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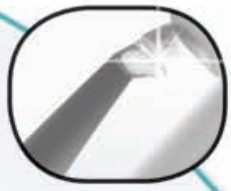

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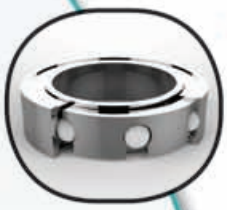

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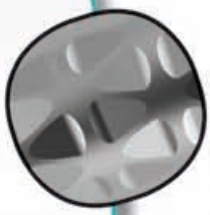

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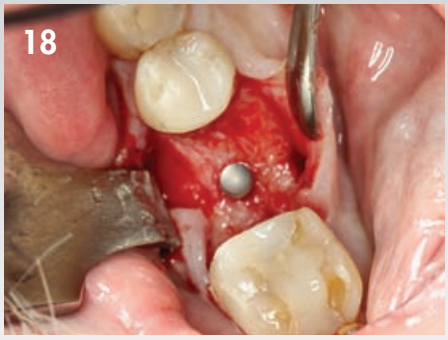

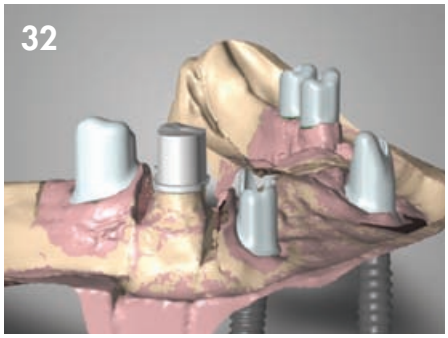

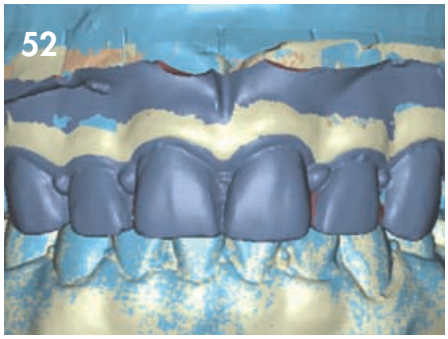

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Cusp replacement with an extensive posterior direct restoration using a nanohybrid bulk-fill ormocer

Jürgen Manhart

Supplementary to bulk-fill composites based on traditional methacrylate chemistry, material options have recently been expanded by a nanohybrid ormocer version, demonstrates.

Today, direct composite restorations in posterior teeth are a part of the standard therapy spectrum in modern dentistry. The performance of this treatment method in the masticatory load-bearing posterior region has been conclusively proven in many clinical studies, even for extensive composite restorations with cuspal coverage.

These restorations are usually carried out in an elaborate incremental layering technique. Aside from the possibilities that highly aesthetic composites offer in the application of polychromatic multiple-layer techniques, there is also a great market demand for the most simple and quick and it is therefore economical to place bulk-fill composite materials for posterior teeth.

Introduction

In recent years, the indications for direct resin-based composite restorations were continuously expanded due to improvements in the technology of composite materials and related adhesive systems, as well as an optimisation of clinical treatment protocols in adhesive dentistry (Wolff et al, 2015; Hickel et al, 2004; Frese et al, 2014a; Frese et al, 2014b; Frese et al, 2014c; Frese et al, 2013; Roggendorf et al, 2012; Manhart and Hickel, 2014; Lynch et al, 2014; Staehle, 2007; Staehle, 1999; Heintze and Rousson, 2012; Deliperi and Bardwell, 2006a).

Today, direct resin-bonded composites are becoming the first choice for many dental practitioners for the restoration of posterior defects; even extensive cavities in load-bearing areas are considered suitable for the direct adhesive technique (Lynch et al, 2014; Deliperi and Bardwell, 2006a; Demarco et al, 2012; Scholtanus and Ozcan, 2014; Laegreid et al, 2014). The maximum preservation of hard tooth tissues using direct composites as an alternative to indirect onlays and partial crowns is one of the major advantages and key elements when restoring severely damaged teeth with cuspal involvement (Hickel et al, 2004; Lynch et al, 2014; Plotino et al, 2008; Denehy and Cobb, 2014; Brackett et al, 2007; Fennis et al, 2004; Segura and Riggins, 1999; Macpherson and Smith, 1994; Mondelli et al, 2013; Kois et al, 2013; Kantardzic et al, 2012; Xie et al, 2012; Elayouti et al, 2011; Kuijs et al, 2006).

The replacement of single cusps with direct composite restorations is meanwhile an accepted treatment method and scientifically proven (Hickel et al, 2005). However,

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Figure 1: Initial situation: insufficient composite restoration with cuspal involvement in a first lower molar

Figure 2: Situation after removal of the old restoration, cavity preparation, application of rubber dam and matrix placement

Figure 3: Adhesive pretreatment of the dental tissues with the universal adhesive Futurabond U (self-etch)

Figure 4: Careful evaporation of the solvent of the adhesive

Figure 5: Light curing of the bonding agent for 10 seconds

Figure 6: A shiny cavity surface means evenly sealing dentin and enamel with adhesive

when the replacement of three or four cusps is needed in very large defects, indirect restorations – requiring additional substance removal in many cases – are still the preferred option for most dentists (Lynch et al, 2014; Laegreid et al, 2014). Longevity studies on posterior composite restorations including cusp replacement show an acceptable performance and qualify this treatment option as an alternative to conventional indirect restorations in selected clinical cases (Scholtanus and Ozcan, 2014; Laegreid et al, 2012; Deliperi and Bardwell, 2006b; Opdam et al, 2008; Fennis et al, 2014).

To date, incremental layering is considered to be the gold standard for placing light-curing composite materials (Park et al, 2008). Generally, conventional composites are placed in individual layers of maximum 2mm thickness, due to their particular polymerisation properties and limited depth of cure. Each increment is polymerised separately for 10-40 seconds, depending on the light intensity of the curing device used and the shade and translucency level of the respective composite paste (Ilie and Stawarczyk, 2014).

Thicker layers of these conventional composites, however, do not polymerise properly and therefore produce poor mechanical and biological properties (Tauböck, 2013; Ferracane and Greener, 1986; Caughman et al, 1991).

Figure 7: Shaping of the distal proximal area with a small amount of Admira Fusion x-tra and a special hand instrument. Light polymerisation of the restorative material for 20 seconds

Figure 8: After polymerisation, a cervical composite bridge stabilises the matrix in the distal contact area

Figure 9: The next increment Admira Fusion x-tra completes the distal proximal wall and forms the outer contour of the distolingual cusp

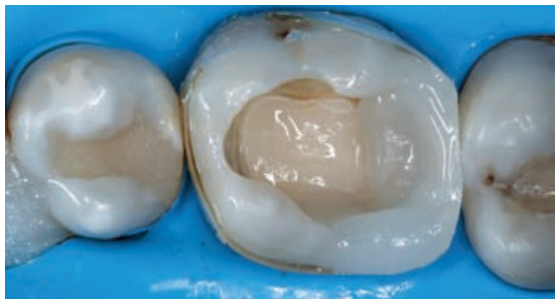

Figure 10: Situation after removal of the metal matrix

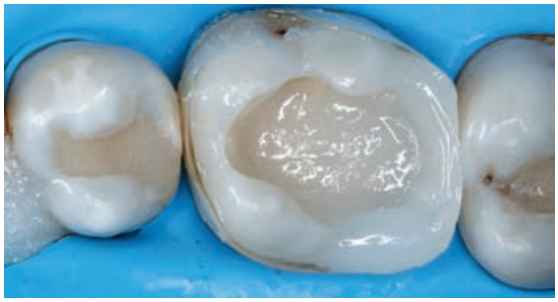

Figure 11: The next increment Admira Fusion x-tra brings the remaining cavity depth to a maximum of 4mm

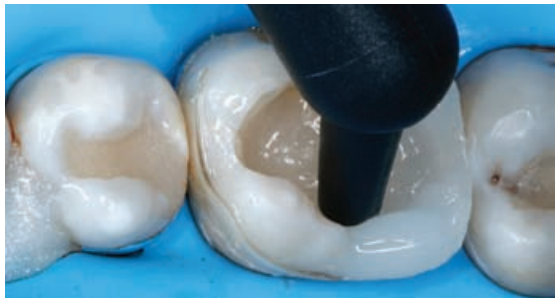

Figure 12: The last layer Admira Fusion x-tra was used to completely fill the cavity

The conventional increment technique can be a very time-consuming and complicated procedure when it is used to restore large and voluminous cavities in posterior teeth.

However, many dentists eagerly wish for an alternative to this highly technique sensitive multiple-layer technique, in order to be able to process posterior composite restorations in less time and therefore more economically (Manhart, 2011; Burtscher, 2011). Bulk-fill composites have been developed in recent years in response to this growing demand for more efficiency. Using a simplified application protocol, these materials can be placed into cavities in increments of 4-5mm thickness with short polymerisation times of 10-20 seconds per increment when a high-intensity curing-light is engaged (Ilie and Stawarczyk, 2014; Manhart, 2011; Czasch and Ilie, 2013; Finan et al, 2013; Manhart, 2010).

Bulk-fill materials

'Bulk fill' means that a cavity can be filled completely in a single step according to state-of-the-art restorative techniques, without having to place multiple layers (Hickel,

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Figure 13: View after sculpting the occlusal surface

Figure 14: Polymerisation of the occlusal composite layer for 20 seconds

2012). To date, the only direct filling materials available for this type of application have been cements and chemically or dual-curing core build-up composites. Nevertheless, cements (glass ionomer cements and derivatives, as well as other cement restoratives) are currently not suitable for placing clinically durable permanent restorations in load-bearing posterior cavities, since their mechanical properties are inadequate for this indication (increased risk of fracture or wear in the areas affected by masticatory loads).

Therefore, cements should only be used for intermediate restorations/long-term temporaries (Hickel et al, 2005; Frankenberger, et al, 2009; Lohbauer, 2010; Burke and Lucarott, 2009; Scholtanus and Huysmans, 2007). Moreover, core build-up composites are not approved for use as restorative materials and they are not suitable for this purpose due to their specific handling properties (eg, lack of sculptability for the design of the occlusal surface anatomy).

Technically, the present bulk-fill composites that are available for the simplified restoration of posterior teeth are not really bulk-fill materials, because in particular many proximal cavities extend into areas that are deeper than the maximum curing depth of these materials (4-5mm) (Frankenberger et al, 2012a; Frankenberger et al, 2012b). Nonetheless, if suitable composites are used, cavities with a depth of up to 8mm – which includes most of the defects seen on a daily basis in dental clinics – can be restored with two increments.

Most dental restorative composite materials contain organic monomer matrices based on traditional methacrylate chemistry, such as bisphenol A dimethacrylate (Bis-GMA) and its derivatives urethane dimethacrylate (UDMA) and triethylene glycol dimethacrylate (TEGDMA) as being the most often used diluent monomer (Peutzfeldt, 1997). Alternative chemical formulations use silorane resins (Guggenberger and Weinmann, 2000; Weinmann et al, 2005; Lien and Vandewalle, 2010; Ilie and Hickel, 2006; Ilie and Hickel, 2009; Zimmerli et al, 2010) and ormocers (Manhart et al, 1999a; Wolter and Storch, 1992; Wolter et al, 1994a; Wolter et al, 1994b; Wolter, 1995; Wolter et al, 1998; Manhart et al, 2000; Hickel et al, 1998; Manhart et al, 1999b).

Ormocers

Ormocers (organically modified ceramics) are organically modified, nonmetallic inorganic compound materials (Greiwe and Schottner, 1990). They are inorganic-organic copolymeric hybrid materials that are composed of an inorganic Si-O-Si-glass network (backbone molecule) and an organic polymer phase (Wolter et al, 1998; Moszner et al, 2002; Moszner et al, 2008).

This new material group was developed by Fraunhofer Institute for Silicate Research ISC, Würzburg, in co-operation with partners from the dental industry and introduced as a dental restorative for the first time in 1998 (Wolter et al, 1994a, Wolter et al, 1994b). Since then, remarkable further developments on ormocer-based composites have been made for this field of application. However, the use of ormocers is not limited to compact materials for dentistry. These materials already have been successfully used since years eg, in electronics, micro-system technology, refinement of plastic materials, conservation procedures and corrosion protection coatings, functional coatings of glass and highly resistant anti-scratch protective coatings (Wolter and Schmidt, 1990; Schmidt and Wolter, 1990; Ciriminna et al, 2013).

Ormocer-based dental restorative materials are currently supplied by two dental manufacturers (Admira product group, Voco; Ceramx, Dentsply). Hitherto existing

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Figure 15: Adjusting static and dynamic occlusion

Figure 16: Final result: the direct ormocer restoration with cusp replacement blends in well to the surrounding hard dental tissue

dental ormocers still contained additional conventional dimethacrylates in the monomer matrix for better handling and manipulation characteristics (in addition to initiators, stabilisers, pigments and inorganic filler particles) (Moszner et al, 2002; Moszner et al, 2008; Ilie and Hickel, 2011). Thus, it is better to refer to these materials as ormocer-based composites.

According to the manufacturer (Voco), Admira Fusion x-tra, the bulk-fill ormocer newly introduced in 2015, does not contain any conventional dimethacrylates in addition to pure ormocer chemistry. This diluent-free restorative material should show an increased biocompatibility (Moszner et al, 2002). It is filled with nanohybrid inorganic particles (84 wt %) and is available in a single universal shade.

A polymerisation shrinkage of 1.2 vol % and a low shrinkage stress have been measured for Admira Fusion x-tra, which can be applied into tooth cavities in single increments up to a maximum of 4mm layer thickness that have to be polymerised for 20 seconds each (curing light power >800 mW/cm²). The high-viscosity, sculptable consistency and the physico-mechanical properties of Admira Fusion x-tra allow the dental team to restore the complete tooth defect using a bulk-fill approach with only one restorative material from cavity floor up to the occlusal surface; it does not require a protective capping layer with an additional composite material unlike low-viscosity, flowable bulk-fill composites.

Clinical case presentation

A 34-year-old male patient requested in our dental office the replacement of his composite restoration in his LL6 (Figure 1). The tooth was endodontically treated and showed an insufficiently shaped direct composite restoration especially in the area of the replaced distolingual cusp and distal marginal ridge, which resulted in frequent food impaction with respective negative consequences. In consultation with the patient and after an explanation of the possible restorative alternatives and treatment fee, the patient decided on a direct nanohybrid ormocer restoration using Admira Fusion x-tra (Voco).

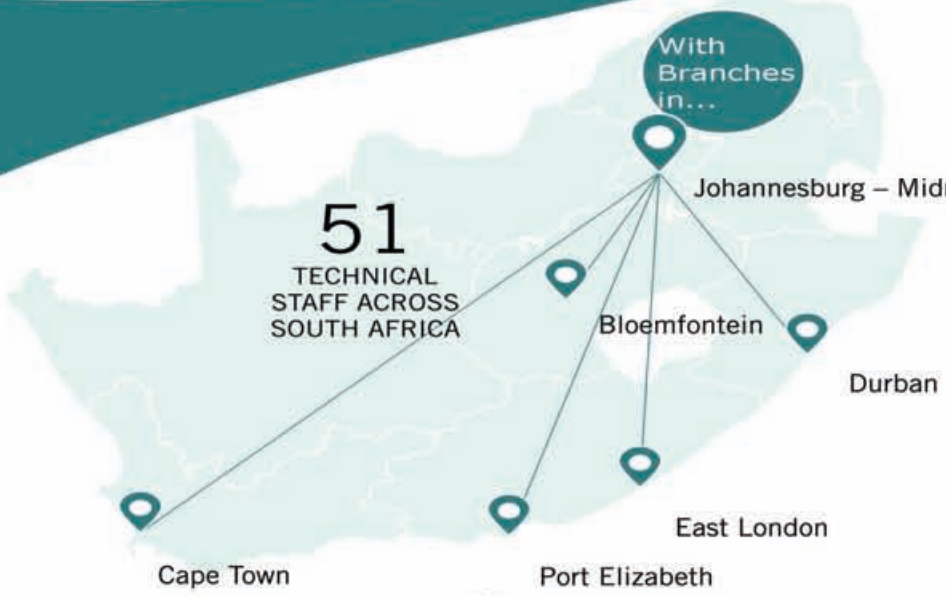
Treatment started with thoroughly cleaning the affected tooth of external deposits using a fluoride-free prophylaxis paste and a rubber cup. Admira Fusion x-tra is only available in one single universal shade, which renders a detailed and sometimes time-consuming shade analysis unnecessary. After careful removal of the old insufficient composite restoration, while conserving the remaining hard tissues, the tooth was excavated and the root canal openings were covered with a glass ionomer base (Ionostar Plus, Voco).

The cavity was finished with a fine-grit diamond bur. The tooth was subsequently isolated with the application of rubber dam, and the defect was confined with a circular metal matrix (Figure 2). The rubber dam separates the operation site from the oral cavity, facilitates clean and effective work and ensures that the working area remains clean of contamination (eg, blood, sulcus fluid and saliva). Contamination of the enamel and dentin would result in markedly poorer adhesion of the composite to the dental hard tissues and endanger the long-term success of the composite restoration with optimal marginal integrity.

Additionally, the rubber dam protects the patient from irritating substances such as the adhesive system. The rubber dam is thus an essential aid in ensuring high quality and facilitating work in adhesive dentistry. The minimal effort required in applying the rubber dam is also compensated for the dental team by avoiding the need to change cotton rolls and the patient's frequent requests for rinsing.

Bonding process

The universal adhesive Futurabond U (Voco) was selected for bonding. This modern one-bottle adhesive can be used



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with (etch-and-rinse approach: selective enamel-etch or total-etch of enamel and dentin) or without (self-etch) prior application of phosphoric acid. In this clinical case, the adhesive was applied using the self-etch technique. Ample amounts of the adhesive Futurabond U were applied and distributed generously in the area of the cavity using a microbrush (Figure 3).

It must be ensured that all cavity areas are sufficiently covered by the adhesive. After at least 20 seconds of carefully scrubbing the adhesive into the hard dental tissues, the solvent was carefully evaporated with oil-free compressed air from the bonding agent (Figure 4), which was subsequently light-cured for 10 seconds (Figure 5).

The result was a shiny cavity surface, evenly covered with adhesive (Figure 6). This should be carefully checked, as any areas of cavity that appear dull are an indication that insufficient amount of adhesive has been applied to those sites.

In the worst case, this could result in reduced bonding of the restoration in these areas and, at the same time, in reduced dentin sealing, which may lead to postoperative sensitivity. If such areas are found in the visual inspection, additional bonding agent is selectively applied to them.

Next, a small amount of Admira Fusion x-tra was applied on the floor of the distal proximal box and the still plastic composite was shaped using a special hand instrument (Easy Contact Point, Helmut Zepf Medizintechnik), which is used for the creation of a physiologically correct formed proximal area with tight contact to the adjacent tooth (Figure 7).

By controlled pressure, the hand instrument is forced towards the mesial surface of the neighboring tooth, anatomically shaping the metal matrix and simultaneously forming a cervical composite bridge, which stabilises the matrix after polymerisation (20 seconds, light power >800mW/cm²) – the instrument is kept in place during light curing – and ensures a tight proximal contact (Figure 8). The formation of physiologically contoured proximal surfaces with tight contacts to neighboring teeth still represents a challenge when using direct composite restorations.
In contrast to amalgam, composites show a certain viscoelastic recovery from distortion, which is often seen as undesirable by the user and complicates the adaptation of matrices to the neighboring tooth by packing pressure (Manhart, 2001; Kunzelmann 2001).

Final stages

With the next increment of Admira Fusion x-tra the distal proximal wall was completed up to the marginal ridge and the outer contours of the missing distolingual cusp were built (Figure 9). The material was again polymerised with a high-performance curing light for 20 seconds (light power >800mW/cm²). Thus, the class II cavity was transformed into a 'functional class I cavity'. Once the proximal composite wall was sufficiently polymerised, the matrix system was removed (Figure 10). As a result, the operating field became more easily accessible with modelling instruments for the following working steps and visual control of further subsequently to apply composite increments was enhanced. Because the remaining cavity depth still exceeded the maximum depth of cure (4mm) of the employed restorative material, a further horizontally orientated layer of Admira Fusion x-tra was placed into the cavity and polymerised for 20 seconds (Figure 11). With a last layer of Admira Fusion x-tra, the remaining volume of the cavity was completely filled up to the occlusal surface (Figure 12).

A functional but effective occlusal anatomy had been finally shaped to complete the direct ormocer restoration (Figure 13). The material was again light-cured for 20 seconds (light power >800mW/cm²) (Figure 14). After removal of rubber dam, the fissure relief and fossae of the occlusal anatomy were finished with a pear-shaped fine-grit diamond bur. In the next step of the standard finishing sequence, a point-shaped fine-grit diamond was then used to finish the convexity of the cusps and triangular ridges.

After the elimination of occlusal interferences and adjustment of the static and dynamic occlusion (Figure 15), the accessible proximal areas were contoured and prepolished with abrasive disks. The use of diamond-impregnated composite polishers (Dimanto, Voco) achieved a satin matte, lustrous finish on the surface of the restoration. Subsequent high-gloss polishing was completed using the same Dimanto polishers with reduced pressure to optimise the luster of the restorative material.

Figure 16 shows the completed direct ormocer restoration with cusp replacement, reconstructing the original tooth shape with an anatomical and functional occlusal surface, a physiological formed proximal contact area, and an acceptable aesthetic appearance. To complete the treatment, a fluoride varnish (Bifluorid 12, Voco) was applied to the affected tooth using a foam pellet.

Conclusion

Composite-based direct restorative materials will gain in importance in the years to come. These restorations present a scientifically proved, high-quality permanent treatment option for the masticatory load-bearing posterior region and

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their reliability has been documented in literature (Heintze and Rousson, 2012; Da Rosa et al, 2011; Van De Sande et al, 2015; Mahnart et al, 2004; Opdam et al, 2014; Opdam et al, 2010).

The results of a comprehensive review have shown that the annual failure rates of direct posterior composite restorations (2.2%) are not statistically different to amalgam restorations (3.0%) (Manhart et al, 2004). Even cuspal coverage direct composite restorations are meanwhile used frequently and prove to be a viable alternative to conventional indirect restorations in selected clinical cases (Scholtanus and Ozcan, 2014; Laegreid et al, 2012; Deliperi and Bardwell, 2006b; Opdam et al, 2008; Fennis et al, 2014).

The growing economic pressure on the healthcare system and, in many cases, a lack of financial means on the part of patients with regard to additional payments adequate to services, are creating a need for reliable, easy-to-use, faster-to-complete and therefore more economical basic posterior restorative treatment options as an alternative to the time-consuming high-end solutions (Margeas, 2014).

In addition to the universal hybrid composites, which are available in various shades and levels of opacity, new bulk-fill composites with optimised depth of cure have lately emerged on the market. They are specially designed for use in posterior dentition, where they produce aesthetically pleasing restorations. The placement procedure is economically more efficient than that of conventional hybrid composites (Manhart et al, 2009; Burke et al, 2009). Supplementary to bulk-fill composites based on traditional methacrylate chemistry, the material options in the sector of light-activated direct placement restoratives with increased curing depth were recently expanded by a nanohybrid ormocer version.

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1-Tooth 1-Time technique: State-of-the-Art Implant Dentistry

Louwrens Swart[1] and Paul Van Zyl[2]

The immediate implant placement and loading of a prosthesis in an edentulous jaw is an accepted treatment modality in dental practices worldwide. Optimization of treatment time is an attractive option for both the treating implantologist and the patient; thus, a single-stage surgical procedure and new loading protocols have been explored. The implant's implant design, core material, and surface modification are important device related factors that may influence primary stability. All of these factors, as well as patient anatomy and bone quality, are prerequisites for immediate loading treatments. Scanning and milling techniques have opened up a new landscape for implant dentistry, enabling implant prosthetic dentistry to take a major step forward. Digital workflows are increasingly used, particularly for single-unit restorations, and they allow for straightforward and cost effective protocols that improve patient satisfaction. One-Tooth One-Time (1T1T) is a technique developed to predictably place implants in the molar area of the mandible, followed by immediate loading of a definitive prosthesis just hours after surgery using the new Straumann® BLX system and a digital workflow.

Initial situation

Patient presented to the office with a missing lower first molar. (Figs. 1-4) His chief complaint was that even if the tooth does not have an impact on aesthetics, he was feeling pain while eating on the respective side because of the pressure onto the gums. (Fig. 5) For this reason he realized he started to shift all his chewing activity to the opposite side and now his wish is to have the site restored as soon as possible.

Considering the patient presents a well balanced occlusion and the missing tooth was the only tooth missing, it was discussed the One-Tooth One-Time technique with the patient which would fulfill his primary wish.

Figure 1: Extra oral – frontal view.

Figure 2: Intra Oral – frontal picture in occlusion.

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Figure 3: Intra Oral – Lateral view in occlusion.

Figure 4: Mandible occlusal view.

Figure 5: Occlusal view region tooth 46.

Treatment planning

A CBCT scan was taken pre-operatively confirming 13 mm of vertical bone between the inferior alveolar nerve and the coronal cortical margin of the mandible, as well as a minimum bone width of 6 mm. The implant selected for the surgical procedure was a Straumann BLX® with ø5.5x10mm followed by Intra Oral scanning plus the manufacturing of hybrid ceramic crown onto a WB Variobase® abutment and torqued to 35Ncm.

Surgical procedure

A flap was raised to expose the alveolar bone in the surgical area (Figs. 6-7). The ideal position for the implant was selected with careful determination of the best 3D position via clinical assessment. A pilot hole (2 mm) was drilled to determine the bone density (Fig. 8). The alignment pin was placed to confirm the ideal 3D position and the preparation depth (Figs. 9-10). The width of the osteotomy was defined by clinical evaluation of bone density and following the

Figure 6: Muco-periosteal flap elevated – Occusal view.

Figure 7: Muco-periosteal flap elevated – Lateral view.

Figure 8: Initial osteotomy with the use of ø2.2mm drill.

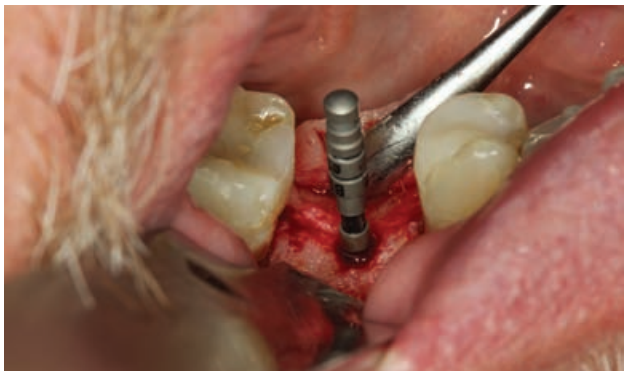

Figure 9: Tri dimensional position confirmed by the alignment pin. Lateral view.

Figure 10: Tri dimensional position confirmed by the alignment pin. Occlusal view.

Figure 11: Osteotomy with ø3.2mm drill.

Figure 12: Osteotomy with ø3.5mm drill.

Figure 13: Osteotomy ready for implant placement.

recommended drilling protocol. (Figs. 11-13).

A 5.5mm x 10mm BLX implant is placed with the use of the ratchet and the Straumann® Surgical Torque Control device. (Figs. 14-15). Because of the very engaging design the implant reached the torque value of 55Ncm. (Fig. 16).

The primary stability was further evaluated using the Implant Stability Quotient (ISQ) level (Osstell; Integration Diagnostics, Gothenburg, Sweden). (Figs. 17-18) A minimum measurement of ISQ necessary for the implant to be sufficiently stable for immediate definitive loading is 60. The BLX WB healing abutment, with a diameter of 6.5 mm, was placed, and the initial neck height of 2.5 mm, was selected determined by the coronal bone anatomy . A-PRF membranes were placed on the buccal surface of all implants to aid soft tissue healing (Fig. 19). Sutures were placed to create a soft tissue seal around the implant (Fig. 20-21). The patient was then transferred to the prosthodontist office.

Prosthetic procedure

The prosthodontic and technical work followed a digital workflow that included a DW intraoral scanner and CAD/CAM processing using Straumann CARES® Digital Solutions.

The Intra Oral Scanner captured the peri-implant mucosal architecture, including the neighboring teeth, in a quadrant-like approach. Then, a monotype scan body was screwed into the implant (Fig.22), and the 3D implant position was determined. The corresponding opposite arch was scanned in the same way. Finally, the bite recording was also digitally transferred.

Based on the .STL file from the IOS, a full-contoured crown was designed as a screw-retained dental hybrid ceramic (Vita Enamic IS-16L, Vita Zahnfabrik, Bad Säckingen, Germany) (Fig.23) and bonded with composite luting cement to a RB/WB Variobase® and produced digitally without any physical models or casting. The virtual crown design was processed and produced with 4-axis wet milling and grinding equipment (CARES C-Series, Institute Straumann AG, Basel, Switzerland). After the crown was milled, the restoration was cleaned with 95% ethanol and, after further post-processing, polished and individually characterized. Then, the prepared crown was directly bonded to a WB Variobase® extra-orally.

First the interproximal fit, and then the marginal integrity of the restoration, were clinically assessed. Identical continuity

Figure 14: Straumann BLX® ø5.5 x 10mm placement initiated with Surgical Ratchet.

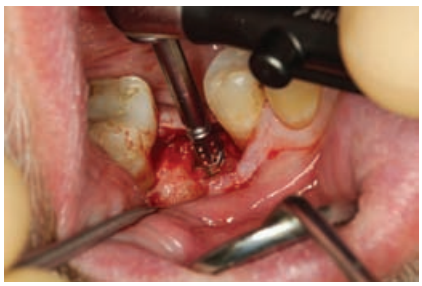

Figure 15: Final implant position.

Figure 16: 55Ncm torque value measure by Surgical Torque Control.

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Figure 17: Smartpeg for ISQ values in position (by Osstell).

Figure 18: ISQ 74 measuring – ideal for immediate loading protocols.

Figure 19: L-PRF membrane accommodated around RB/WB BLX healing abutment.

Figure 20: Soft tissue properly sutured – Lateral view.

Figure 21: Soft tissue properly sutured – Occlusal view.

with dental floss was separately checked for the mesial and distal contact surfaces. Next, the occlusal scheme was checked statically and dynamically with Shimstock foil, achieving light occlusal contacts.

The restoration was screwed with a torque of 35 Ncm, according to the implant provider's recommendations. The screw access hole was sealed with Teflon tape and composite material (Figs.24-25). PeriaFig.al radiograph was used to check the position of the implants after the procedure (Fig.27). Follow up X-rays was taken at the day of suture removal (15 days) (Fig.27), in 3 months (Fig.28) and 6 months (Fig.29).

Treatment outcome

To perform 1-Tooth 1-Time technique patient selection is key, with only one missing posterior tooth required to be restored in well balanced occlusion relation. It is critical to select an implant design that will ensure primary stability and enhanced bone-to-implant contact. Fully tapered implants favour this outcome.

The Straumann® BLX implant is designed for increased primary stability to enable immediate treatment protocols. The first requirement is that the implant should achieve primary stability, and thereafter a crown can be manufactured with full digital flow. This has the added advantage of no impression material ever coming into contact with the surgical wounds.

Digital implant dentistry will soon have an enormous impact on daily dental practice because of its precision in replicating the structures in the mouth. Analogue methods using traditional impressions often encounter inaccuracies. This new standard, as with all newly acquired knowledge, requires experience and familiarity with the products used. While some adjustments to the occlusal and interproximal contacts were needed, this need is way less than in analogue way. Digital protocols lead to more predictable results and a more efficient workflow, which will help control costs and save time for both the patient and the dental team.

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Figure 22: Monotype scan body in position for digital impression.

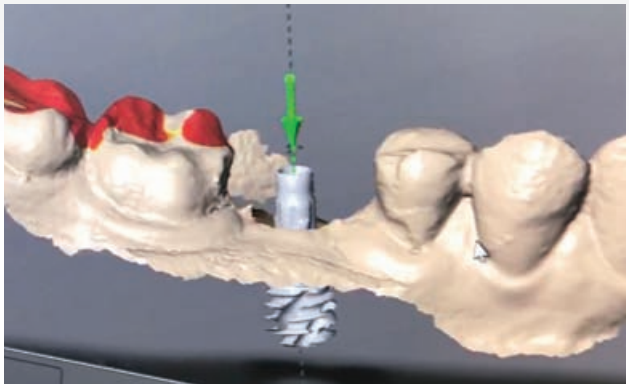

Figure 23: Computer Aided Designing (CAD) of the immediate final crown on a WB Variobase®.

Figure 24: Final crown in position occlusal view.

Figure 25: Final crown in position lateral view.

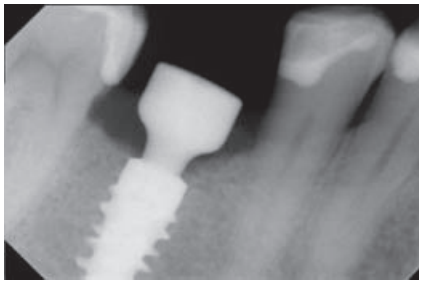

Figure 26: Periapical X-Ray immediately after implant placement before crown seating.

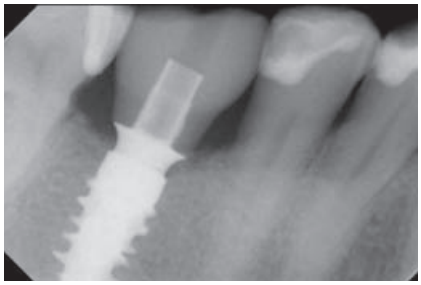

Figure 27: Periapical X-Ray 15 days follow-up.

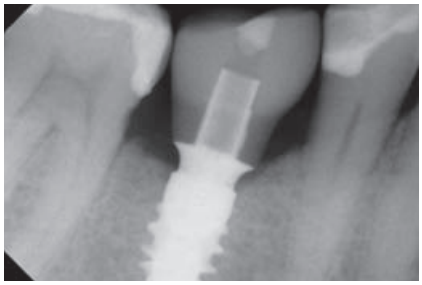

Figure 28: Periapical X-Ray 3 months follow-up.

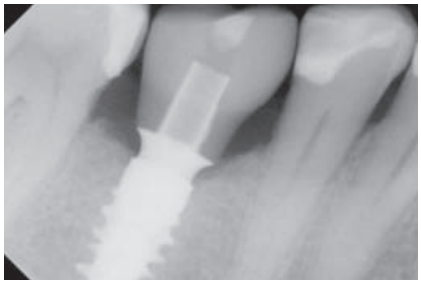

Figure 29: Periapical X-Ray 6 months follow-up.

Conclusion

The 1T1T technique presented showed a missing lower first molar treated with implant and restored with the definitive crown a few hours after the surgical procedure. This treatment modality has been shown to be a reproducible and predictable treatment option through the combination of the Straumann® BLX implant system and its respective digital workflow.

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A pictorial essay illustrating the root to crown concept using a single-file preparation system and CAD/CAM technology

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Introduction

Indirect restorations are the restorative method of choice on most endodontically treated teeth which have lost substantial amounts of tooth structure. A core build-up with or without post placement may be required to supplement retention and resistance form. Today, it is hard to envisage the laboratory fabrication of an all-ceramic restoration without the use of any CAD/CAM technology. The introduction of optical intra-oral scanners allows for a complete digital workflow between dentists and laboratory.

A key benefit of digital impressions is that the scanned preparation can be immediately evaluated on the computer monitor, thus permitting any inadequacies to be corrected immediately. Digital acquisition also eliminates numerous manual processing steps in the dental practice: the selection of the impression trays; the mixing of the impression materials; waiting for the impression material to set; and the production of a plaster model, and registering a bite. Fewer treatment and processing steps result in fewer sources of error and a more predictable outcome of the final result.

This pictorial essay illustrates the workflow of a clinical case report of a maxillary premolar that required root canal treatment, core-build up and placement of a new porcelain crown, using the latest materials and techniques.

Case Report

Figure 1a: A 45-year old, female patient presented with discomfort on her maxillary left first premolar that was restored with a lithium disilicate crown.

Figure 1b: After removal of the original crown, extensive decay of the remaining tooth structure was evident.

Figure 1c: The decay was removed and the pulp was exposed.

Figure 2a: A temporary crown was fabricated using Integrity™ Temporary Crown and Bridge Material (Dentsply Sirona) and temporarily cemented.

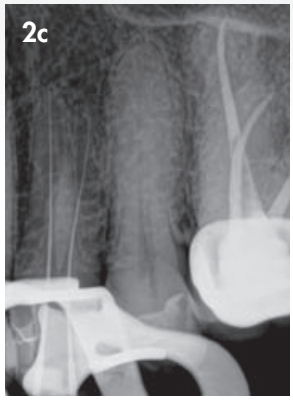
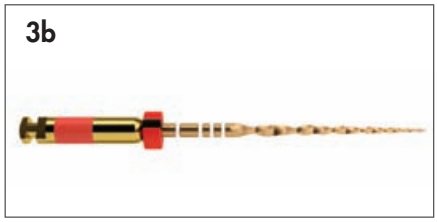


Figure 2b-c: The temporary crown was accessed and an emergency root canal treatment was done. Length determination was determined using a ProPex Pixi™ electronic apex locator (Dentsply Sirona) (Figure 2b) and confirmed radiographically (Figure 2c).



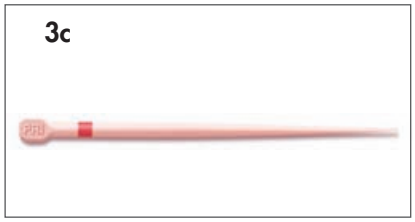


Figure 3a: At a follow-up visit, a micro glide path was prepared with a size 10 K-File in the buccal and palatal root canal systems before the glide paths were expanded with a reciprocating WaveOne® Gold Glider instrument.

Figure 3b-c: Root canal preparation was completed with a Primary WaveOne® Gold file before two Primary WaveOne® Gold Gutta Percha Points (Figure 3c) were used to confirm the cone-fit radiographically. After following a standard irrigation protocol, the two canals were obturated with the Primary WaveOne® Gold Gutta Percha Points, AH Plus® Cement and the Calamus® Dual Obturation System.

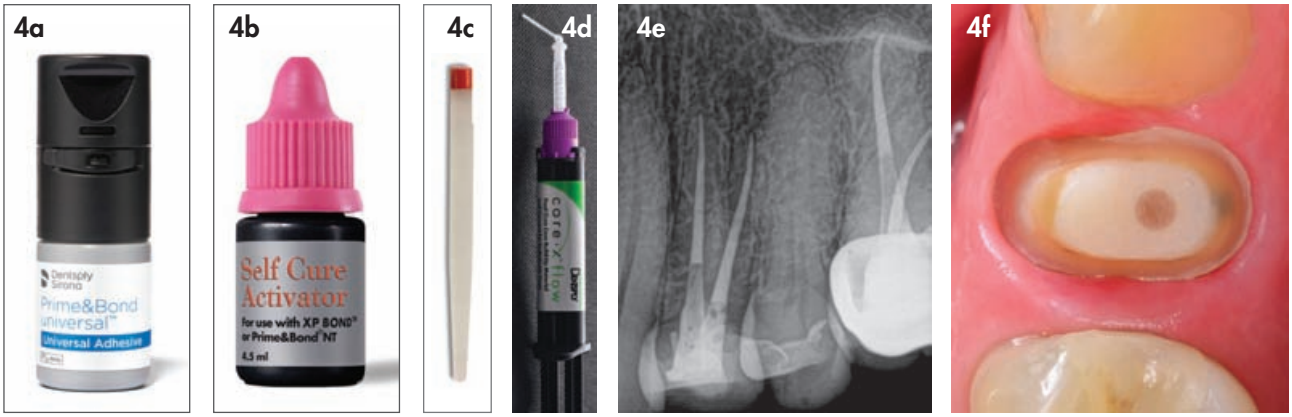


Figure 4a-e: A post space was prepared in the palatal root canal, the access cavity and post canal space were cleaned with air abrasion using the bicarbonate soda in the Aqua-abrasion unit (Velopex). The canals and the access cavity were simultaneously etched with 36% phosphoric acid (Dentsply Sirona), before a mixture of Prime&Bond Universal™ Adhesive (Figure 4a) and Self Cure Activator (Figure 4b) were applied according to the manufacturer's instructions. A fiber post (XPost™, no.2) (Figure 4c) was cemented using Core-X™ flow dual-cure core build-up material (Figure 4d), while the same material was used to build-up the core inside the temporary crown. Figure 4e shows a periapaical radiograph of the root canal treatment after obturation and core build-up. The temporary crown was removed and Figure 4f illustrates the clinical result of the core build-up.

Figure 5a: The margins of the crown preparations were improved by using diamond coated ultrasonic tips (Sonic Tip for Crown Prep, Komet1), driven by an ultrasonic scaler before retraction cord was packed for gingival retraction.

Figure 5b: An optical impression was made using the Omnicam acquisition camera on the Sirona Connect Unit (Dentsply Sirona) of the preparation, antagonist and bite registration. The temporary crown was modified and cemented with a non-eugenol temporary cement.

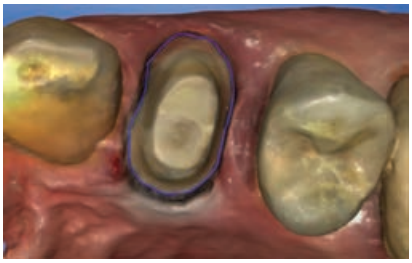


Figure 6a: Sirona Connect software computed a virtual 3D model and the preparation margin was drawn in using the automatic margin detector before it was electronically submitted to the dental laboratory.

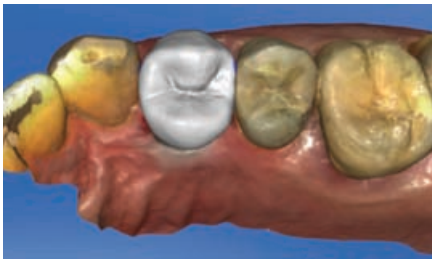


Figure 6b: The biogeneric software created a patient specific restoration, with precise morphology of the restoration.

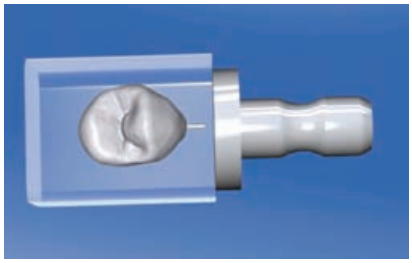


Figure 6c: The dental technician then made corrections to the proximal and occlusal contact points. In the milling preview the position of the restoration within the ceramic block was viewed before the milling unit was activated to initiate the machining process.

Figure 7a: An inLab MC X5 milling and grinding unit (Dentsply Sirona) was used to grind the crown from a shade A2, lithium disilicate block.

Figure 7b: Shows the completed lithium disilicate crown after the crystallisation firing cycle, polishing, staining and glazing in the dental laboratory.

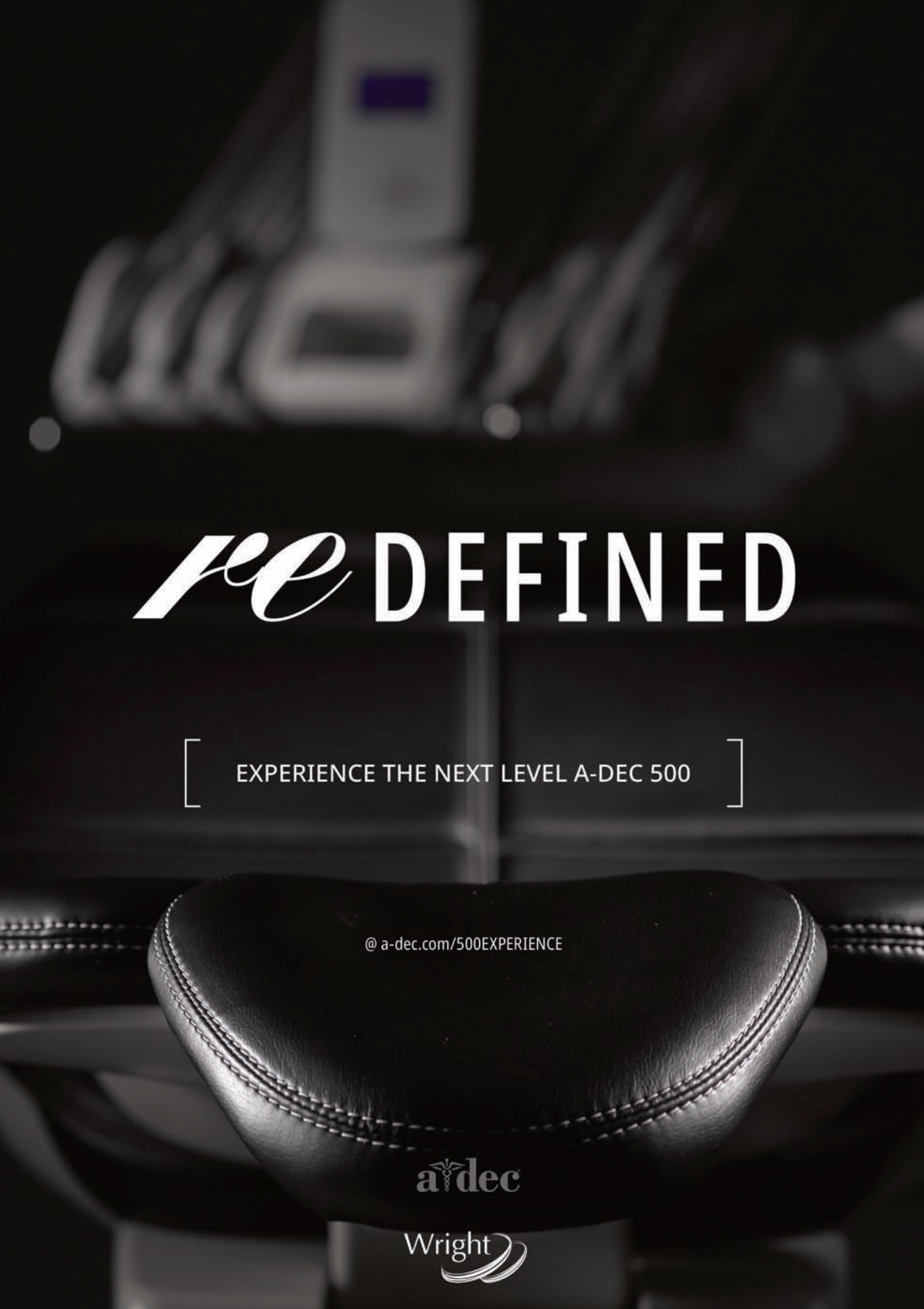

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Figure 8a-c: At the cementation appointment, the temporary crown was removed and the tooth preparation cleaned with a slurry of pumice and water to remove any remnants of temporary cement. The internal surface of the crown was etched with 9.5% hydrofluoric acid for 20 seconds, rinsed with water and air-dried. A generous amount of silane coupling agent was applied to the etched internal surface of the crown, left undisturbed for 30 seconds before it was air-dried for 15 seconds. The enamel and dentine of the tooth preparation was etched with 36% phosphoric acid for 15 seconds before it was rinsed with water and lightly air-dried. Prime&Bond Universal™ Adhesive was applied to the etched tooth preparation and the etched and silanated internal surface of the crown before the solvent was evaporated using a light air stream from the 3-in-1 syringe. Shade A2 of Calibra® Ceram Adhesive Resin Cement (Figure 8a) was dispensed into the crown before it was seated onto the tooth preparation. The margins were light-cured for 5 seconds and the excess cement removed before all the exposed margins were light-cured for 20 seconds. The final, highly aesthetic occlusal and buccal view of the bonded crown with good contact points, anatomic contour and excellent marginal adaptation can be seen in figure 8b and figure 8c respectively.

Conclusions

1. The use of the WaveOne® Gold Glider, a single reciprocating glide path instrument to expand the glide path allowed for easy root canal preparation with the reciprocating WaveOne® Gold Primary file.
2. Core build up was achieved by using XPost™ in combination with the Core-X™ flow dual-cure core build-up material. Because the Core-X™ flow dual-cure core build-up material can be used for post cementation and core build up at the same time, it simplifies the procedure and saves valuable clinical time.
3. The Sirona Connect unit with the Bluecam acquisition camera allows clinicians to obtain very accurate digital impressions that can be sent to the laboratory to manufacture and to characterise the final shape and form to obtain a high level of aesthetics.

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Prosthodontic solutions for elderly patients

Ramona Buser,[1] Qin Yue,[2] Patrick Zimmermann,[3] Valerie G. A. Suter,[4] Samir Abou-Ayash,[5] Martin Schimmel[6]

Abstract

With the so-called "baby boomer" generation reaching retirement, a new challenge in implant dentistry has emerged. Predominantly, tooth loss occurs later in life, accompanied by increased demand for partial dental prostheses. Edentulous patients are more difficult to treat due to advanced age, functional dependence, illness, and financial instability. Prosthetic planning becomes more complex as interindividual diversity increases with age. Considerations such as resilience, physical and mental status, medical history, and drug prescriptions must be individually assessed. Treatment planning and restoration design should fulfill both functional requirements and esthetic demands. Prosthesis design should prevent further harm to the patient. This tertiary prevention approach should prevent local inflammation of the oral tissues, but also prevent secondary systemic infections, such as aspiration pneumonia. There are many prosthetic options for partially or fully edentulous patients. Dental technicians should be aware of the advantages and disadvantages of the various treatment concepts and materials, and contribute professional knowledge to the patient, dentist, and often thirdparty milling centers. Using CAD/CAM technology, customized attachments and prostheses can be individualized according to each patient's requirements. Utilizing a combination of manual and digital production techniques, oral reconstructions can be rationally manufactured. The duration of implant osseointegration remains unknown, but reports of up to 30 years' follow-up are emerging. Hence, the environment of the implant – the patient – will change significantly, and implant restorations should be flexibly designed to meet the changing needs of an aging patient. This "back-off strategy" should be implemented, and prostheses should be continuously subjected to critical reevaluations and adaptation.

Keywords: Gerodontology, prostheses, edentulous, dental laboratory work

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Introduction

The main focus of this article lies on elderly, partially dentate and edentulous patients with implant-supported or implant-retained reconstructions. Individual patient needs and how they are met are discussed, as are fabrication technologies, questions regarding choice of material, and the conceptual collaboration between the dentist and the dental technician. Ultimately, this article makes a case for modern reconstructive dentistry that offers a sophisticated treatment concept adapted to the needs of each patient. It intends to raise awareness of the variety and versatility of the available approaches.

At what age is an individual considered elderly or old? There is no hard and fast rule, as this question has a philosophical component in which medical, social, and psychological factors play a role (Bürger 1960; Rowe et al. 1997). The natural process of aging is progressive and irreversible, and pathological changes may influence and accelerate the process.

The far-reaching consequences of the aging process are also felt in the field of dentistry. Physiological and pathological changes can affect teeth, nerves, muscles, and hard and soft tissues. Aging can thus influence the ability to chew, swallow, and interact as well as esthetics (Müller et al. 2016a). Poor chewing efficiency and/or pain related to teeth or dentures affect food intake, which may have consequences for general health (Schimmel et al. 2015). Missing teeth or poorly fitting dentures can

have a negative effect on social interactions and self-esteem (Stenman et al. 2012). Dental care is an indispensable aspect of maintaining quality of life in old age.

Oral hygiene to maintain oral and general health is the primary goal in care for elderly patients. Well-designed and well-fitting prosthetic reconstructions of missing teeth are further important factors to restore function, esthetics, and quality of life. Whereas in former decades, prosthetic treatment for elderly patients meant in most cases full denture prosthodontics, the picture has changed in recent years. An increasing number of individuals retain their natural dentition until late in life, and the relative number of edentulous patients is decreasing at a high rate (Jordan et al. 2016; Schneider et al. 2017; Slade et al. 2014). However, the total number of elderly patients is increasing dramatically due to demographic changes; hence, edentulism is not likely to be eliminated in the near future. In the United States alone, it is estimated that 10 % of the total adult population is edentulous, i.e. 32–35 million edentulous patients (Slade et al. 2014).

"Soft" factors when dealing with patients

Each member of the reconstructive team must naturally be familiar with the basics of partial and full denture prosthetics, static and dynamic load and occlusion, as well as phonetics. Equally important are the "soft" factors when dealing with patients that make personal contact with the patient advisable, if not indispensable. Here, it is worth considering some characteristics of the age group. Among these are possible difficulties associated with the loss of a partner, physical or psychological illness, use of medication, eating habits, or a change in the ability to adapt and react. Dealing with (older) patients demands empathy and understanding for their situation. Dentists and dental technicians should, therefore, periodically update their awareness of the basic tasks carried out by natural teeth, and the oro-facial system in general (Chen et al. 2012). Tooth loss leads to anatomical and morphological changes with which many patients have difficulty coping. Quality of life is restored only when patients are in possession of a functional prosthesis tailored to their individual needs.

Meeting high expectations

The expectations of young-old patients, the so-called baby boomers now reaching retirement age, has increased with respect to the quality, function, and esthetics of their prosthetic restorations. We are currently observing the transition from one generation of older patients – the postwar generation – to the next – the baby boomers (Schimmel et al. 2017a). The

Figure 1: Not only younger but also many older people have no desire to be seen wearing clearly identifiable dentures – the demand is for a prosthesis that mimics natural dentition, as shown here with overdentures in both jaws.

latter are accustomed to a high level of service from dentists and dental technicians that they do not intend to forego as they grow older. Many older people are looking for an esthetic restoration that looks perfectly natural (Fig. 1). As a result, a stronger focus on implant prosthetics is developing in the rehabilitation of elderly patients. Implant therapy renders various therapy options possible to edentulous patients – from simple and functional to functionally and esthetically high-end solutions. In order to provide this kind of restoration, dental technicians need detailed knowledge of the positioning of prosthetic teeth, materials, and function as well as of the abovementioned soft factors. They must also understand how these individual aspects interact, and appraise the significance of the restoration to the patient.

Regrettably, the manufacture of removable partial and full dental prostheses is frequently given little attention by the dental laboratory. What is achieved to perfection by dental technicians in other areas such as fixed restorations, should also be a matter of course for removable prostheses. This is where priorities need to be set in an age cohort in which up to 50 % wear removable dental prostheses (RDP) (Schneider et al. 2017). Highly qualified dental technicians are needed within the treatment team that looks after partially dentate and edentulous patients in order to assist in finding the single optimal choice from the variety of restoration options available. As both the complexity of reconstructive work and average patient age continue to increase, one person needs to take the lead and maintain an overview of the entire process. This influences communications between the dentist, patient, and dental technician in which digital channels of communications are playing an increasingly greater role.

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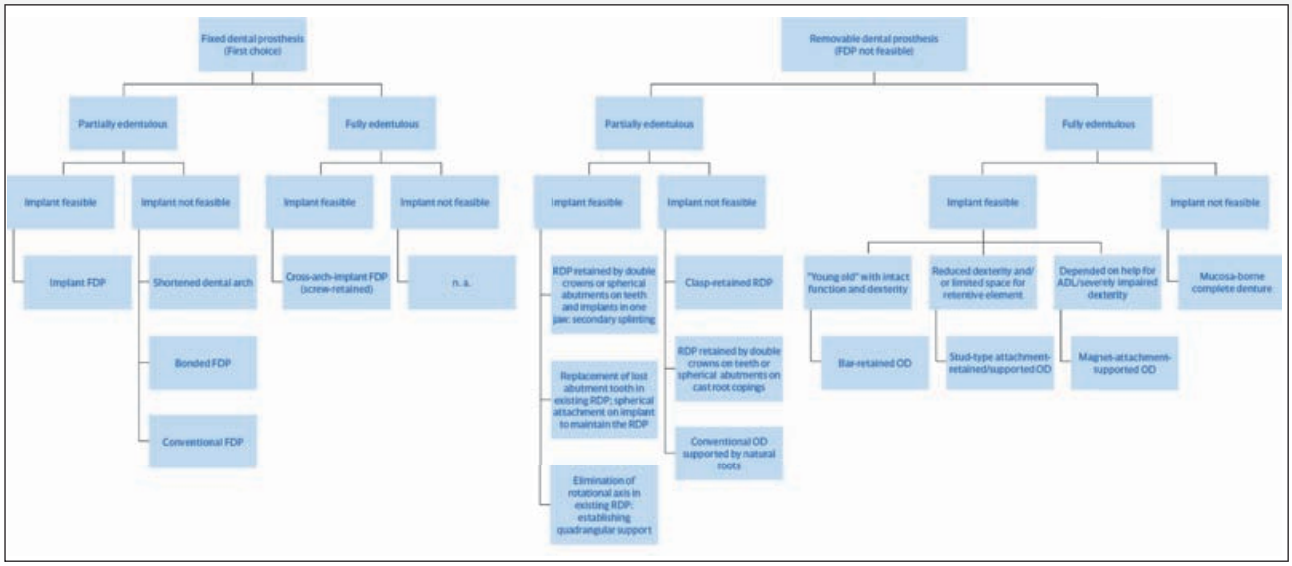

Flow chart to illustrate prosthodontic treatment options for the elderly patient. The most important decision is whether to plan a fixed (FDP) or a removable dental prosthesis (RDP); RDPs should only be planned if the restoration with FDPs is contraindicated, e.g. when the patient is no longer as resilient to extensive dental treatment, cannot maintain correct oral hygiene or the dental/general prognosis is doubtful. Overdentures (OD) retained or supported by natural teeth provide better tactile sensitivity than implant-supported ODs, but abutment teeth may develop caries or periodontal problems

Figure 2a-c: Depending on the indication, a removable implant-supported, bar-retained prosthesis is recommended for edentulous patients. It can be cleaned more easily than fixed full arch prostheses, but is still extremely stable. Labwork mundwerk dental (Bern).

Figure 3: Where abutment teeth are available, the clasp-retained denture represents a cost-efficient option.

Selecting the restoration concept

Implant-supported restorations

Implant therapy is a thoroughly investigated approach for restoring partially dentate and edentulous patients. Treatment planning is managed by a team of professionals.Age-related factors, such as multimorbidity, manual dexterity and potential limitations thereof, as well as reduced adaptability are included as part of the process. It should be considered that the restoration may need to be modified at a later date to account for diminished strength and dexterity of the hands and/or other co-morbidities, including cognitive

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Figure 4: Clasp-retained restorations often fulfill esthetic requirements, even in the anterior mandible. The amount of metal should be kept to an absolute minimum; two clasps normally suffice.

Figure 5: The distribution of abutment teeth in the lower jaw at the front and side allows for clasp-retained prostheses.

Figure 6: Design and retentive force of an implant overdenture should be adapted to the patient's individual capacity. Therefore, the dental team should increasingly pay attention to "non-dental" planning factors.

impairment. With increasing multimorbidity, it should be possible to revert to a prosthesis that is easier to handle in order to facilitate hygiene care for nursing staff if necessary (Müller et al. 2013). In addition, the individual needs of the patient, as well as general health and financial means must be considered during treatment planning. Ultimately, subjective factors and individual adaptability are key to the success or failure of prosthetic therapy.

The initial decision is whether to opt for a fixed or removable solution (see flow chart). In addition to oral comfort, hygiene plays a role here. As long as a few basic principles are followed, an implant-retained removable prosthesis facilitates oral hygiene (Figs 2a–c). If a fixed solution is selected, it must be designed with accessibility for oral hygiene.

Clasp-retained dentures

In addition to classic crown or bridge restorations, removable devices are frequently provided for patients in the third and fourth phase of life. For financial reasons, clasp retained dentures are often the first choice for partially dentate patients. The aim is to have as few clasps as possible and as many as necessary to establish an equilibrium between damage and benefit from the metallic structures. N.B.: 5-year survival rates were reported to be as low as 86.6 % for direct abutment teeth (Tada et al. 2013). If the abutment teeth are favorably distributed and provide appropriate support, two clasps are sufficient (Budtz-Jorgensen et al. 1995) (Fig. 3). The restoration should be designed to facilitate repair if further teeth are lost. The palatal plate has an advantage over the bikini design in terms of force distribution and when transitioning to a full denture, but is sometimes not well tolerated by patients. Here too, the periodontally and interdentally open design of the structure is very important to allow for good oral hygiene even in old age (Budtz-Jorgensen 1999) (Figs 4–5).

Age- and function-oriented dental care concept

We recommend an age- and functionoriented care concept – this also applies to implant-supported overdentures. At the School of Dental Medicine of the University of Bern, we follow a graded approach of implant prosthetics that is adapted to the manual strength and dexterity of the patient (Fig. 6). Given that the implant's success is to be secured, if possible, for the remainder of the patient's life, implant treatment must therefore be aligned to whether the patient can autonomously insert, remove, and clean the restoration (Müller et al. 2016b). Additionally, it must also be possible to remove the restoration. Two-piece implant abutment retentive elements are preferred on the shortest and smallest implants possible that will still assure long-term function under masticatory forces. This will reduce invasiveness and morbidity during the treatment's surgical phase. Ideally, implants should also be retrievable or easily put to sleep, if adequate care can no longer be assured (Schimmel et al. 2017a).

We design our implant prosthetic concept for edentulous patients according to the McGill consensus and a functional classification for completely edentulous patients. These concepts should only be applied if the IOD is opposed by a complete mucosaborne prosthesis, otherwise a higher number of supporting implants should be discussed (Fig. 7):

- for young-old people: maximal rigidity via a bar restoration. Typically a milled bar on two tissue-level implants with distal extensions (max. 7 mm)
- when there are vertical space constraints or potential

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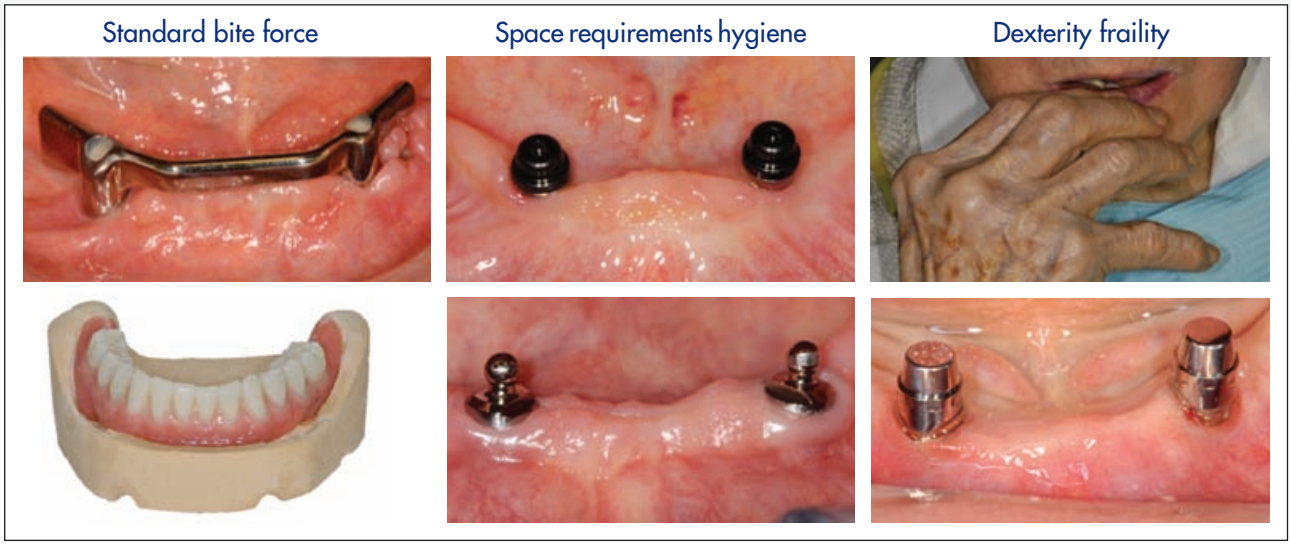

Figure 7: At the University of Bern a phased approach is followed for edentulous patients, depending on anatomy and functional capacity. We prefer two-piece implants placed with minimally invasive surgery and adapted to co-morbidities. The length and diameter should be as small as possible, but as large as necessary.

difficulties cleaning a bar restoration: stud-type attachments like the Novaloc™ anchor (Straumann, Basel/Switzerland)
- for patients with nursing care requirements and/or severely reduced dexterity: magnets (e.g. Titanmagnetics K-Line, steco, Hamburg)

Examples of tooth- and implant-supported restorations

Restorations can be retained in a variety of ways and we select the approach on a case-by-case basis (Fig. 8).

Spherical abutments with residual dentition (removable prostheses)

In Switzerland, a method frequently applied following root canal treatment is the use of cast root caps with soldered spherical or Gerber attachments. Given the correct indication and treatment, this treatment modality shows good survival of anchor teeth and prostheses (Mercouriadis-Howald et al. 2018). When used in combination with implants, they offer patients a securely retained removable restoration (Fig. 9). This option is a relatively simple, implant-supported solution, particularly in terms of after-care. In just a few easy steps, the retention force (e.g. DalboPlus anchor, C+M, Biel, CH) can be increased or the retentive part replaced. If it needs to be extended, an additional anchor can be easily integrated into the existing prosthesis. If an abutment tooth is lost, an implant can be placed in the same position and the well-adapted prostheses can continue to be used.

Stud-type anchors (removable prostheses)

For edentulous patients, it is recommended to retain an overdenture with at least two implants in the mandible and four in the maxilla. However, a recent review found evidence that four or six implants should preferably be placed in the mandible and maxilla, respectively (Kern et al. 2016; Schley et al. 2013). The actual retention element consists of a stud-shaped retention part and a transmucosal cuff (Figs 10a–b). While the male part serves as the implant abutment, the female retentive element is incorporated into the base of the prosthesis. Impression-taking is sometimes challenging due to space requirements – the prosthesis must be milled out generously. An example of modern retention systems is the Novaloc™ attachment (Straumann AG, Basel) (Schimmel et al. 2017b). The retention force is individually set via the retention caps so that the patient can handle the prosthesis him- or herself. This must be clinically tested, as manual strength is often overestimated. Another challenge comes with reline impressions: we always remove the housings before the impression, as stud-type attachments are very sensitive to even subtle changes in height. Alternatively, the housings can be secured with a direct technique, which promises the best clinical results.

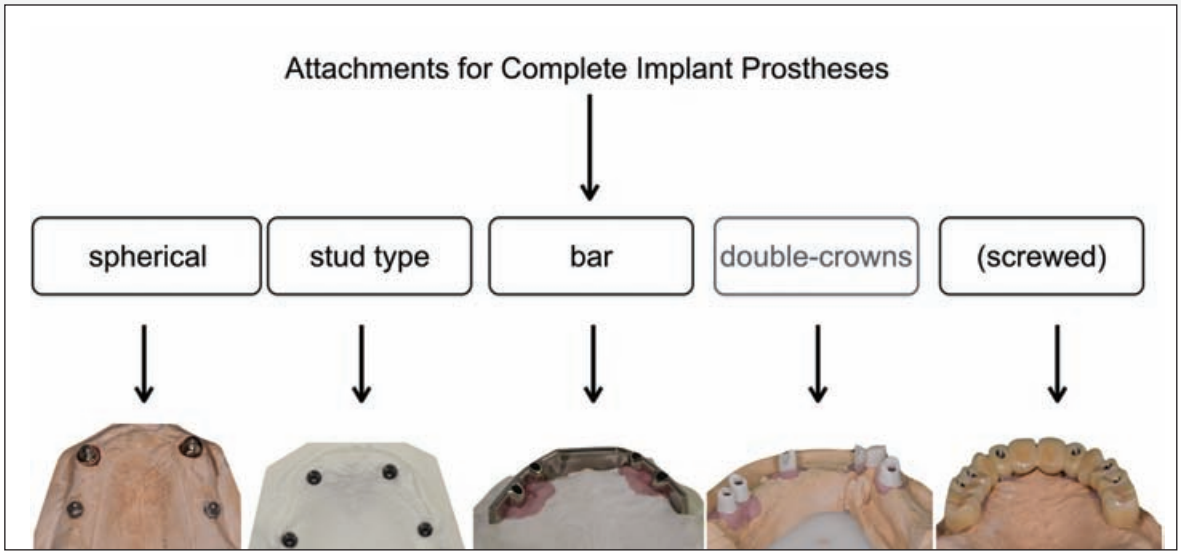

Figure 8: Examples of anchorage.

Figure 9: Distal implants in implant-assisted overdentures help to avoid a rotational axis by establishing quadrangular support. This reduces movement of the denture under function and improves the prognosis of the abutment teeth.

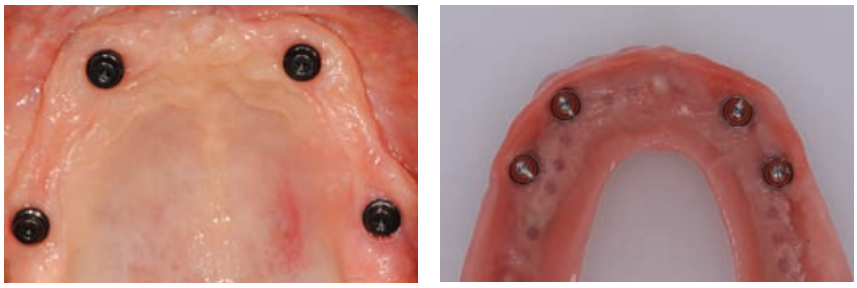

Figure 10a-b: Straumann Novaloc-retained removable prosthesis without a palatal plate where space is too limited for primary splinting. At least four implants are indicated.

Bar retention (removable prostheses)

In this era of CAD/CAM technology, we can mill highly individualized bars and could manufacture the bar clips with electroplating techniques for optimal results. However, given financial constraints and the demand for easily manufactured/maintained designs, the goal should be simplicity. Experience with the CAD/CAM-fabricated titanium parallel Dolder bar with distal extensions has been very positive at the University of Bern for many years (Fig. 11a) (Katsoulis et al. 2011).

At least two implants are required in the mandible and four or more in the maxilla (Kern et al. 2017); other concepts are still experimental with high rates of complications (Zembic et al. 2017). The implants are primarily splinted via the parallel-milled bar, also enabling the use of short implants in the maxilla. The minimum length of the retentive bar should be 20 mm to allow for adequate retention and horizontal stability.

One should bear in mind that the minimum height of the bar in the maxilla can significantly affect speaking. A minimum of 12 mm space from implant neck to incisal edge is recommended (Phillips et al. 2001), and an offset of 2 mm between the apical side of the bar and the mucosa has proved clinically valuable in maintaining correct hygiene and avoiding hyperplasia (Fig. 3a). Further attention should be given to not blocking the anterior third of the palate with the bar-overdenture, where the tongue forms consonants like "s", "l", "t" or "n". If there is still a large amount of alveolar

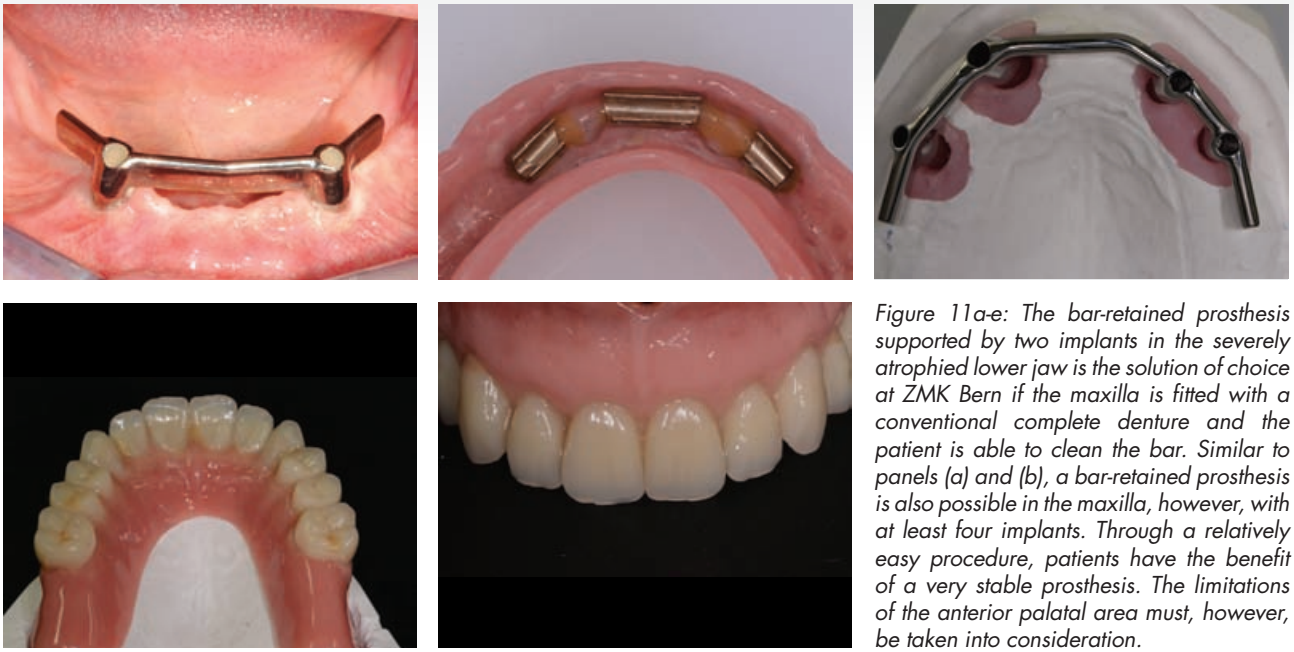

Figure 11a-e: The bar-retained prosthesis supported by two implants in the severely atrophied lower jaw is the solution of choice at ZMK Bern if the maxilla is fitted with a conventional complete denture and the patient is able to clean the bar. Similar to panels (a) and (b), a bar-retained prosthesis is also possible in the maxilla, however, with at least four implants. Through a relatively easy procedure, patients have the benefit of a very stable prosthesis. The limitations of the anterior palatal area must, however, be taken into consideration.

bone present, either another retention system must be chosen, or sufficient osteoplasty must be performed during implant surgery.

The bar is milled out of a solid block of titanium or CoCrMd alloy with increased stability relative to soldered gold bars, allowing for non-linear geometries that help respect functionally important anatomical areas, like the anterior third of the palate or the floor of the mouth. Also, there is no necessity for additional abutments, which helps to reduce costs and avoid potential technical complications.

Ideally, diagnostic steps for a bar-retained overdenture comprise a diagnostic set-up with critical appraisal of the available vertical and horizontal space. This is especially true for maxillary implant overdentures.

To anchor the milled bar, we prefer the appropriate prefabricated Dolder gold clips (C+M, Biel, Fig. 11b). These can be easily activated and deactivated and show very reliable retention over a long time (Kobayashi et al. 2014). Finally, the overdenture is finalized (Figs 11c–e); both pink and white esthetics can be individually adapted as desired. This therapeutic approach has many functional advantages and is well accepted by patients.

Double-crown retained prostheses (removable prostheses)

Double-crown, e.g. telescopic-crown, retained prostheses represent a valuable form of treatment with many advantages; for example, they can be easily converted, extended, and repaired, and are suitable for patients with limited manual dexterity. In addition, they allow the combined use of both natural dentition and implants in one jaw. There is now a wide variety of materials suitable for use with this indication, but only a few material combinations are well documented. The standard of care remains gold primary and secondary abutments, cast and electroformed, respectively. Another popular combination is zirconium dioxide primary with electroformed secondary crowns. Several recent reports also describe a complete CoCrMd primary-secondary-tertiary system (Kurzrock 2017). Modern subtractive and additive CAD/CAM manufacturing techniques are now expanding the horizon to a variety of new materials, e.g. PEEK or PEKK. However, only when long-term clinical experience is available will we know how these materials tolerate sustained use. One disadvantage is the high cost of manufacturing and the combination of various materials, although CAD/CAM technology (from milling to selective laser melting) promises lower costs in the future (Figs 12a–d).

Simple reconstructions using implants (fixed removable)

An efficient approach to fixed restorations for edentulous patients is the Straumann Pro Arch concept. This concept is the subject of an ITI-supported study at the Department for Reconstructive Dentistry and Gerodontology (ZMK Bern) and Queen's University Belfast, Northern Ireland. Patients

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Figure 12a-d: Clinically demanding situations, as with the tumor patient shown here, can be handled efficiently using CAD/CAM technologies.

receive four or six implants in the edentulous mandible on a randomized basis. Standard tissue level implants with a minimum length of 8 mm are used interforaminally. Ultra-short (4 mm) tissue level implants are used for posterior support. The idea behind this approach is to provide a fixed implant-supported prosthesis without inserting long implants at an angle or having to perform bone augmentation. Furthermore, it is often possible to avoid time-intensive and costly bone augmentation procedures. In addition, it would be easy to remove the four posterior implants should it be necessary to "downgrade" to an overdenture when the patient can no longer clean or handle the prostheses at an advanced age (Figs 13a–c).

Oral hygiene

When planning prosthetic implant therapy, the top priority is to facilitate oral hygiene. In this regard, removable prostheses have a clear advantage over fixed prostheses.

With patients whose manual dexterity is limited, unsplinted retaining elements (e.g. spherical attachments, or Novaloc™) are preferred. If oral hygiene can be assured by the patient, family, or nursing staff, an implant-supported bridge or bar-supported overdenture is possible, supported by a minimum of four implants. Space for cleaning must be ensured when designing fixed restorations (Figs 14a–b).

Materials

A great deal has changed in recent years with regard to materials for removable prosthetic restorations. The use of CAD/CAM technology allows for the use of numerous innovative materials (Fig. 15).

All-metal frameworks

The history of porcelain-fused-to-metal crowns is documented in detail. In addition to casting, frameworks are now also produced via machine milling and additive fabrication by means of laser sintering on a powder bed.

Metal-free frameworks

All-ceramic restorations on a high-strength zirconium-oxide framework have also become accepted as reliable. These offer an excellent fit thanks to CAD/CAM manufacturing processes. The current focus for framework materials is on high performance polymers that are generally thought to present many advantages. There is, however, a significant disadvantage that should be considered. To properly enable oral hygiene, restorations must be designed to allow easy cleaning (self-cleaning, inter-dental spaces for the inter-dental brush). Designing the framework to fulfill this need involves maintaining the distance to the gingiva, which can be difficult when using PEEK or PEKK. The materials'

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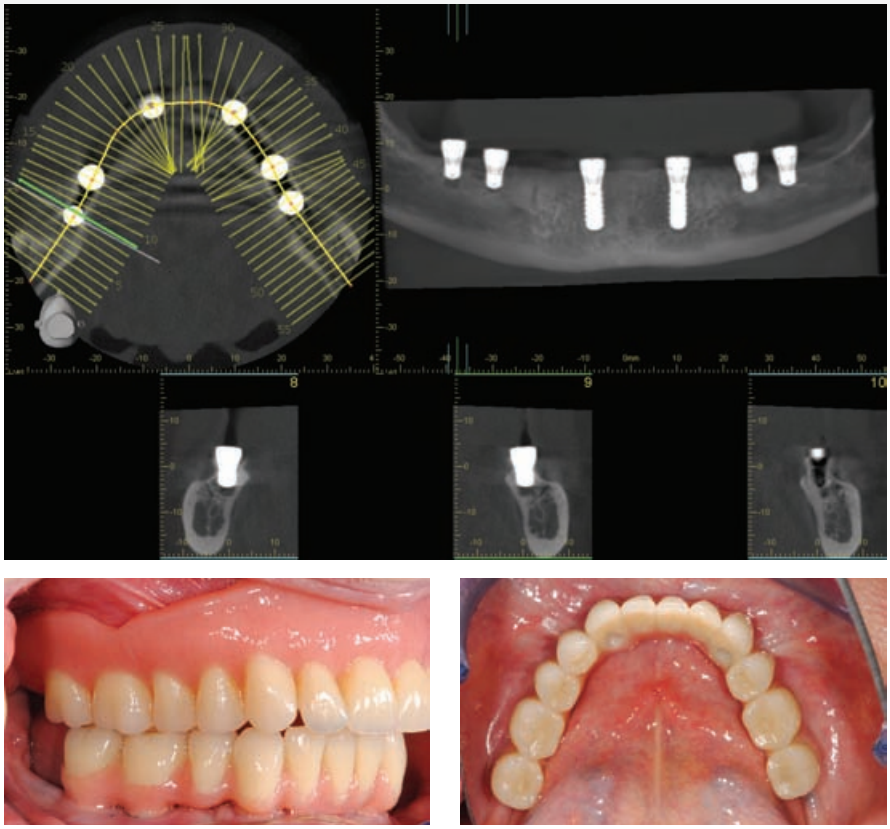

Figure 13a-c: Bone augmentation procedures can often be avoided by using the Straumann Pro Arch concept, even for fixed cross-arch prostheses. It is currently being investigated in a clinical study at the ZMK Bern, supported by the ITI Foundation.

characteristics make it difficult to maintain adequate dimensions for the framework. If this can be achieved, such polymers could be suitable for use in implant prosthetics (Fig. 16). The material has a certain elasticity, and is adaptable to a certain point compared to high-tensile material (Silla et al. 2016).

Esthetic finishing

According to the indication and the patient's wishes, lithium disilicate, zirconium dioxide, composite resins, or preformed teeth can be used for esthetic finishing. Once again, a customized restoration concept in combination with the needs of the patient are the primary points of consideration (Zimmermann et al. 2016). From experience, we know that wear must be taken into consideration when working with composites and/or synthetic teeth (Fig. 17). Pronounced wear leads to loss in the vertical dimension, accompanied by reduced chewing function. In such cases, depending on the load, the teeth must be replaced after several years (Balshi et al. 2016).

"Digital dentistry" for aging patients

Using new concepts, we are able to offer a variety of therapeutic options to patients in their third or fourth life phase. Digital solutions for the edentulous jaw are particularly patient-friendly; for instance, when using the digital workflow, depending on the situation and system, the number of appointments can be reduced (Schimmel et al, 2016). For example, patients who are very advanced in age often have difficulty getting used to a new prosthesis. In this instance, we can (e.g. using the AvaDent system, Global Dental Science Europe, Tilburg, Netherlands) simply copy the old prosthesis and use it as the basis for a new set of dentures (Figs 18a–c). Similarly, if a set of dentures is lost, it can be reproduced within a short time at no great effort.

It should also be noted that it is now possible to produce bar- or screw-retained implant-supported prostheses without a model following a completely digital workflow (Figs 19a–c).

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1. BISCO has, on file, the calcium release data for Theracal LC.
2. Gandolfi MG, Siboni F, Prati C. Chemical-physical properties of TheraCal, a novel light-curable MTA-like material for pulp capping. International Endodontic Journal. 2012 Jun;45(6):571-9.
3. BISCO, Inc. data on file.

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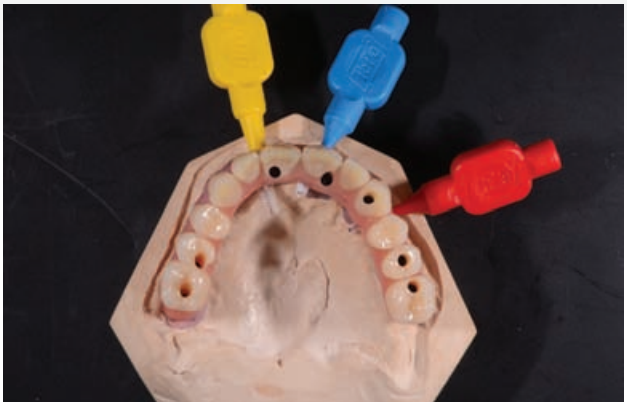

Figure 14a-b: Facilitated oral hygiene is a crucial component of geriatric dentistry. The restorations shown here are very demanding of patients and should only be realized in this form if the patient is still able to handle fine oral hygiene tools.

Figure 15: Dentistry today is characterized by the variety of materials available – this demands a broad knowledge of materials on the part of the dental technician.

Figure 16: New machine-processible materials, such as PEEK or PEKK, are accompanied by new characteristics that must, however, prove themselves over time.

Figure 17: Implant-supported fixed hybrid prostheses in a case with advanced resorption Cawood IV.

Conclusion

Many questions in implant dentistry remain unanswered as we face a rapidly aging society and frequently see patients who are advanced in age. Will patients be able to afford an implant-supported prosthesis? Are the boom years of well-funded pensions over? How will increasing life expectancy and the current discussions regarding pension funding be addressed (McKenna et al. 2015)? Already today, many older patients whose quality of life depends on a good prosthesis can only finance it thanks to financial support from third parties. Cost-efficient options will be required when moving forward. As in every other area of prosthetic dentistry, the edentulous patient should have the possibility to choose between various treatment options without having to sacrifice reconstruction quality. Whether the optimal solution involves removable complete dentures, a removable implant-supported prosthesis, or a fixed prosthesis, this area is an important component of reconstructive dentistry and should be given sufficient attention. The exacting partially dentate or edentulous patient in the future will spend more time consulting the practice and dental laboratory. Here, it is important to be able to supply a suitable concept for every need. In the end result, there is no better feeling for the dental team than to be able to provide patients with a functioning restoration that improves their quality of life.

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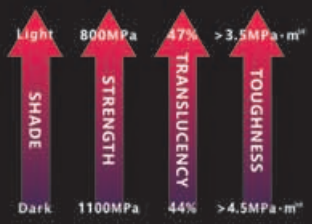

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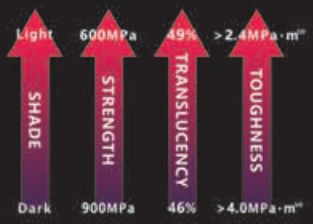

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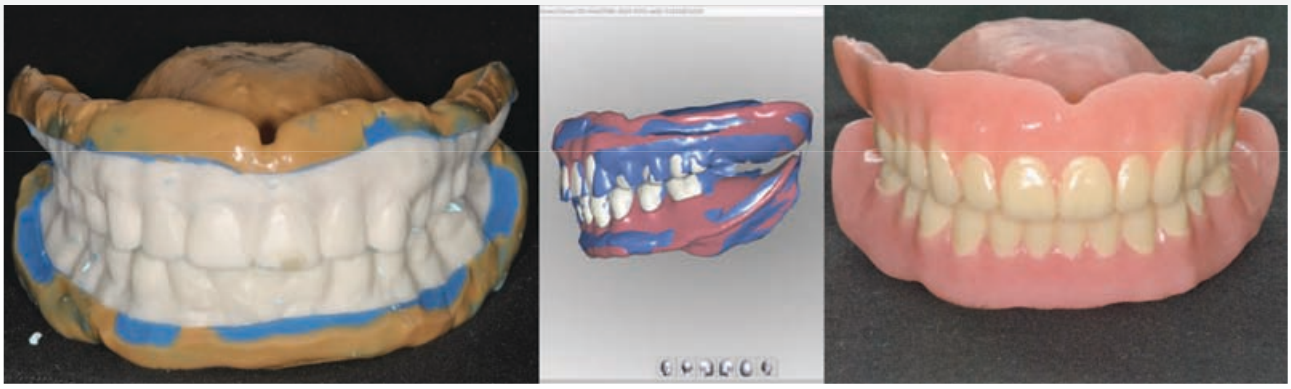

Figure 18a-c: Example of cost-effective option with a computer-aided workflow: complete copy denture using the AvaDent system. More processes are needed for the elderly patients of today and tomorrow that are light on the wallet and enable a more than adequate quality of life.

Figure 19a-c: The AvaDent system allows a complete denture to be transformed into a fixed supraconstruction by means of digital duplication techniques.

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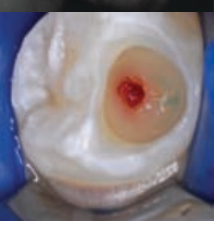

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PRESENTED BY PROF. P. VAN DER VYVER

75% practical tips and hands-on - 25% theory

MAX 10 DELEGATES
8 CPD POINTS

ENDO MODULE 1: 5th JULY 2019 - Mastering Endodontic Treatment on Maxillary Molars

This one-day hands-on course will allow you to conduct more successful Endodontics on maxillary molars with more precision and predictable results. Registrants will perform an endodontic treatment from start to finish on special plastic teeth with MB2 canals, using the latest equipment, endodontic materials and techniques.

What will be discussed and demonstrated?

- Anatomy and morphology of maxillary molars
- Placement of rubber dam in 30 seconds
- Pre-endo build-up using sectional matrix systems
- Modification of access cavities to increase the detection of MB2 canals
- Removal of pulp stones and calcifications
- Step-by-Step protocol to locate and negotiate MB2 canals
- How to prepare predictable and time saving glide paths
- How to manage moderate to severe canal curvatures during canal preparation
- Irrigation protocols to ensure adequate chemical debridement
- How to manage open apices using MTA
- How to use CBCT in the identification of periapical pathology and root canal anatomy when treating maxillary molar teeth
- Importance of coronal seal and how to ensure long-term success

If you are a beginner: after this course you will have more confidence in endodontically managing maxillary molar teeth.
If you are experienced: you will get a lot of practical tips that will enhance your workflow and manage more complex cases.

ENDO MODULE 2: 2nd AUGUST 2019 - Mastering Endodontic Treatment on Mandibular Molars, Premolars, Canines and Centrals

This one-day hands-on course will encourage you to conduct more predictable Endodontics on mandibular teeth with simple and complex anatomy. Registrants will perform endodontic treatment from start to finish on one extracted premolar (or canine or central) and molar using the latest equipment, endodontic materials and techniques.

What will be discussed and demonstrated?

- Anatomy and morphology of Mandibular Molars, Premolars, Canines and Central Incisors
- Clinical steps to discover the mid-mesial root canal system in molars
- Clinical steps to discover the multiple canals in premolars, canines and incisors
- Instruments required to manage mandibular teeth with multiple canal systems
- The benefit of CBCT for complex anatomy
- Rubber dam isolation for mandibular teeth
- Review of glide path preparation, root canal preparation, irrigation protocols and obturation

If you are a beginner: after this course you will have more confidence in endodontically managing mandibular teeth.
If you are experienced: you will get a lot of practical tips that will enhance your workflow and manage more complex cases.

ENDO MODULE 3: 4th OCTOBER 2019 - Mastering Endodontic Treatment on Maxillary Anterior Teeth and Premolars (including Apexification, Apexogenesis, Revascularisation and Pulp Capping)

This one day hands-on course will allow you to conduct more successful Endodontics on maxillary centrals and teach you how to deal with open or immature apices with more precision and predictable results.

Registrants will perform an endodontic treatment from start to finish on one extracted central incisor, perform a pulp cap and apexification procedure using the latest equipment, endodontic materials and techniques.

What will be discussed and demonstrated?

- Anatomy and morphology of maxillary central incisors and premolars
- How to re-attach fractured fragments
- Apexification vs. apexogenesis vs. revascularisation
- Step-by-step protocol on how to close an open apex
- Direct pulp capping using MTA - instruments and techniques
- Root canal preparation instruments for large canals
- Management of calcific metamorphoses

If you are a beginner: after this course you will have more confidence in endodontically managing maxillary incisors and premolars with normal anatomy and teeth involved in trauma.
If you are experienced: you will get a lot of practical tips that will enhance your workflow and manage more complex cases.

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RESTO MODULE 1: 19th & 20th JULY 2019
Posterior Direct Restoratives

Direct restorative procedures have a significant impact on the profitability of a restorative dental practice. By mastering the critical steps in different procedures, clinicians can deliver greater efficiency, more predictable outcomes and overall patient and clinician satisfaction. This module will deal with direct restorative procedures that form approximately 68% of all procedures in the general dental practice.

What will be discussed and demonstrated?

Hands-on Sessions

- Rubber Dam isolation for restorative dentistry
- Place a fissure sealant on an extracted tooth after air polishing
- Tips for predictable cavity preparation
- Practice the step-by-step protocol on the build of the correct anatomy for Class 1 restorations
- Practice the modified occlusal stamp technique
- Practice the placement of a Class V restoration using a direct and direct-indirect technique
- Practice a Class II restoration and learn tips and tricks for matrix management

Additional Demonstrations

- Resin infiltration (icon technique)
- Ideal cavity preparation for Class II restorations
- Clinical steps to manage a pulp exposure with MTA
- Matrix modification for deep subgingival Class II preparation

Entry Requirements for courses:
BChD, BDA or equivalent qualification.
Course Fees: R2,500 per module

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rene.catchpole@dentsplysirona.com or **Tel: 066 473 6415**
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RESTO MODULE 2: 20th & 21st SEPT 2019
Class IV and Indirect Restoratives

Direct and indirect aesthetic restorative procedures have a significant impact on the profitability of a restorative dental practice. By mastering the critical steps in different procedures, clinicians can deliver greater efficiency, more predictable outcomes and increase overall patient and clinician satisfaction. This module will deal with more advanced direct restorative techniques and single unit indirect restorations that total approximately 48% of the total revenue of a restorative general practice.

What will be discussed and demonstrated?

Aesthetic Class IV restorations

- Direct build up
- Matrix technique
- Injection moulding technique
- Cavity preparation principles
- How to hide the fracture line in Class IV restoration
- Anatomy and polishing techniques for optimal results
- Direct-indirect composite veneer technique for peg shaped laterals
- BioClear matrix technique for Class II and IV restorations
- Tooth fragment re-attachment - materials and techniques

Single Unit Crowns and inlays/onlays

- Indications and guidelines for core build up procedures
- Preparation guidelines for crown preparations
- Tissue management procedures
- Impression techniques:
  - Putty wash technique
  - Sandwich technique
  - Injection moulding technique
  - Wafer impression technique
- Temporary crown and bridge materials
- Cementation protocol for inlays, onlays and crowns

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Short cut in the digital fast track

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Kyung-Sik Park

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242, Gangseo-ro, Gangseo-gu
Seoul, South Korea
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Introduction

The shape of an anterior restoration significantly influences the symmetry of the gingival contours. Provisionals that have proved to be suitable both in terms of their function and esthetics allow permanent restorations to be precisely manufactured with the help of digital methods.

Unfavourably positioned teeth and/or an asymmetric contour of the soft tissue represent a considerable challenge in the already difficult anterior zone. In order to achieve a natural-looking result, the shape and shade of the restoration have to be suitably matched to the remaining teeth and, furthermore, the soft tissue needs to be properly conditioned. In many cases, provisional restorations are initially used by the dental team so that the special requirements of the gingiva can be effectively addressed.

Case Study

The 33-year-old patient consulted our practice about having defective dental braces removed after three years of orthodontic treatment. He asked us to treat the carious lesions in his teeth and enhance the appearance of his smile. The first esthetic analysis revealed an unfavourable length-to-width ratio of the anterior teeth (Fig.1). As a result, the patient wished to have his front teeth lengthened. The upper left canine had to be endodontically treated due to advanced necrosis of the pulp t issue.

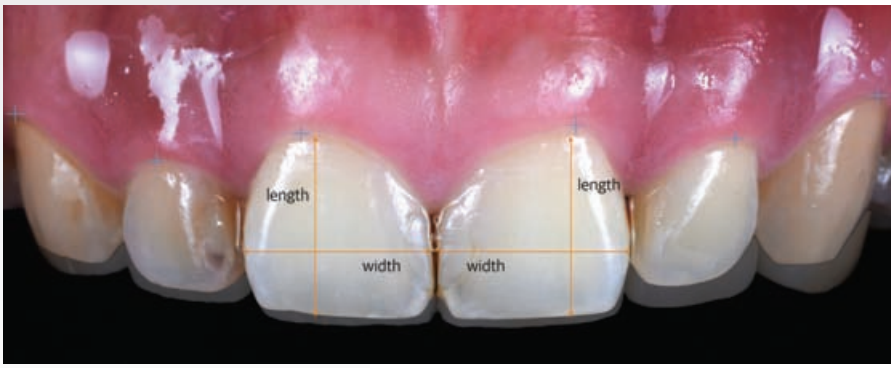

Figure 1: Fig 1: Preoperative view.

Figure 2: IPS e.max Press Multi ingot shade A2.

Figure 3: Situation after the removal of caries lesions and root canal treatment

Figure 4: Provisional composite resin restorations for evaluating their function and esthetics.

Figure 5: Final preparation of the teeth.

Planning

Our plan was to reconstruct the upper anterior teeth. In choosing the most suitable material for the restorations, we had to take into account the fact that the patient enjoyed eating hard nuts. Furthermore, he reported that he had a habit of grinding his teeth at night and clenching his jaws. Consequently, the anterior crowns would have to be not only functional and esthetic, but also very strong and tough. We planned to use six all-ceramic crowns to optimize the length-to-width ratio (tooth lengthening) and even out the gingival contour.

Manufacturing technique and selection of the materials

In order to minimize the risk of fracture of the ceramic restorations, we decided to use IPS e.max Press lithium disilicate ceramic, which demonstrates a high toughness of 470 MPa as well as excellent esthetics. In addition to the monochrome press ingots, this ceramic system includes a polychromatic material (Fig.2). IPS e.max Press Multi ingots are used to fabricate highly esthetic monolithic restorations that do not need any characterization. They feature a lifelike progression of the shade and translucency between the

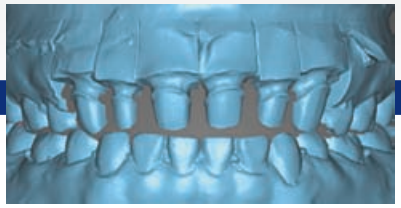

Figure 6 Scanned data of the final preparation.

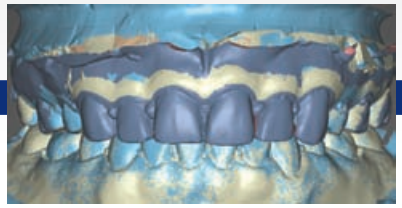

Figure 7: Superimposed scanned data of the prepared model and the model with the provisional crowns.

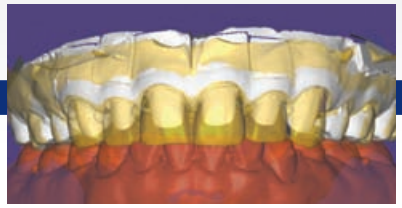

Figure 8: Slight adjustments during the design phase.

dentin and incisal areas.

The press technique, which involves the use of a full-contour wax-up, offers a quick and uncomplicated method of manufacturing crowns. Moreover, the press technique allows us to reproduce delicate gingival contours with utmost precision. In restorations that are built up in layers, the ceramic sometimes shrinks, making it difficult to accurately replicate the gingival contours of the provisionals. In our opinion, the IPS e.max Press Multi ceramic has two decisive advantages. First of all, its true-to-nature shading imitates that of natural teeth in the cervical and in the incisal region. In contrast to the restorations pressed with monochrome ingots, the polychromatic restorations require less time and effort to fabricate, since they do not have to be customized with layering ceramics in the incisal region. Secondly, IPS e.max Press Multi has just the right translucent properties to allow the necessary transmission of light .

Clinical treatment

First, endodontic treatment was performed and the carious lesions were removed. The teeth were then restored with composite fillings. The front teeth requiring treatment were suitably prepared (Fig. 3) and the provisional crowns were placed (Fig. 4).

The right lateral incisor was lengthened. The provisional crowns helped to support the gingival contours and establish a symmetric appearance. Once the desired symmetry of the teeth and gingival tissue was attained, the teeth were prepared for the permanent restorations (Fig. 5) and impressions were taken.

CAD/CAM processes in the fabrication of restorations

Prior to the removal of the provisional crowns, additional precision impressions were taken. In the laboratory, the data of the preparation models and the provisional crown models was captured using the double scan method. The digital data sets were superimposed on each other. The abutment teeth were separated and the margins and contours were adjusted (Figs 6 to 8).This approach allowed the shape of the provisional crowns to be exactly replicated.

We focused on recreating the subgingival contours, which support the oral soft tissue, so that the restorations would not have to be individually adjusted in the dental office. The crowns were milled from a dimensionally stable wax disc. ProArt CAD Wax yellow was used in the present case (Figs 9 and 10). This material is specially designed for use with IPS e.max Press. The smooth surfaces of the wax ensure precision results and high accuracy of fit. The material burns out without leaving any residue. Up to this point, it was possible to reduce the manual work to a minimum.

Spruing and pressing

In the next step, the wax crowns were reproduced with a pressed ceramic (IPS e.max Press Multi). For the investment procedure, the milled wax crowns were attached to a special prefabricated precision wax component (IPS Multi Wax Pattern). At this stage, it is import ant to make sure that the attachment joint is not too thick and that it is aligned with the labial surface. This helps to accentuate the unique shade gradations of the material. The wax restoration attached to the Wax Pattern was subsequently secured in the slot of the IPS Multi investment ring base. The position of the sprues was checked with the help of the IPS Sprue Guide (Fig. 11). The shade progression within the crown can be adjusted as required. For example, if the incisal portion should be more pronounced, the Wax Pattern is simply moved downward on the investment ring base (max. 2 mm). The preheating, pressing and divestment steps were carried in the customary

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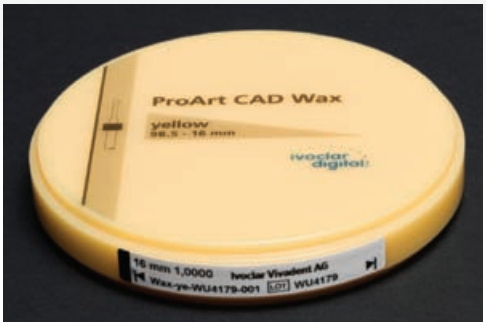

Figure 9: ProArt CAD Wax yellow disc.

Figure 10: CAD/CAM-manufactured full-contour wax crowns.

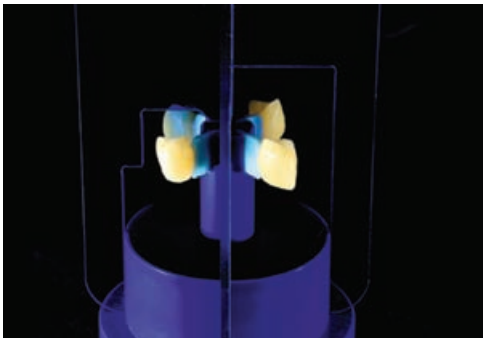

Figure 11: Full-contour wax crowns attached to the IPS Multi investment ring base and verification of the position of the wax crowns with the help of the IPS Sprue Guide.

Figure 12: Completed crowns on the model.

way and in line with the instructions of the manufacturer.

Finishing

The pressed restorations can be adjusted if desired in order to accentuate certain individual characteristics. In the present case, the unglazed restorations were tried in the patient's mouth before the stains and glaze firing. At this stage, most of the clinically important properties were clearly recognizable: tooth axes, suitable pressure on the adjacent soft tissue (e.g. papillae and gingival contour), harmony of the lip line and incisal edges as well as the symmetry of the crowns. The patient was satisfied with the optimized length-to-width ratio of the teeth. The main aim now was to reproduce this situation with utmost precision. The inter-occlusal record was sent to the laboratory in order to minimize the work involved in the adjustment of the occlusion.

The surface texture of the IPS e.max Press Multi crowns was created with suitable grinding instruments before the glaze firing cycle. The restorations were then characterized with IPS Ivocolor® stains (copper, white and anthracite) and glazed. The crowns were manually polished to the desired brilliant sheen (Fig. 12).

Placement

The excellent collaboration of the dentist, dental technician and the patient paid off: The restoration was swiftly placed in the practice without having to make any further adjustments. The clinical situation which was created on the model and with the help of provisional restorations could be successfully reproduced in the permanent restoration (Fig.13). The patient and the dental team were highly satisfied with the result. The entire treatment process was straight forward and efficient.

Result

One month later, the teeth and gums looked beautiful and healthy without any inflammation (Figs 14 and 15).

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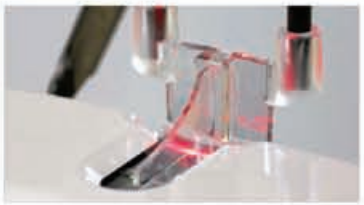

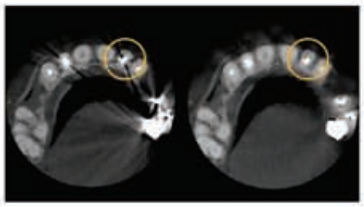

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Figure 13: IPS e.max Press Multi restorations immediately after placement.

Figures 14 and 15: Result after one month in situ.

Digital workflows minimize efforts but maximize esthetics. The possibility of replicating the subgingival contours of the provisional crowns allowed a variety of modifications to be made during the treatment process. The IPS e.max Press Multi material itself offers an impressive array of esthetic properties. If a restoration requires even more individualized characteristics, the incisal area can be built up with IPS e.max Ceram layering materials (cut-back technique). The presented process shows that the traditional press technique combined with CAD/CAM methods offers a wide variety of benefits and provides a basis for new and innovative applications. The discovery of further creative uses involving a combination of these two techniques is only a question of time.

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Injection moulding with composite to obtain a predictable aesthetic outcome

Ali Salehi[1]

Introduction

Using the injection moulding technique, composite restorations are created by injecting the composite into a silicone key that is directly positioned into the patient's mouth. The main advantage of this technique is that restorations can be first modelled in wax on a stone model, and then copied and transferred in detail to the natural teeth.

For complex morphologies, challenging aesthetic cases or cases requiring reestablishment of the occlusal vertical dimension, a predictable result can be obtained and chair time reduced with this relatively simple procedure. Adjustments can also be made afterwards if needed. Because these restorative treatments usually comprise extensive surfaces, the composite used should be strong and wear resistant enough and also offer the desired optical properties. G-ænial Universal Injectable is an ideal product for this indication thanks to its great thixotropy and excellent mechanical & aesthetic properties.

Case report

A 34-year-old, pregnant woman came to the dental office with the request to improve the aesthetic appearance of her smile. Her chief complaint concerned the shape of the lateral incisors (Fig. 1-2). She had already undergone a bleaching treatment and two veneer-lays on the heavily discoloured teeth 14 and 15, due to endodontic treatments covered with voluminous amalgam restorations in the past. After explaining the different

options, she decided to go for a treatment with direct composites because of financial reasons and the idea of the minimally invasive nature of the procedure.

A wax-up was made of the desired tooth morphology that had been defined in consultation with the patient (Fig. 3). Next, a non-perforated metal impression tray was filled with a transparent vinyl polysiloxane material (EXACLEAR, GC) and placed over the stone model with the wax-up (Fig. 4-5). The tray's only purpose being to be used as a mould to create the key, a full-arch tray with a smooth inner surface was selected so that the silicone could be retrieved easily in its whole and without damage

[1] Dr. Ali Salehi, France
Dr. Salehi graduated in 2007 as a Master in Dentistry at the Faculty of Dental Medicine of Strasbourg University, France. He completed an Erasmus internship at the Faculty of Dentistry of the Johannes Gutenberg University in Mainz, Germany. From 2008 - 2015, he was a clinical consultant at the Department of Prosthetics of the University of Strasbourg. and became a part-time Clinical-University Assistant in the same department in 2015.
Dr Salehi also maintains a private practice in Strasbourg.

Figure 1-2: Initial situation.

(Fig. 6-7). Care was taken not to press too hard, so that all incisal edges were covered with a sufficiently thick layer in order to avoid potential tearing or deformation which could lead to a bad reproduction of the wax-up in the mouth of the patient. The tray was sufficiently filled to cover all teeth, up to the second premolars.

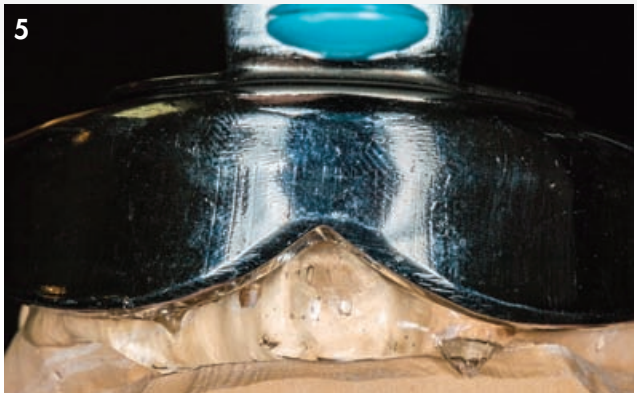
As a rule of thumb, the silicone key should always extend so far that it includes at least two teeth distally from the teeth to be treated on both sides; this ensures stability of the key when it is positioned in the mouth and a proper reproduction of the aesthetic project for a more predictable final result. In this regard, it should be noted that in a more ideal situation, a rubber dam could be used. In this case, the teeth should be sufficiently exposed through the dam and the clamps placed distally enough to avoid interference with the key. The latter should be trimmed cervically to allow proper seating without any tension between the key and the rubber dam.

A fine, needle-shaped bur was used to drill the holes in the key through which the composite will be injected (Fig. 8). These holes were positioned at the middle of the incisal edge of each tooth, half-way between the distal & mesial borders, and made as small as possible but large enough to enable the tip of the composite syringe to pass easily and completely (Fig. 9). Care was taken not to damage the vestibular part inside the silicone key with the bur, to maintain the information of surface texture that had been created during the wax-up. This will guarantee a proper transfer and respect the idea of a predictable final aesthetic result.

After cleaning, the procedure was started with a central incisor. The neighbouring teeth were isolated with Teflon tape (Fig. 10). Then, the enamel was etched (Fig. 11) to create extra micromechanical retention, carefully rinsed and dried. A frosty appearance of the surface was obtained (Fig. 12). A universal adhesive (G-Premio BOND, GC) was applied, left undisturbed for 10 seconds and thoroughly dried with maximum air pressure for 5 seconds before lightcuring (Fig. 13).

Next, the silicone key was positioned onto the teeth and the composite was injected (Fig. 14). G-ænial Universal Injectable (GC), shade A1 was selected for the procedure because of its high filler load and wear-resistance. The syringe was placed in the hole and slightly orientated towards vestibular. During the injection, a little bit of overflow is needed to ensure that all small voids at the

Figure 3: A wax-up was made in consultation with the patient.



Figures 4-7: A metal impression tray was filled with transparent vinyl polysiloxane (EXACLEAR, GC) and used to copy the stone model with the wax-up.

margins and interproximal spaces are filled. This can easily be verified through the transparent key (Fig. 15). Next, G-ænial Universal Injectable was light-cured through the transparent silicone. After removal of the key, the excess was taken out with a surgical scalpel blade (blade #12, Swann-Morton; Fig. 16). Further finishing was done with a flame-shaped bur at the cervical margin, to correct any possible overcontouring, (Fig. 17) and with metal strips (New Metal Strips, GC) interproximally (Fig. 18). Metal strips are more rigid than transparent ones, which makes them more efficient

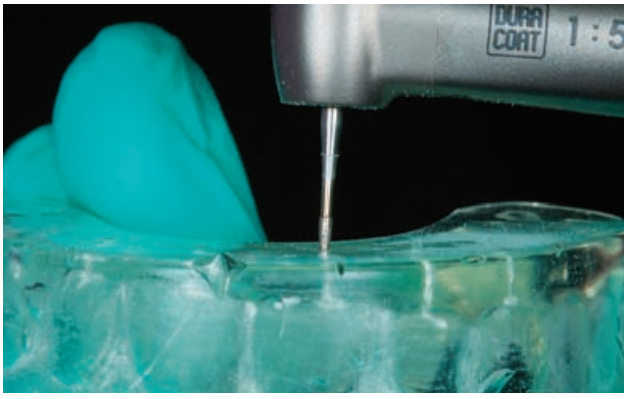


Figure 8: A needle-shaped bur was used to drill holes through the silicone key ending in the middle of the incisal edge.

Figure 9: It was checked whether the holes were large enough to enable the tip of the composite syringe to pass easily and completely.

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Figure 10: Neighbouring teeth 11 and 22 were isolated using Teflon tape.

Figure 11: The enamel of tooth 21 was etched to enhance micromechanical retention.

Figure 12: After etching, the enamel surface showed a matt appearance.

Figure 13: The universal adhesive G-Premio BOND (GC) was applied in accordance with the manufacturer's instructions and light-cured.

and easier to use. Note that even though some bleeding might occur during this stage, finishing and polishing should be carried out thoroughly as smooth margins will help the gingiva to heal faster but also maintain the gingival health over time. The same procedure was repeated on the other incisors and the canines (Fig. 19-20).

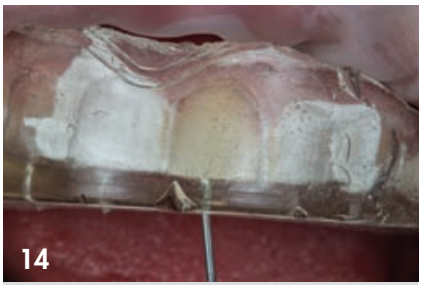

Figure 14: G-ænial Universal Injectable (GC) was injected into the silicone key.

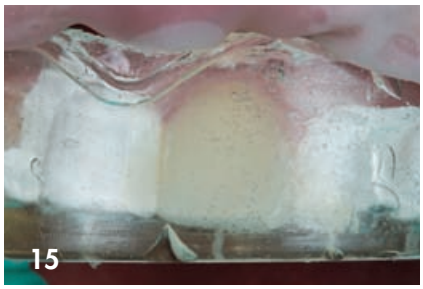

Figure 15: Due to the high transparency of the key, it can be visually checked if a sufficient amount of composite has been injected to cover the entire surface. The composite can also be easily light-cured through the key.

Figure 16: The excess was removed with a scalpel (blade #12). Due to the presence of the Teflon tape, the excess did not stick to the neighbouring teeth and it was easy to remove.

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Figure 17: A flame-shaped finishing bur was used.

Figure 18: Interproximally, the margins were finished with metal strips.

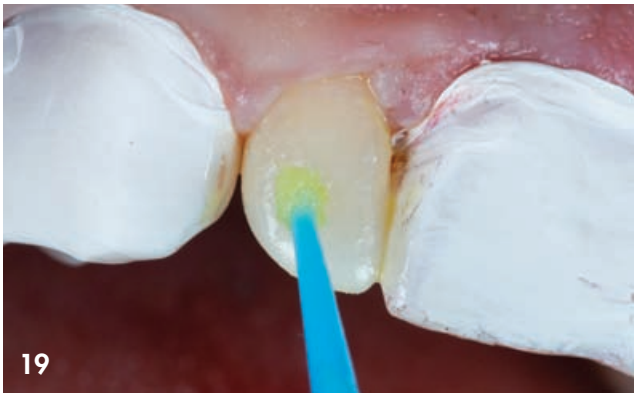

Figure 19: The same procedure as shown for tooth 21 was repeated for the other teeth. Application of G-Premio BOND on tooth 12.

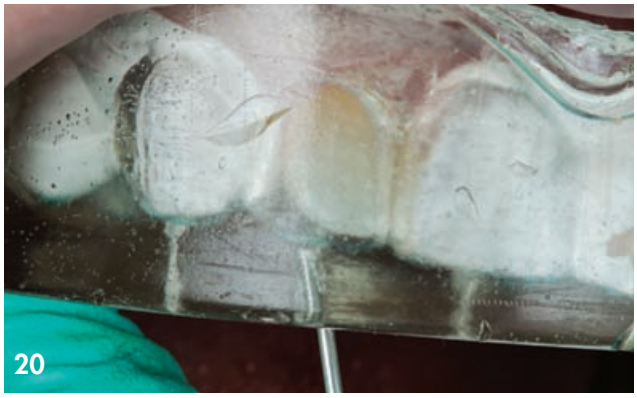

Figure 20: Injection of G-ænial Universal Injectable (GC) into the EXACLEAR key.

Figure 21-22: Result immediately after curing the composite.

Immediately after, it can be seen that the surface texture of the wax-up was transferred in detail to the direct veneers in the oral cavity, which gives the teeth a very natural and lifelike appearance (Fig. 21-22). Three days after the treatment, the gingival tissue had healed entirely (Fig. 23-25). In the recall session one week later, the surface was

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Figure 23-25: Gingival healing 3 days after the treatment.

Figure 26-28: Final polishing was done at the recall session.

Figure 29-30: Result after final polishing.

polished again with soft rubbers and cotton wheels with polishing paste (DiaPolisher Paste, GC) (Fig. 26-28), to enhance the gloss while preserving the texture (Fig. 29-30).

The injection moulding technique is an easy approach that allows to plan restorations with complex morphology in advance and copy them in a predictable manner to the clinical situation. Even the surface texture can be copied from the wax-up, which saves valuable chair-time. In order to have a long-lasting result, the composite needs to have good mechanical properties. Considering the interesting properties of G-ænial Universal Injectable, being even stronger than many paste composites, it can be safely used for that purpose.

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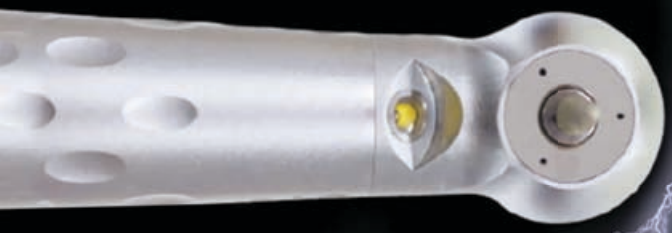

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Active care bleach: infiltrate and restore

Jordi Manauta[1]

Case details

Bleaching is no longer a vanity procedure. For many years, the benefits of non-invasive techniques have been proven to deliver amazing results, when the indications are followed correctly. The use of bleaching therapy to diminish and treat white spots is not without controversy, being rejected by some but adopted by many others.

The infiltration technique has been widely proven to eliminate unsightly enamel spots, if the depth is correctly evaluated and the indications are followed correctly; for example, in deep lesions, infiltration used in isolation is likely to be ineffective.

In the author's experience, bleaching of white and amber spots before treatment has been a winning strategy and the following points have been noted:

1. Amber spots. Generally, these turn into white spots, which are more susceptible to the acid treatment of infiltration therapy
2. White spots. Two phenomena happen in these cases. The first is a reduction in opacity due to a balance in the refraction index of the disarranged prisms. The second is that little or no bleaching occurs to the white spot. This enables it to blend better due to the low contrast between the newly bleached surrounding tissues and the white spot itself.

[1] Jordi Manauta graduated cum laude in dentistry from UNITEC (Universidad Tecnológica de México) and was apprentice to Dr Miguel Angel Tamés (Mexico) and Dr Walter Devoto (Italy). He holds Operative and Aesthetics Dentistry Master in UIC (Universitat Internacional de Catalunya) in Barcelona and is visiting professor in Siena and Marseille Universities. Author of the book, Layers (Quintessence, 2012) and Scientific consultant for two European journals, Jordi has authored and co-authored many publications in international journals. He works full-time in his private practice.

Figure 1: Initial evaluation of the patient, a 23-year-old woman, who was very dissatisfied with the present situation and the aggressive treatment option she had been recommended.

Figure 2: A cross-polarised picture is taken to better assess the extent of the lesion. Transillumination is used to estimate the depth of the lesion (not shown). It is decided to start a bleaching therapy to try and minimise the contrast between the spots and the tooth, and to bleach the amber spots

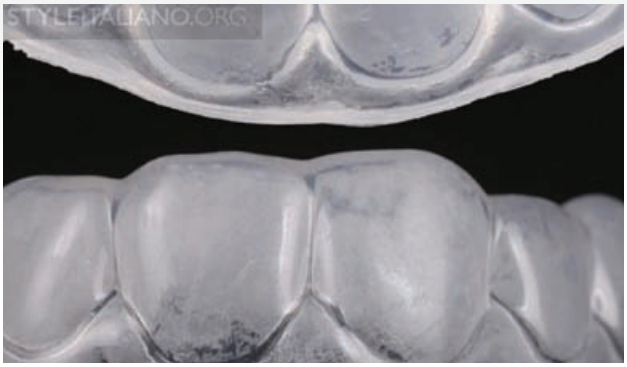

Figure 3: Bleaching trays must be extremely precise, cervical sealing must be perfect in order to keep the bleaching product in place and away from intraoral moisture

Figure 4: Fitting of the bleaching tray. The selected bleaching therapy was carbamide peroxide 10% for 20 days (White Dental Beauty, Optident) worn overnight. No sensitivity was reported; we are increasingly seeing this phenomenon with the new generation of products

Figure 5: After 20 days bleaching. Picture with lateral flashes

Figure 6: Cross-polarised image showing the latest situation. Some spots have vanished, the amber spots have turned white and other spots have softened in saturation

Figure 7: Adjacent comparison, note the amber spot

First-choice treatment

Bleaching should be a mandatory resource before stain treatment and restorative therapy. There is little awareness in the profession of the benefits of bleaching and some of the harmless side effects are also feared.

Infiltration therapy should be a first-choice treatment, together with bleaching for these cases. Icon Dry, which is used as a preview of the resin filtration after erosion, should be applied for two minutes to obtain proper visual assessment. Icon infiltration resin has to penetrate completely and a three-minute application is advised.

Figure 8: Mirror-like comparison

Figure 9: Mirror-like comparison of before bleaching (lower) and after (upper) with deep-view contrast

Figure 10: Post-bleaching evaluation, the patient starts treatment with resin infiltration. The first step is to isolate using rubber dam

Figure 11: 15% hydrochloric acid application for two minutes (Icon Etch, DMG, Germany). This step can be repeated up to four times. Increasing application frequency runs the risk of deeply eroding the teeth from intraoral moisture

Figure 12: Air drying, note how the spots become tremendously white

Figure 13: Treat with alcohol (Icon Dry, DMG, Germany). Manufacturer suggests a 30 second application of this agent. This is the result after 30 seconds

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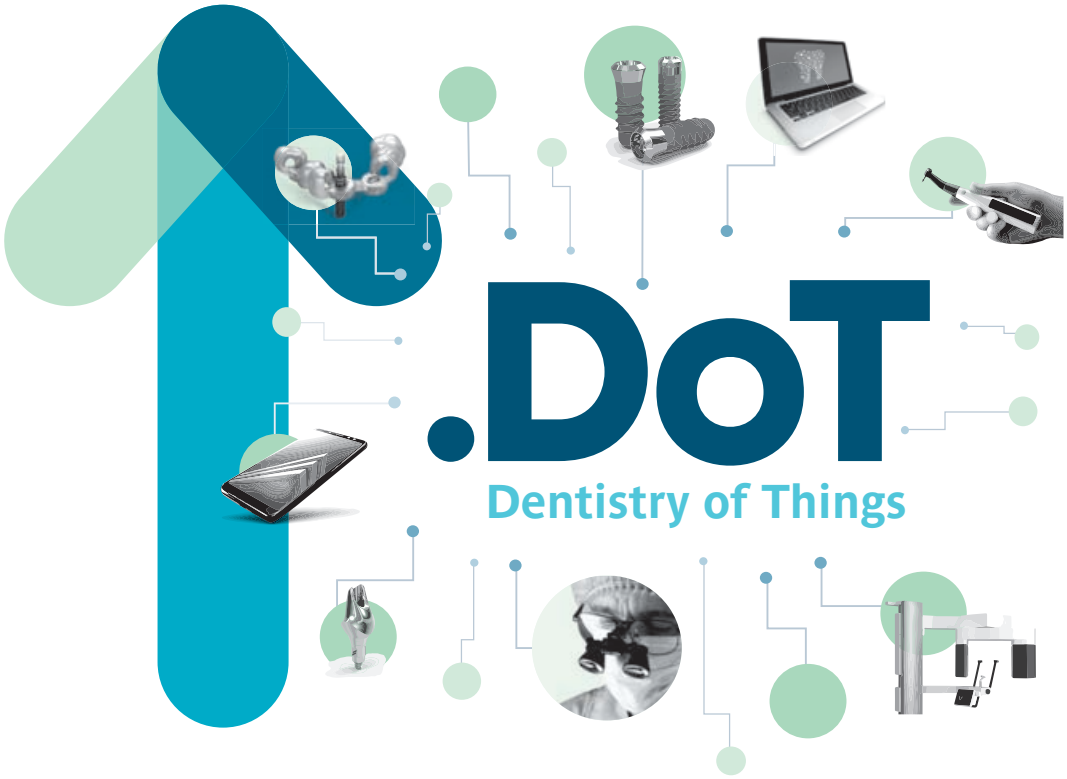

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Figure 14: In the author's experience, this product applied for two minutes gives a better penetration and thus a better preview of the real outcome. At this stage, the clinician should decide whether to repeat the full erosion cycle or start the resin infiltration

Figure 15: Air drying of alcohol is very easy and, if the previous step was successful, infiltration can begin

Figure 16: Erosion is visible, especially when completing four cycles or more

Figure 17: Resin infiltration. The resin has extremely low density and is solvent free and therefore able to penetrate as much as the alcohol. It is advisable to keep the lights low and allow the material to penetrate for about three minutes; failure to do so may result in an incomplete infiltration and a different result than the one obtained in the preview with Icon Dry

Figure 18: After infiltration, a small layer of enamel is placed to cover up the erosion caused during therapy

Figure 19: Polishing is mandatory with or without the use of a final composite layer

Figure 20: Final result after three weeks

Figure 21: Cross polarisation image shows a good result, which is not excellent, but not visible to the naked eye

Figure 22: Deep-view contrast of the final situation (increase in contrast, decrease in brightness of the digital image) helps in analysing the picture and allows a true assessment of the remaining lesions

Figure 23: Deep-view contrast of the initial situation dry

Figure 24: Mirror-like comparison of before (lower) and after (upper) treatment

Figure 25: A similar case was planned to be treated in the same way, but after 30 days bleaching, all the spots had disappeared (digital mock-up, right-hand side shows before the treatment, left-hand side shows after treatment)

CPD QUESTIONNAIRE 9.3.1

Article: Cusp replacement with an extensive posterior direct restoration using a nanohybrid bulk-fill ormocer. Manhart, page 6

1. *According to the author, what is becoming the first choice for many dental practitioners for the restoration of posterior defects:*

a Glass-ionomer cement
b Direct resin-bonded composites
c Amalgam

2. *What, according to the author, is considered to be the gold standard for placing light-curing composite materials:*

a Incremental layering
b Stratified layering

3. *In the case described, the patient requested the replacement of the composite restoration in which tooth?*

a LR6 b UL6
c UR6 d LL6

4. *Which statement is correct. Any areas of cavity that appear dull are an indication that:*

a An insufficient amount of adhesive has been applied to those sites.
b Too much adhesive has been applied to those sites

5. *Which statement, according to the author, is correct:*

a Composites show a certain viscoelastic recovery from distortion
b Amalgam shows a certain viscoelastic recovery from distortion

Article: A pictorial essay illustrating the root to crown concept using a single-file preparation system and CAD/CAM technology. Van der Vyver et al, page 26

6. *Key benefits of digital impressions include the following:*a a

a Elimination of impression tray selection
b Immediate correction of inadequacies
c Elimination of mixing of material and bite registration
d All of the above e None of the above

7. *In the case study described the micro- glide path was produced by which instrument?*

a Size 10 K-File b Size 15 K-File
c ProGlider d WaveOne Gold Glider
e None of the above

8. *True or False. Core-X dual-cure core build-up material can be used for post cementation as well as core build simultaneously.*

a True b False

9. *In the case study described the glide path was expanded by which instrument?*

a Primary WaveOne Gold File b WaveOne Gold Glider
c Size 10, 15 and 20 K-File d None of the above

10. *Which statement is correct.*

a Direct restorations are still the preferred restorative method on most endodontically treated teeth.
b Indirect restorations are still the preferred restorative method on most endodontically treated teeth.
c Neither of the above

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CPD QUESTIONNAIRE 9.3.2

Article: Prosthodontic solutions for elderly patients.
Buser et al, page 32

11. Which statement is correct. Consequences of the aging process include:

a Pain related to teeth or dentures affecting food intake
b The ability to chew, swallow, and interact
c A negative effect on social interactions and self-esteem
d All of the above
e None of the above

12. In the United States alone, what percentsage of the total adult population is estimated to be edentulous:

a 5%
b 10%
c 15%
d 20%

13. Which statement is correct. "Soft" factors when dealing with elderly patients include:

a Physical or psychological illness
b The loss of a partner
c Use of medication
d All of the above
e None of the above

14. What is often the first choice for partially dentate patients

a Classic crown or bridge restorations
b implant supported dentures.
c Clasp-retained dentures

15. For edentulous patients, it is recommended to retain an overdenture with at least:

a Two implants in the mandible and four in the maxilla
b Four implants in the mandible and two in the maxilla
c Four implants in the mandible and four in the maxilla
d Two implants in the mandible and two in the maxilla

Article: Prosthodontic solutions for elderly patients.
Buser et al, page 32

16. The advantages of double-crown retained prostheses include:

a They allow the combined use of both natural dentition and implants in one jaw
b They are suitable for patients with limited manual dexterity
c they can be easily converted, extended, and repaired
d All of the above

17. In bar-retained prostheses, what is the recommended minimum space from implant neck to incisal edge

a 20mm
b 15mm
c 12mm
d 10mm

18. When using double-crown retained prostheses, what, according to the authors, is the standard of care:

a Zirconium dioxide primary with electroformed secondary crowns
b Gold primary and secondary abutments, cast and electroformed, respectively
c a complete CoCrMd primary-secondary-tertiary system

19. What is a significant disadvantage of metal-free frameworks:

a To properly enable oral hygiene, restorations must be designed to allow easy cleaning
b They are ill-fitting
c They have no elasticity

20. Which statement is correct? When following a completely digital workflow:

a It is not possible to produce bar- or screw-retained implant-supported prostheses without a model
b It is now possible to produce bar- or screw-retained implant-supported prostheses without a model

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References: 1. Prasad & Mateo, July 2016, internal report. **2.** Garcia-Godoy F, et al. *J Clin Dent*, submitted August 2018.

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