were screwed and tightened to 35Ncm on each implant and the screw access holes were sealed with composite restorative material. Subsequently, the implant crowns were cemented using soft temporary cement (Tempbond, Kerr) (Mehl et al, 2008). The monolithic translucent zirconia crowns on the central incisors were cemented with a resinous cement with zirconia primer (Multilink Automix, Ivoclar Vivadent) (Thompson et al, 2011).

The patient was satisfied with the functional and aesthetic outcome at the end of the treatment and no complications were noticed at the 16-month review appointment.

Clinical report two

A 25-year-old female patient with amelogenesis imperfecta required restorations of her posterior teeth to improve function and eliminate tooth sensitivity. The maxillary and mandibular anterior teeth were previously restored with definitive restorations.

Intraoral and radiographic examination confirmed the diagnoses of hypocalcified type of amelogenesis imperfecta and acquired tooth loss of the mandibular right first molar (Figures 5 and 6) (Gadhia et al, 2012).

The treatment plan involved adhesive onlays to restore the maxillary and mandibular posterior teeth. Inadequate interocclusal space was present between the molar teeth and the patient was not willing to accept metal restorations for the definitive prostheses. Preparation for glass ceramic onlays could have detrimental effects on the tooth vitality.

Monolithic translucent zirconia onlays on the molar teeth were planned to facilitate the rehabilitation allowing minimal tooth reduction of 0.5mm.

The preoperative treatment planning involved articulated study models and diagnostic wax ups (Malik et al, 2012). After completion of the diagnostic stages of the treatment plan, the definitive restorations were constructed using monolithic translucent zirconia onlays (Straumann Cares monolithic restorations) for the molar teeth and lithium disilicate onlays (IPS E.max, Ivoclar Vivadent) for the premolar teeth (Malik et al, 2012).

The casts were scanned with CS2 scanner and the Cares Visual software (Straumann Cares System 8.0) (Kapos and Evans, 2014).

Subsequently, the restorations were stained to achieve an optimal colour match (Rinke and Fischer, 2013). All restorations were cemented with a resinous cement with zirconia primer (Multilink Automix, Ivoclar Vivadent) (Figures

Figure 5: Preoperative occlusal view of the maxillary teeth

Figure 6: Preoperative occlusal view of the mandibular teeth

Figure 7: Postoperative maxillary occlusal view showing the monolithic translucent zirconia restorations

Figure 8: Postoperative mandibular occlusal view showing the monolithic translucent zirconia restorations

7 and 8) (Thompson et al, 2011).

The patient was satisfied with the functional and aesthetic outcome at the end of the treatment, tooth sensitivity was controlled and no complications were noticed in the teeth or restorations at the nine-month review appointment.

Discussion

The literature review revealed that the long-term survival of monolithic translucent zirconia restorations lacks evidence.

Nevertheless, improved properties regarding aesthetics, tooth reduction and ceramic chipping in comparison to traditional zirconia cores are reported (Nakamura et al, 2015; Jung et al, 2010; Harianawala et al, 2014).

Preliminary outcomes show high survival rates for full-arch and single-unit tooth- and implant-supported prosthesis (Carames et al, 2015; Venezia et al, 2015; Moscovitch, 2015), but longer observation periods are necessary to draw definitive conclusions.

Traditionally, metal restorations have been used in patients with developmental conditions, especially in cases of

reduced interocclusal space, which show good long-term outcomes but compromised aesthetics (Gadhia et al, 2012; Malik et al, 2012).

Monolithic translucent zirconia restorations could offer an alternative restorative material in cases of reduced interocclusal space where aesthetic requirements are critical allowing minimal tooth reduction of 0.5mm (Nakamura et al, 2015).

Careful polishing after adjusting the zirconia surfaces to prevent wear to the opposing teeth and cementation with a resinous cement with zirconia primer are prerequisite to a successful outcome (Preis et al, 2015; Rinke and Fischer, 2013).

There are limitations on the use of monolithic zirconia restorations. Their fabrication requires computer-aided design and computer-aided manufacturing (CAD/CAM) technology and a multi-step polishing protocol after occlusal adjustment, which requires a variety of special diamond burs, diamond-impregnated silicone instruments and diamond pastes. Besides, there is no evidence regarding the effect on the survival of the prostheses or the opposing teeth if the surface glaze wears off.

Regular review appointments and individualised maintenance are suggested to monitor the integrity of the prostheses, the condition of the abutment teeth and identify any complications at an early stage.

Summary

Monolithic translucent zirconia restorations may offer improved aesthetics, minimal tooth reduction and elimination of ceramic chipping compared to traditional zirconia cores and conventional metal restorations.

However, there is limited evidence on the survival of monolithic translucent zirconia restorations.

Preliminary outcomes suggest promising results, but longer observation periods are necessary as the use of monolithic translucent zirconia increases.

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