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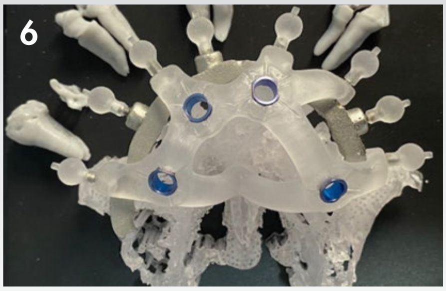

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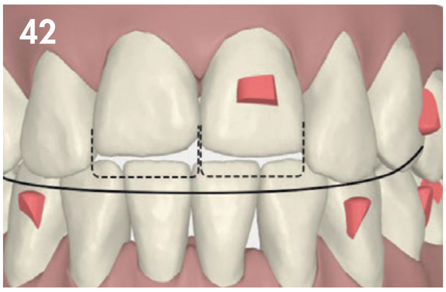

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Guided full arch implant surgery - a novel approach using a chrome cobalt bone reduction guide: A case report

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Abstract

Introduction. Many patients require solutions to shift from a failing dentition to a full arch rehabilitation using dental implants. Placement of four implants through guided surgery combined with an interim, immediately loaded prosthesis constitutes a predictable treatment for full arch rehabilitation. The aim of this report was to present the digital workflow and clinical use of a chrome cobalt bone reduction guide, which can simplify implant rehabilitation in terminal dentitions and increase precision and predictability of treatment outcome.

Material and Methods. The patient was treated with a full arch implant-based fixed maxillary prosthesis with immediate function. A virtual patient was created and implant planning software was used to create three guides: a tooth-supported guide, stabilized by three stabilizing pins, a bone reduction guide fabricated from chrome-cobalt, and an implant guide that fit onto the bone reduction guide.

Results and discussion. In this case of full-arch prosthetic implant-based rehabilitation in the maxilla, the use of a chrome cobalt bone reduction guide was successful in increasing stability, resistance to fracture and predictability of the alveoloplasty procedure.

Conclusions. This novel approach using a chrome cobalt bone reduction guide can be particularly useful when working in areas with reduced bone density.

Key-words: Guided implant Surgery, Full Arch Implant Rehabilitation, Digital implant Workflow, surgical Guide, implant planning software

Short title: Chrome Cobalt Bone Reduction Guide for Implant Rehabilitation

Introduction

In clinical practice, many patients require solutions to shift from a failing dentition to a full arch rehabilitation using dental implants. These cases often present with a high level of complexity. Placement of four or six implants through guided surgery and installation of an interim, immediately loaded and functional prosthesis constitutes a predictable restorative treatment for full arch rehabilitation, with high medium to long-term implant survival rates.[1] This approach is beneficial for the patient, as it contributes to maintenance of the vertical dimension of occlusion (VDO) and the lower facial

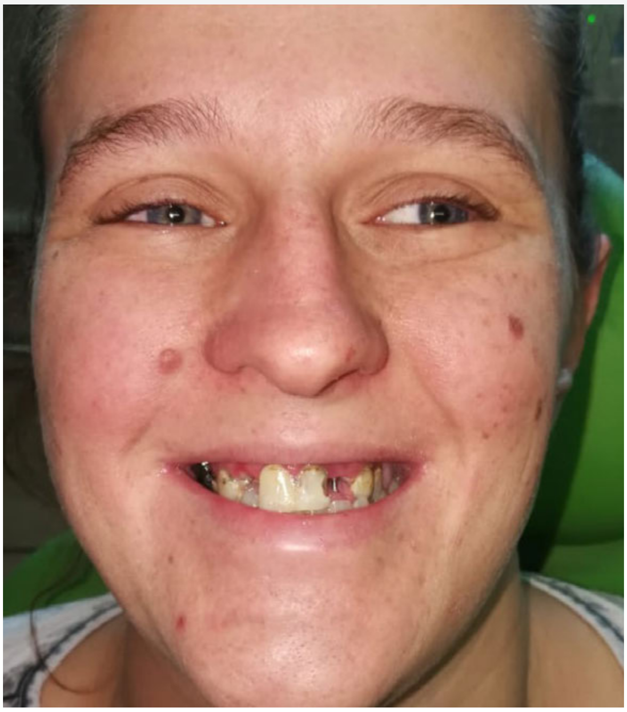

Figure 1. Extraoral digital photograph with patient displaying an exaggerated smile.

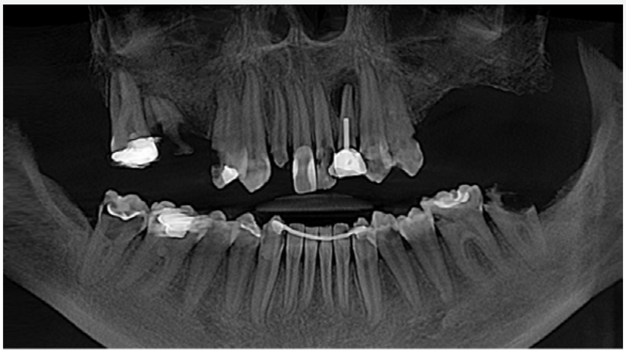

Figure 2. Panoramic image of patient displaying failing dentition with several pathological conditions, further restricting the available bone for implant placement.

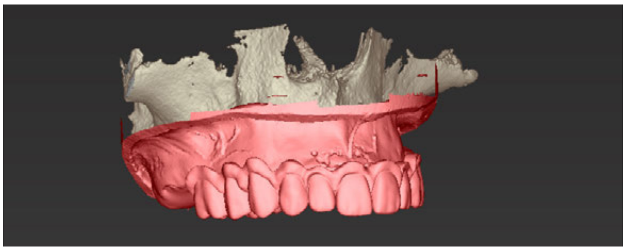

Figure 3. Digital design of immediate interim prosthesis to aid in virtual implant planning.

height, while providing protection to the extractions sockets. Immediate complete dentures have high patient acceptance as it can restore the patient's appearance and self-esteem, reducing the psychosocial effects of edentulism.[2]

In general, precision and predictability of dental implant treatment have improved due to digital technologies and 3D implant software. A virtual patient can be created to assist with the planning of prosthetically driven implant placement through the integration of CBCT Digital Imaging and Communication in Medicine (DICOM) files, digital scanning Standard Tessellation Language (.STL) files, and JPEG files from digital photographs, which enables accurate planning of the oral rehabilitation procedures from a craniofacial virtual perspective.[3,4]

The success of full arch rehabilitations with dental implants using digital technologies greatly relies on surgical guides fabricated through computer aided design/computer aided manufacturing (CAD/CAM) technology.[5] Guided implant surgery present several advantages, including lower risk of damage to anatomic structures, limited risk for complications, such as bone dehiscence and fenestration, use of restorative-based surgical plans and higher predictability. However, when surgical guides are used, the resulting increase in surgical steps requires the surgeon to become familiar with the guided workflow in order to avoid inaccuracies.[6]

In terms of type of support, there are three different types of implant surgical guides: bone-supported, mucosa-supported and tooth-supported guides. Mucosa and bone supported guides are frequently used in the rehabilitation of patients who present a terminal dentition and those who are fully edentulous.[7] Stabilizing pins are used in order to improve the stability of mucosa and bone supported guides, limiting movement of the guide during surgery. In spite of the use of stabilizing pins, bone and mucosa supported guides have been reported to present lower stability when compared to tooth supported guides.[8]

The sequential use of multiple surgical guides has been previously described in the literature in the rehabilitation of patients with a failing dentition.[4] The "three guide technique" uses three reference osteotomies for three stabilizing pins. The same osteotomies are repeatedly used to fixate the first guide (a tooth supported reference guide), the second guide (used for bone reduction), and the third guide, which is used for surgical implant placement. The accurate fit of

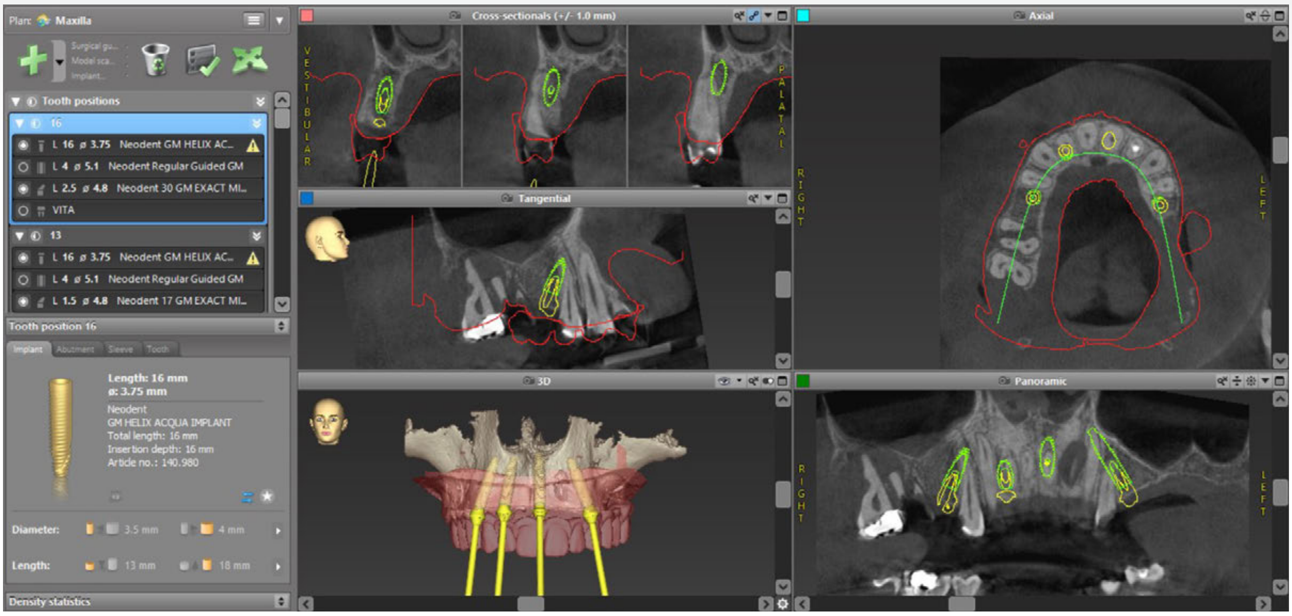

Figure 4. 3D surgical plan for computer-guided implant surgery.

each guide is essential, since it will reflect the precision of the planning and affect final implant positions.[9]

In many cases, terminal dentitions are associated with poor alveolar bone quality, often presenting associated pathologies. Because bone density cannot accurately be measured through cone beam computed tomography (CBCT), frequently bone type can only be confirmed after teeth extraction.[10] In type III and IV bone, use of the same reference osteotomies for three different guides can lead to wear of the osteotomies due to the repetitive insertion and removal of stabilizing pins. This reaming can decrease accuracy of fit, potentially affecting final implant position and treatment outcomes. Hence, reinsertion of reference pins for multiple guides can be challenging in poor quality bone.

In patients with a failing dentition, bone reduction (alveoloplasty) is often part of the surgical treatment plan, with the aim of optimizing the shape of the alveolar ridges, creating adequate inter-arch space or hiding the transition zone between the superior border of the denture and the mucosa in the maxilla in order to improve aesthetics in patients with high smile lines.4 When using traditional reduction guides made from resin, there is a risk of breakage while securing it in place prior to alveoloplasty.[11]

In order to overcome this limitation, we created a rigid bone reduction guide made from chrome cobalt, which includes the final implant placement guide through the addition of five extra stabilizing pins. The chrome cobalt bone reduction guide adapts to the labial and buccal surface of the maxilla and, after alveoloplasty, the implant placement guide is anchored to the reduction guide through five pins, with a palatal stop used as the sixth reference point. To our knowledge, no previous studies have reported the use of chrome cobalt bone reduction guides that connects to the implant placement guide. The aim of this technique report is to present the digital workflow and clinical use of a chrome cobalt bone reduction guide, which can simplify implant rehabilitation in terminal dentitions and increase precision and predictability of treatment outcome.

Case Report

A 27-year-old female in good general health with several missing and compromised teeth in the maxilla presented for treatment (Figure 1). Upon clinical examination, it was concluded that the remaining maxillary dentition was severely compromised due to caries and dental fractures. Those findings were confirmed by a panoramic x-ray, which also revealed severe periapical pathology on tooth 22 (Figure 2). There were no noises or deviations in the temporomandibular joint and the patient did not present limitation when opening her mouth. Upon palpation, there was no tenderness in the masticatory muscles.

Extra oral and intraoral digital photographs were taken

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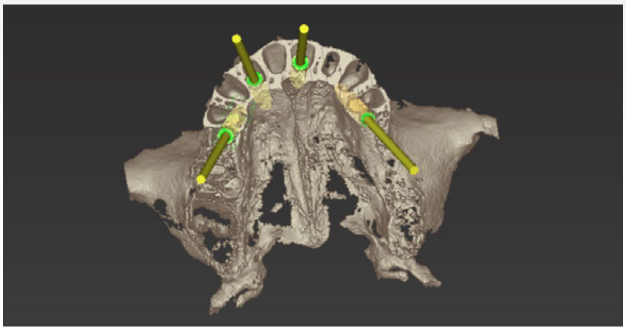

Figure 5. The desired bone reduction was virtually performed on the CBCT DICOM images using the virtual implant planning software.

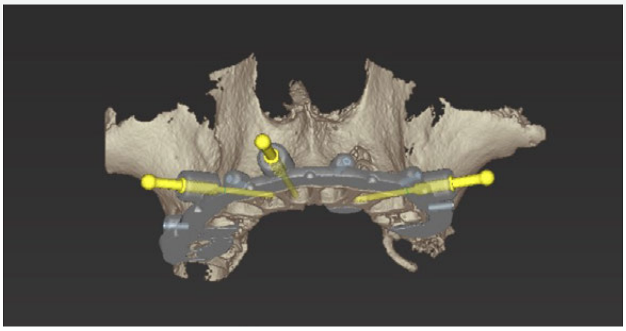

Figure 6. Bone reduction guide with 3 reference guide pins.

and exported as Joint Photographic Experts Group (JPEG) files. Through full face extra oral photographs, maxillary lip position and gingival display were recorded.

After the initial clinical and radiographic evaluations, the patient was diagnosed with a terminal maxillary dentition and presented with different treatment options. The most predictable option to meet the patient's expectations in terms of rehabilitation treatment was a full arch implant-based fixed maxillary prosthesis with immediate function and the possibility of salvaging and restoring the lower dentition.

Treatment planning

The patient was subjected to a pre-operative cone beam computer tomography (CBCT) (Orthophos, Dentsply Sirona) scan for analysis of the alveolar ridge anatomy pertinent to implant placement. An intraoral scan (Omnicam, Dentsply Sirona) was performed and the resulting standard tessellation language (.STL) data files provided information on dental hard and soft tissues.

All files containing diagnostic information, i.e. intraoral scanning .STL files, CBCT DICOM files, extra and intraoral photographs were exported to a specialized dental laboratory (Oracav Dental Laboratory, Pretoria, South Africa). Using DICOM files as the foundation, 3D volumetric data of the craniofacial hard tissues and remaining dentition were segmented and inserted into a virtual implant planning software (coDiagnostiX, Dental Wings, Montreal, Canada). The STL data of hard and soft tissues were included into the virtual implant planning software and combined with the DICOM data.

A digital denture was designed using Cares Visual, Dental Wings CAD/CAM software by selecting and importing maxillary teeth from an online library, which were edited in terms of shape and position to match the patients' smile and occlusion (Figure 3).[12] The final digital denture was imported into the implant planning software and a prosthetically driven surgical plan for computer-guided implant surgery was generated in the implant planning software (Figure 4,5,6).

The location of three stabilizing pins was defined after the virtual creation of the tooth-supported guide. This reference guide is highly accurate in replicating the position of the

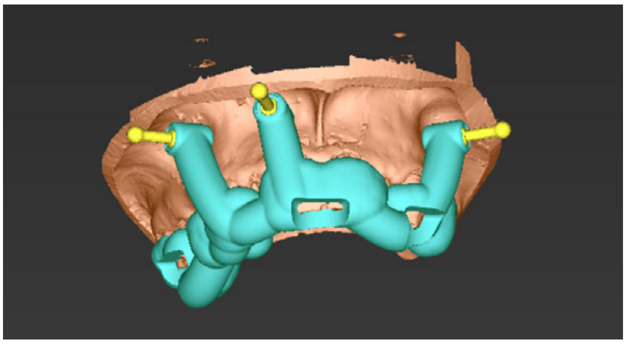

Figure 7. Tooth supported guide to accurately transfer positions of osteotomies for stabilization pin placement.

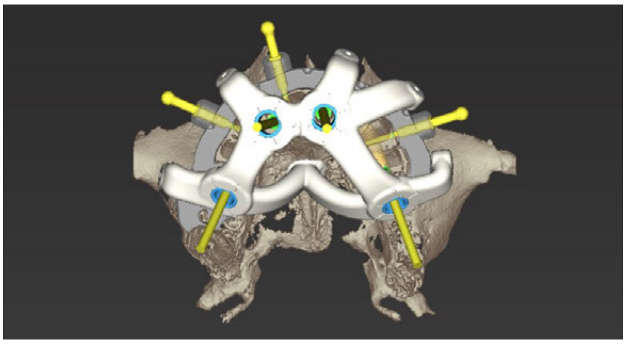

Figure 8. Implant placement guide fixates on bone reduction guide and additional positive palatal stop as reference.

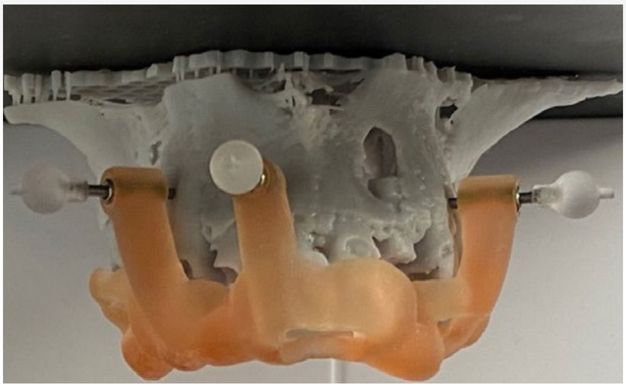

Figure 9. A) Tooth supported reference guide fitted onto a 3D printed model of the maxilla with the 3 anchor pins fitting the guide to the bone.

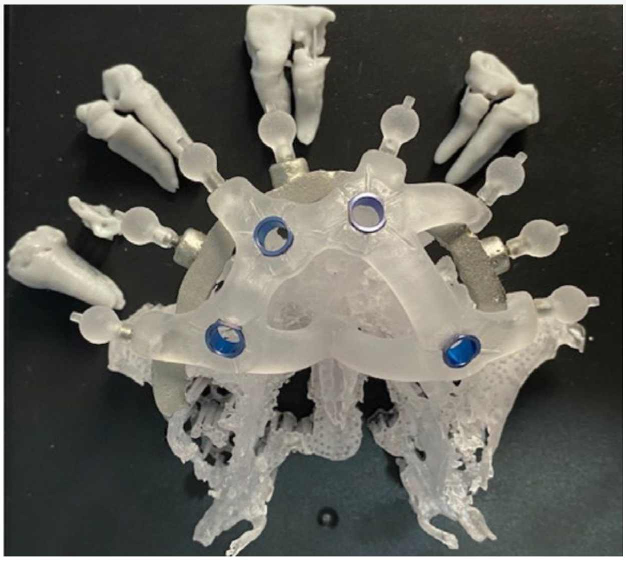

Figure 9. B) Chrome cobalt bone reduction guide with the implant placement guide fitted onto the 3D printed maxilla with planned bone reduction.

stabilizing pins for the subsequent guides, being supported by the residual dentition (Figure 7).

Next, the bone reduction guide was created keeping the exact same location of the stabilizing pins used for the first surgical guide. Five additional stabilizing pin slots were created by the dental technician to allow anchorage of the implant placement guide onto the bone reduction guide. Lastly, the implant placement guide was designed with a positive palatal stop, used as an additional reference point (Figure 8).

All three surgical guides, i.e. the reference guide, bone reduction guide and implant placement guide, were exported as STL files for 3D printing (Straumann Rapid Shape, Heimshein, Germany).

The dental technician transformed the bone reduction guide into a chrome cobalt guide, which adapts to the labial and the buccal surfaces of the maxilla. All three guides were carefully examined for fit prior to surgery on 3D printed models (Figure 9). An immediate denture was manufactured for immediate loading.

Surgical procedure

The surgery was performed in a hospital setting under general anaesthesia. After precise fitting of the reference tooth supported guide, three 1.4 mm osteotomies were created by perforation of soft tissues and penetration of the alveolar bone with surgical drills, followed by the insertion of three stabilizing pins (Figure 10).

The tooth supported guide was removed and all residual maxillary teeth were extracted as atraumatically as possible. The chrome cobalt bone reduction guide was secured and stabilized through stabilizing pins, which were located at the exact same positions as the initial tooth-supported guide (Figure 11).

Bone reduction was performed through piezo surgery to the desired bone level as planned, with the reduction guide in place (Figure 12).

After completion of bone reduction, the implant placement guide was fitted through five additional pre-planned stabilizing pins in the bone reduction guide (Figure 13). Shortened stabilizing pins were used to secure the implant guide in place. The final reference point was confirmed through a positive stop in the palate.

A guided implant kit was used for implant placement with the guide in place after confirmation of all reference points, according to the manufacturer's instructions (Neodent Grand Morse Guided implant kit). Following the drilling protocol recommended by the manufacturer, four Neodent implants (Grand Morse Helix Acqua) were placed with a fully guided protocol. Final insertion torque ranged from 45 to 60 Ncm per implant. The cumulative or composite torque across the four implants was 220Ncm.This torque value was deemed high enough for immediate loading. For a four-implant approach with minimal bone-to-implant contact for all implants, a composite insertion torque has been suggested by Jensen & Adams (2012) in order to help the clinician establish a quantitative threshold to allow for immediate function.[13] This threshold has been clinically established to be 120 Ncm, with minimum of 30 Ncm per

Figure 10. Accurate fitting of tooth supporting reference guide stabilized by three anchor pins.

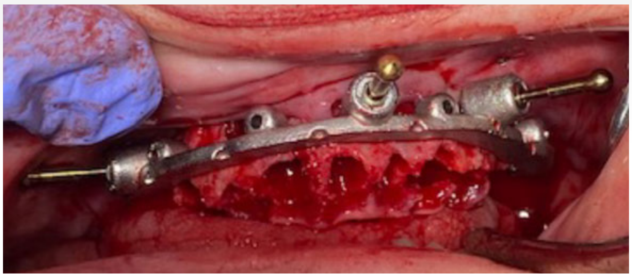

Figure 11. Chrome cobalt bone reduction guide fitted with three anchor pins inserted into the three initial osteotomies used for the tooth supported guide.

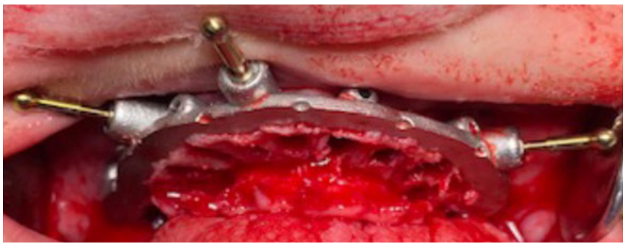

Figure 12. Completion of bone reduction, using the reduction guide as reference.

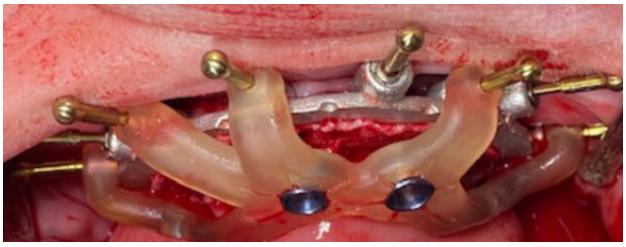

Figure 13. Implant placement guide slotted into the bone reduction guide through five additional slots.

implant.[14] After primary stability was confirmed, multi-unit abutments 17 or 30 degrees were connected to the tilted implants for adequate orientation of screw access holes.

The following is a description of the four implant locations with the mini conical abutment connected to each implant to facilitate ideal screw access location.

15: 30° 2.5 4.8 Neodent GM Exact Mini Conical Abutment

11: 17° 2.5 4.8 Neodent GM Exact Mini Conical Abutment

22: straight 2.5 4.8 Neodent GM Straight Mini Conical Abutment

25: 30° 2.5 4.8 Neodent GM Exact Mini Conical

Abutment

Straight and angled multi-unit abutments were used for the anterior implants. Temporary titanium cylinders were secured to the abutments and a pre-fabricated denture was retrofitted to function as a fixed provisional prosthesis. The provisional prosthesis was fitted 12 hours after implant surgery. All implants were splinted with a metal bar incorporated in the temporary prosthesis (Figure 15). A postoperative panoramic radiograph was taken, as well as final intra and extra-oral photographs (Figures 14, 15 and 16).

Discussion

In this article, the successful use of a novel chrome-cobalt bone reduction guide as part of a guided full-arch implant-supported rehabilitation of a patient who has a terminal dentition is presented. To the best of our knowledge, no studies in the literature have previously reported the use of a computer-generated bone reduction guide made from chrome- cobalt.

With regard to dental implant planning, patients with a terminal dentition greatly differ from edentulous patients, who often present some degree of alveolar bone resorption. A terminal dentition typically needs reduction of the alveolar bone after teeth extraction, particularly in the maxilla.4 The alveoloplasty procedure optimizes the anatomy of the alveolar ridge in order to facilitate implant placement and installation of the prosthesis.[15] Precision is key when performing this surgical procedure, as incomplete, uneven or exaggerated reduction can result in less than ideal implant location, which can in turn compromise the restorative stage. The efficacy of guided dental implant protocols relies on

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Figure 14. Prefabricated denture fitted to temporary titanium cylinders and secured to multi-unit abutments

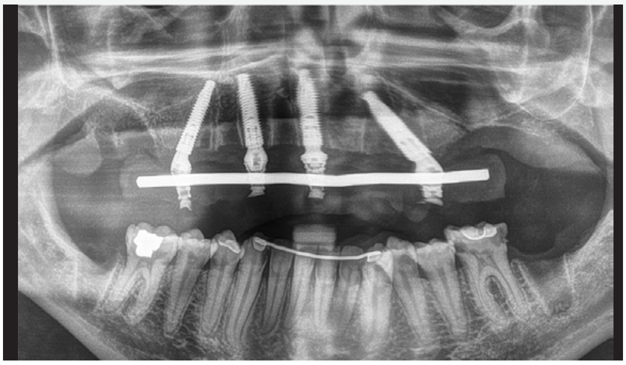

Figure 15. Postoperative panoramic image displaying completed treatment.

Figure 16. Postoperative clinical photo 12 hours after surgery.

the precision of the transfer of information from the virtual to the oral environment through surgical guides. Computer-generated guides are an integral part of the digital workflow in implant rehabilitation, and the transfer of information depends on the fit of the guide, its accuracy and stability during surgery.[16–18]

In our clinical experience, due to the highly invasive nature of the bone reduction that is often required in terminal dentitions, the stability of the surgical guide is usually put to the test during surgery, particularly when dealing with poor density alveolar bone. Computer-generated stereolithic guides are typically made of dental resin.[19] We have observed that during extensive alveoloplasty, particularly in poor density alveolar bone (types III and IV), there is always a risk for breakage or dislodgement of the resin guide due to wear of the osteotomies after repeated inserted stabilizing pins. Lack of stability can ultimately affect alveolar bone reduction and implant positioning.[20] In case of movement or collapse of the guide during surgery, the procedure is likely to become compromised, potentially leading to detrimental changes to workflow and unpredictable treatment outcomes.[21]

This report describes the clinical application of a chrome cobalt bone reduction guide, which presented a few advantages in relation to resin surgical guides. Firstly, the metallic nature of the guide significantly increased resistance to fracture during surgery. Secondly, the creation of five additional stabilizing pins in the implant placement guide improved its stability. Guide stability is essential, as it determines the accuracy of the surgical outcome in relation to the planned treatment[20], reason why this novel approach seems promising.

When compared to conventional procedures, digital technologies present several advantages for dental implant treatment, such as the possibility of digitally creating the desired shape of the alveolar ridge (Fig 6+7), ideal implant positioning and occlusion of the prosthesis before going into the oral environment.[7] The use of advanced virtual implant planning software and the creation of a virtual version of the patient have made it easier to simulate and plan implant positioning based on functional, aesthetic, prosthetic and anatomical factors.[22]

The use of digital technologies greatly diminishes the risk for unexpected intra-operative situations, providing a realistic view of relevant anatomic landmarks. For the dental surgeon, this can result in increased treatment predictability and decreased stress during surgery, while for the patient, it leads to a better overall experience and improved aesthetic outcomes.[23,24]

As a technique report, this study has limitations, mainly due to the lack of comparison between chrome-cobalt and resin guides in terms of precision, accuracy and treatment results. This should be evaluated in future studies with adequate sample size. Another potential limitation of the technique described is the higher cost of chrome-cobalt guides, as compared to resin guides

Conclusions

In a case of full-arch prosthetic implant-based rehabilitation in the maxilla, the use of a chrome cobalt bone reduction guide was successful in increasing stability, resistance to fracture and predictability of the alveoloplasty procedure. This has led to the successful oral rehabilitation of our patient in this case report. This novel approach can be particularly useful when working in areas with reduced bone density.

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Unilateral Class II treatment using fixed orthodontic appliances with open coil spring, sliding hook and light Class II elastics

Marthinus Johannes Coetsee Jnr [1] and Marthinus Johannes Coetsee Snr[2]

Abstract

Orthodontic correction of a Class II malocclusion often requires distalization of molars. Various appliances and approaches have been designed to accomplish molar distalization. This case report describes the management of a 13 year old female patient who presented with a unilateral Class II malocclusion. Extra-oral examination indicated a convex profile accompanied by an accentuated labiomental fold. Intra-oral examination showed that the maxillary dental midline was displaced to the left and the incisors were proclined. The treatment plan consisted of a non-extraction protocol using the Damon Q system. The bracket slots were 0.022 mm and a sequence of Copper Nickel Titanium (CuNiTi) and stainless steel (SS) arch wires were used in combination with an open coil spring, sliding hook and light Class II elastics. Treatment yielded a Class I molar and canine relationship as well as midline and overjet correction.

Keywords: Fixed orthodontic treatment, Class II division 1, subdivision, non-extraction, Damon system, molar distalization

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Introduction

When deciding on the correct orthodontic treatment plan, the age, anteroposterior discrepancy and compliance of the patient should be taken into account.[1] Adopting a non-extraction protocol often requires maxillary molar distalization to create a Class I molar relationship. Unilateral maxillary molar distalization presents with the added challenge of having to design and implement an asymmetric force system.[2]

Angle Class II subdivision classification describes an asymmetrical occlusion where the molar relationship is Class II on the one side and Class I on the other side. The majority of patients with this malocclusion present with a maxillary midline coincident to the midsagittal plane whereas the mandibular midline is displaced toward the Class II side.[3-5] The primary contributing factor of this malocclusion is the unilateral distal positioning of the mandibular first molar in relation to the maxillary first molar on the Class II side, creating a type 1 subdivision.[3-6] Other contributing factors to a type 1 subdivision are: an asymmetric mandible, the posterior position of the glenoid fossa and a functional shift of the mandible.[3,5-11]

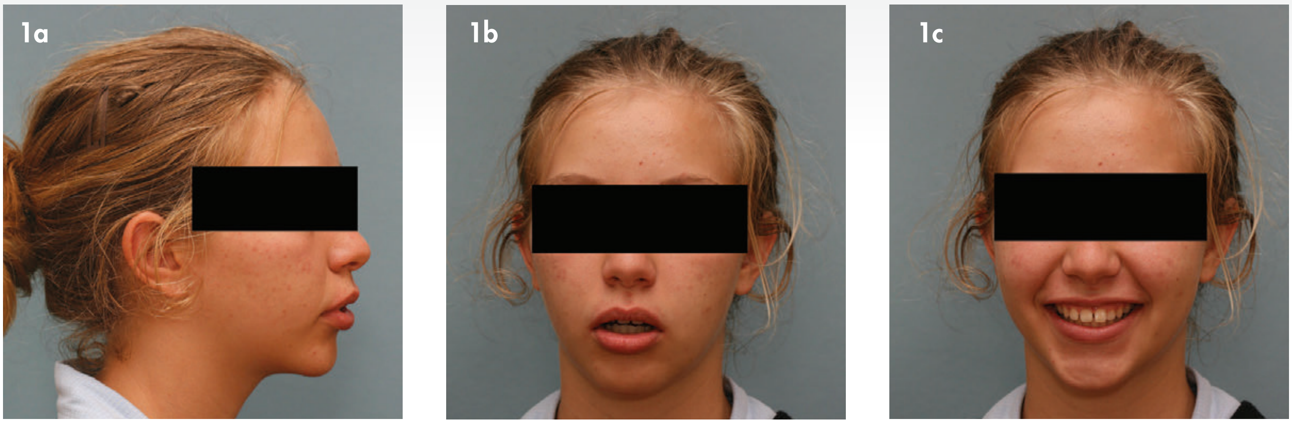

Figure 1 (a – h): Pre-treatment photographs.

A secondary contributing factor but less likely, is the mesial positioning of the maxillary first molar on the Class II side. Here the mandibular midline is coincident to the midsagittal plane and the maxillary midline deviates to the Class I side, creating a type 2 subdivision.[5,12]

Options for the correction of a Class II subdivision malocclusion can be divided into 3 distinct categories namely: non-extraction protocols, extraction protocols and orthognathic surgery. This case report describes a non-extraction approach to correct an Angle Class II division 1 type 2 subdivision malocclusion.

Case Report

A 13 year old female patient presented at a private practice concerned about the flaring of her maxillary incisors. Clinical examination revealed an Angle Class II division 1 malocclusion with a type 2 subdivision on the right hand side. Extra-oral examination indicated that the patient was dolichocephalic with a convex profile and adequate facial symmetry but with a possibility of lower lip wedging. Intra-oral examination revealed a permanent dentition with a maxillary midline deviation of 3.5mm to the left of the midsagittal plane. The maxillary arch showed mild spacing and the mandibular arch mild crowding.

Radiographic examination

Examination of the pre-treatment orthopantomogram revealed a permanent dentition with no pathology present. Third molars were developing. (Figure 2)

The pre-treatment cephalometric analysis (Table 1) indicated a Class II skeletal relationship. Figures 3 (a and b) show the pre-treatment lateral cephalogram and the cephalometric analysis done with the Dolphin® orthodontic software.

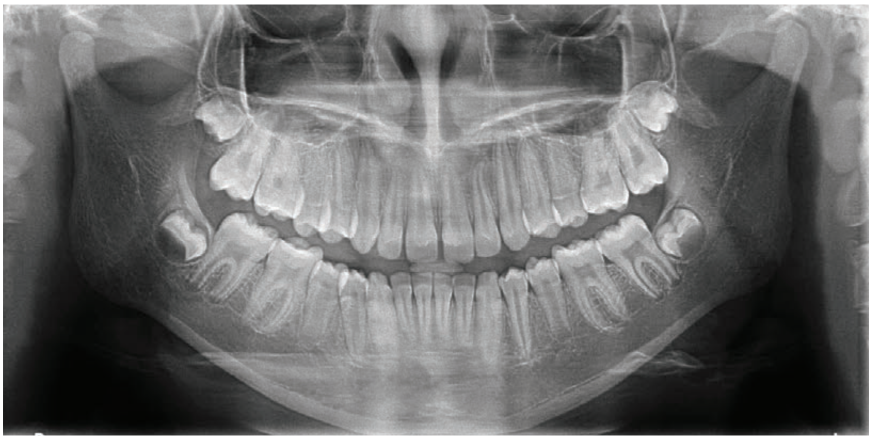

Figure 2: Pre-treatment orthopantomogram.

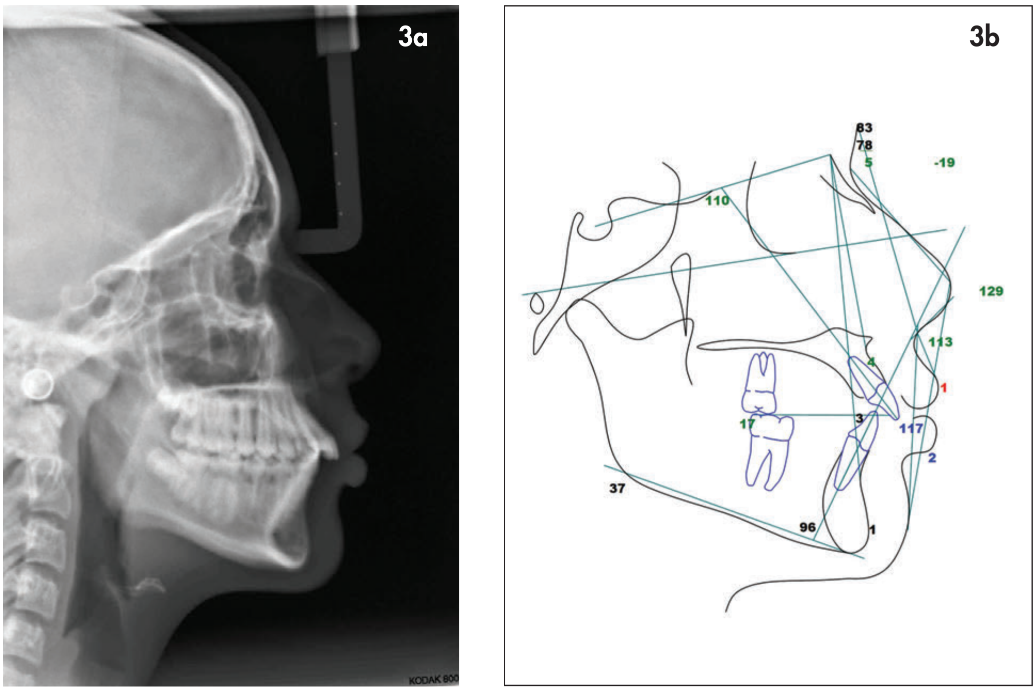

Figure 3: (a) Pre-treatment lateral cephalogram and (b) cephalometric analysis.

Table 1: Pre-treatment cephalometric analysis

Cephalometric values	Normal	Pre-treatment
Nasolabial angle (˚)	102.0	112.7
Upper lip to E-plane (mm)	-5.1	0.9
Lower lip to E-plane (mm)	-2.0	2.4
Upper lip thickness at point A (mm)	17.0	15.2
Upper lip thickness at vermillion border (mm)	13.6	12.6
SNA (˚)	82.0	83.4
SNB (˚)	80.9	78.3
ANB (˚)	1.6	5.1
Wits	-1.0	1.5
Convexity (A-NPo) (mm)	1.0	4.4
Interincisal (˚)	130.0	116.9
U1 – SN (˚)	102.7	110.3
U1 – NA (˚)	22.8	26.9
U1 – NA (mm)	4.3	5.2
L1 – NB (˚)	25.3	31.1
L1 – NB (mm)	4.0	6.1
L1 – MP (˚)	95.0	96.1
MP – SN (˚)	33.0	36.7
Y-axis (˚)	67.0	67.4
Occlusal plane – SN (˚)	14.4	17.2

Diagnosis

Soft tissue

The patient presented dolichocephalic with a convex profile and an accentuated labiomental fold.

Skeletal

Mild Class II skeletal malocclusion, (Steiner 5.1˚) and convexity (4.4 mm) with a mesiognathic maxilla (83.4˚) as well as mandible (78.3˚) and a normal growth pattern (Y-axis 67.4˚).

Dentoalveolar

Angle Class II division 1 with subdivision on the right side with proclined and protruded maxillary and mandibular incisors. Maxillary midline deviation of 3.5mm to the left accompanied by mild spacing opposed to mild crowding of mandibular incisors.

Treatment objectives

The aim of the treatment was to achieve a Class I molar and canine relationship on the right hand side and maintain the Class I molar and canine relationship on the left hand side. Further objectives were to correct the overjet, close the maxillary spaces, align the mandibular incisors and to correct the midline discrepancy.

Treatment options

A. Extra-oral appliance

Unilateral molar distalization, by making use of face bows such as the power arm face bow, swivel- offset face bow, soldered offset face bow and spring attached face bow.[13]

B. Intra-oral fixed appliances

i) Pendulum appliance
This appliance derives its anchorage from the palate through a Nance acrylic button and the activating force from a 0.032" Beta Titanium (TMA) spring. The spring applies a light, continuous force to the maxillary first permanent molars.[14]

ii) Beneslider
Temporary anchorage devices (TADs) offer absolute anchorage through the use of skeletal structures for anchorage. The Beneslider is a maxillary device designed for distalization. It is connected to two coupled mini-implants that are placed in the anterior segment of the palate. It uses slide mechanics for distalization.[15,16]

iii) Appliances like the Jasper Jumper, Twin Force Corrector and Power Scope are fixed to the maxillary and mandibular arch wires and are normally used to correct enlarged overjets in Class II malocclusions. They can also be used to distalize maxillary molars unilaterally or bilaterally.[17]

iv) Class II elastic and nitinol open coil spring

C. Intra-oral removable appliances

Removable appliance with distalization screw.[18]

Treatment plan

The Damon Q fixed orthodontic appliance was used in the maxilla and mandible. Treatment started with 0.014 CuNiTi arch wires in the maxilla and mandible. The 14 and 15 were bonded once the 16 has been distalized.
- Standard torque brackets were used (+15°) on 11 and 21, (+6°) on 12 and 22, (+7°) on 13 and 23.
- Low torque brackets (-11°) were used on the 32 – 42.
- Standard torque brackets (+7°) were used on the 33 and 43.

A nitinol open coil spring was used between the 13 and 16. A sliding hook was placed mesial to the coil. The patient was instructed to use a 3.5oz 6.35mm Class II elastic from the hook to the 46 on a full time basis.

Traction started on a 0.016 x 0.025 SS maxillary arch wire (extending 2mm past the buccal tube) to allow distalization of the maxillary molar. This arch wire in combination with the standard torque brackets allowed retraction and loss of torque of the maxillary incisors during treatment. A 0.019 x 0.025 SS mandibular arch wire was used with elastic ligatures placed over the brackets from 33 – 43. This was necessary to obtain maximum torque expression as there is 25° play between the brackets and this arch wire. A 0.017 x 0.025 TMA arch wire was used for final detailing during finishing of the treatment.

Post treatment retention consisted of a clear removable retainer in the maxilla and a fixed lingual splint in the mandible.

Treatment progress

Figure 4 (a – e) shows the placement of 0.016 x 0.025 SS arch wire in maxilla, 0.019 x 0.025 SS in the mandible, an open coil and sliding hook and a 3.5oz 6.35mm

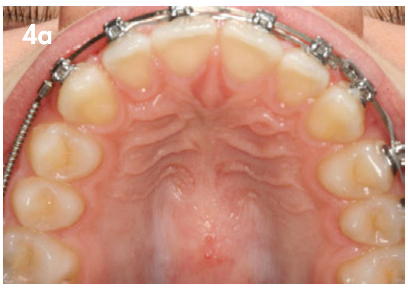

Figure 4 (a – e): Placement of distalizing appliance.

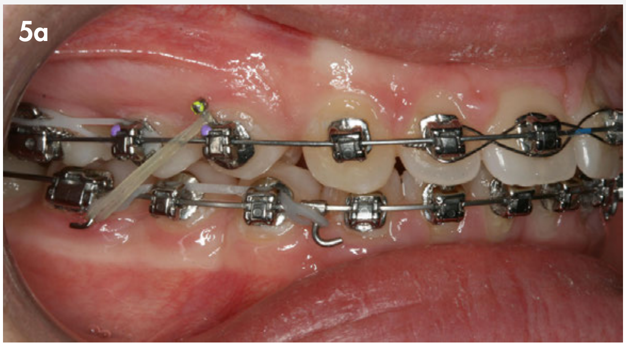

Figure 5: (a) Class I molar relationship.

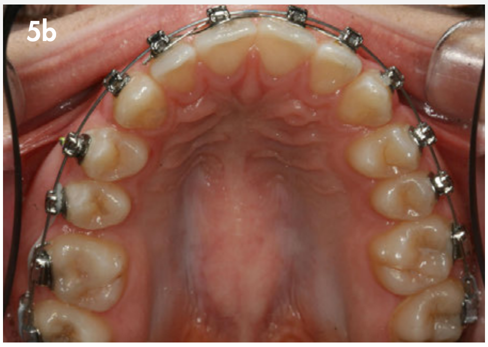

Figure 5: (b) Space created distal to the 15.

Class II inter-arch elastic on the right. The maxillary arch wire extended 2mm distal to the 16 to allow for distalization while the Class II elastic was in use. The premolars were bonded as soon as a Class I molar relationship was achieved.

Figure 5 (a – b): (a) Shows the Class I molar relationship, natural distal movement of the 14 and 15 and the bonding of the 14 and 15. A 0.018 CuNiTi arch wire was used to align the premolars. A 2oz 4.76mm Class II elastic was used to maintain anchorage and to further distalize premolars (b) Space created distal to the 15.

Figure 6 (a–d): Shows the progression of midline correction. This was achieved through sliding mechanics to close spaces and to correct overjet with the use of an elastomeric chain and a unilateral Class II elastic on the right.

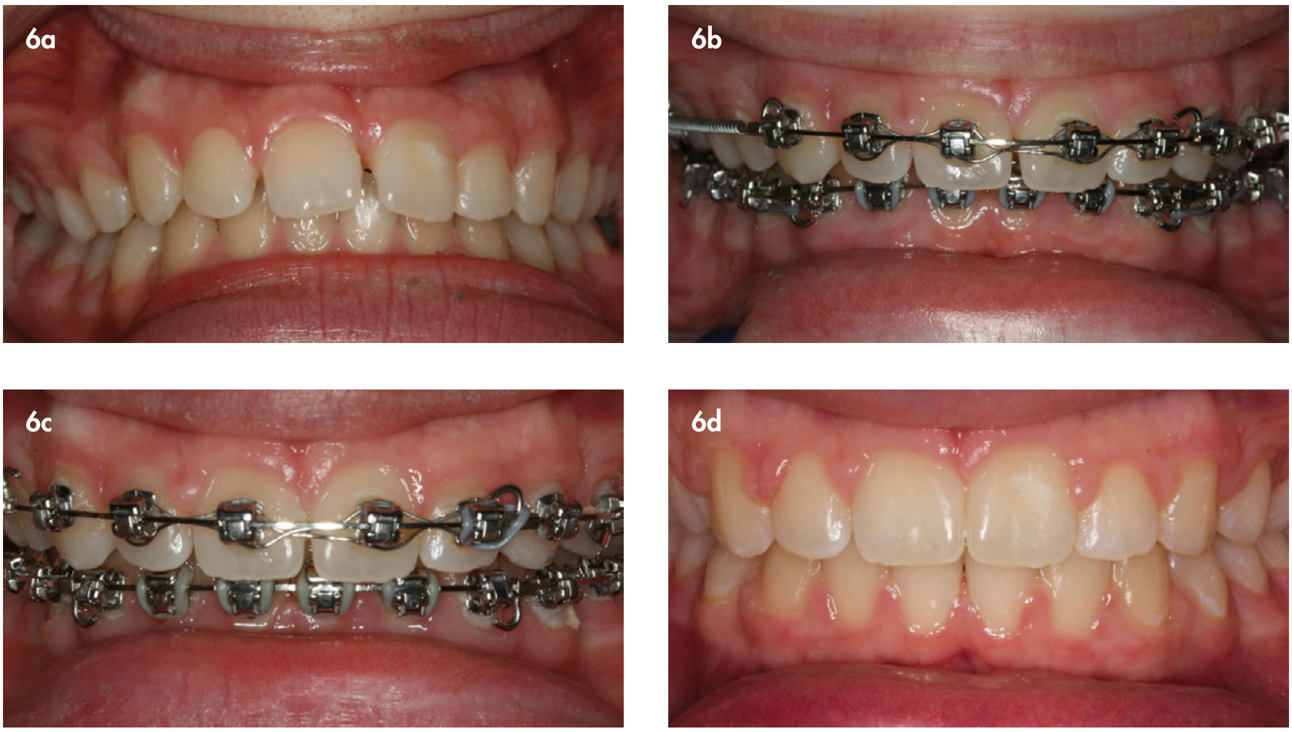

Figure 6 (a-d): Shows the progression of midline correction.

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Table 2: Sequence of arch wires and inter-arch elastics used during treatment

Arch wires		Inter-arch elastics	
Maxilla	Mandible	Size and force	Direction
0.014 CuNiTi	0.014 CuNiTi	-	-
0.018 CuNiTi	0.018 CuNiTi	-	-
0.014 x 0.025 CuNiTi	0.014 x 0.025 CuNiTi	-	-
0.018 x 0.025 CuNiTi	0.018 x 0.025 CuNiTi		
0.016 x 0.025 SS	0.019 x 0.025 SS	3.5oz, 6.35mm	Class II
0.016 x 0.025 SS	0.017 x 0.025 TMA		

Treatment outcome

Upon analysing the final records (Figures 7 – 8, Table 3), all objectives outlined at the start of treatment were achieved. The final result showed a Class I molar and canine relationship with good interdigitation (Figure 7 a – h). The maxillary and mandibular midlines coincided with the midsagittal plane. The protrusion of the maxillary incisors was corrected (110.3° to 100.3°) the mandibular incisors showed further proclination at the end of treatment (96.1° to 100.5°) and the interincisal angle improved (116.9° to 122.0°).

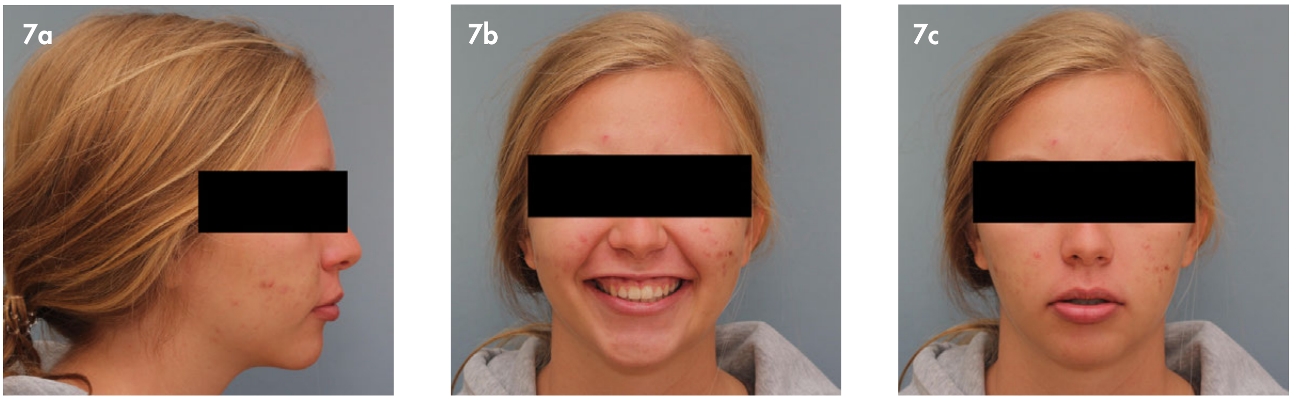

Figure 7 (a – h): Post treatment photographs.

Cephalometric values

Table 3 shows the pre and post treatment cephalometric values and Figure 8 (a – b) shows the lateral cephalograms before and after treatment.

Table 3: Cephalometric values before and after treatment

Cephalometric values	Normal	Pre-treatment	Post-treatment
Nasolabial angle (°)	102.0	112.7	107.2
Upper lip to E-plane (mm)	-5.1	0.9	-0.8
Lower lip to E-plane (mm)	-2.0	2.4	0.6
Upper lip thickness at point A (mm)	17.0	15.2	15.1
Upper lip thickness at vermillion (mm)	13.6	12.6	12.0
SNA (°) 82.0	83.4	81.4	
SNB (°) 80.9	78.3	78.1	
ANB (°) 1.6	5.1	3.4	
Wits -1.0	1.5	-3.6	
Convexity (A-NPo) (mm)	1.0	4.4	3.0
Interincisal (°)	130.0	116.9	122.0
U1 – SN (°)102.7	110.3	100.3	
U1 – NA (°)22.8	26.9	18.9	
U1 – NA (mm)	4.3	5.2	5.2
L1 – NB (°)25.3	31.1	35.8	
L1 – NB (mm)	4.0	6.1	6.3
L1 – MP (°)95.0	96.1	100.5	
MP – SN (°)33.0	36.7	37.2	
Y-axis (°) 67.0	67.4	67.7	
Occlusal plane – SN (°)	14.4	17.2	22.3

Discussion / literature review

The following factors were taken into consideration for the decision to use Class II elastics for this patient.

1. Mild molar distalization was required in this case
2. Incisor retraction required no torque preservation and less molar anchorage
3. Lower incisor axial inclination was acceptable

Any inter-arch mechanics such as elastics or fixed functional appliances have a proclination effect on mandibular incisors. Unfavourable mandibular incisor inclination requires intra-arch mechanics in combination with TADs for anchorage. The further proclination of the lower incisors in this case could have been avoided with further negative torque placed into the 0.019 x 0.025 SS arch wire.

Extraction of a maxillary premolar on the Class II side is an acceptable treatment alternative for a patient with a full

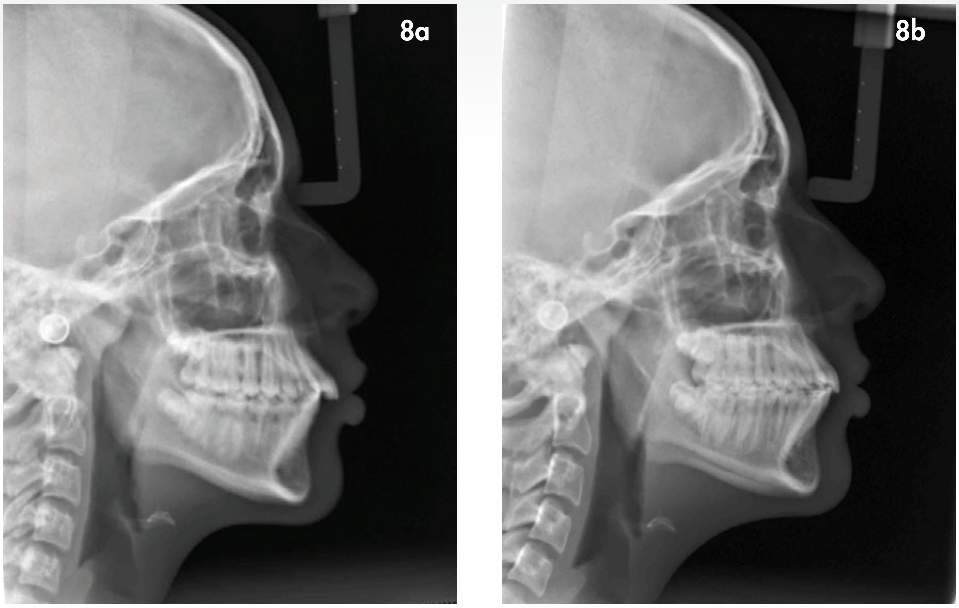

Figure 8 (a – b): cephalograms before treatment (a) and after treatment (b).

Class II molar relationship (needing 7mm distalization) and crowding in the affected quadrant.[5]

Various skeletal, dental and soft tissue aetiological factors have been identified as the cause of asymmetrical malocclusions.[19 - 22] In case of dentoalveolar origin the asymmetry can be ascribed to an unfavourable sequence of eruption, a loss of permanent teeth or premature loss of deciduous teeth. In case of a skeletal origin the asymmetry can be related to a developmental or acquired anomaly in either the maxilla, mandible or both.[23] Studies conducted by Alavi et al[3] and Rose et al[4] found that the main components of asymmetric Class II subdivision malocclusions are of dentoalveolar origin. In their studies, the skeletal component was not ruled out but found to be less prevalent in comparison.

This was confirmed by Janson et al[5] as well as Azevedo et al[24] which evaluated Class II subdivision patients with facial asymmetry and concluded that the subdivision is primarily dentoalveolar with little skeletal involvement.

There are various non-extraction approaches to correct a dental asymmetry. The most frequently utilized is the distalization of molars. Traditionally extra-oral traction was used to achieve the desired result. The headgear can be adjusted to ensure a distalizing force on the preferred side.[25,26,27] The results were favourable but, like various other approaches such as intermaxillary elastics and removable appliances, it is reliant on patient cooperation to achieve the result.[28,29] Clemmer and Hayes[30] confirmed this through a study assessing cooperation in headgear patients and found that the appliance was worn for an average of 55.8% of the prescribed hours.

Fixed intra-oral appliances have been designed to exert a continuous force to achieve molar distalization. This includes the distal jet, pendulum appliance, Jones Jig, Keles slider, Wilson arches and K-loop.[31] These noncompliance methods have been measured on cephalometric radiographs and indicated that the distalization of the maxillary molars is accompanied by distal tipping of the molars and anchorage loss due to the mesial displacement of maxillary premolars.[32] The proclination of the maxillary incisors and increase in overjet are also known side effects of these appliances.[33 - 36]

Distalizing appliances have been used in conjunction with TADs, which offer absolute anchorage through the use of skeletal structures.[37 - 46] Mini-implants have been attracting a lot of attention, due to their versatility and minimally invasive surgical nature. The disadvantage is that it requires a two phase approach as modification to the appliance is required once distalization has been achieved.[47 - 51] A device designed to solve this problem is the Beneslider. It is connected to two coupled mini-implants that are placed in the anterior segment of the palate and uses slide mechanics for distalization.[15,16]

Conclusion

- A sliding stop with a nitinol open coil is an acceptable method of non-extraction treatment in a Class II division 1 subdivision case.
- It is important to take into consideration the pre-treatment mandibular incisor inclination as Class II elastics tend to procline mandibular incisors.
- It is suggested that Class II elastics are not used in unfavourable lower incisor cases.
- The correct diagnosis must determine the individualised treatment approach and appliance selection.

Disclosure of financial interest

The authors report no financial interest in the products mentioned in this case report.

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A full digital workflow with 3D-printed temporary restorations

Anthony Mak[1] and Andrew Chio[2]

The evolution of digital technologies in dentistry has paved the way for the development of simplified and predictable protocols in field of restorative dentistry. Digital dental technologies have allowed the seamless delivery of complex treatments.

Proper treatment planning protocols are the foundation of any fixed restorations in the arch involving dental implants. The data or information from the CBCT scan and intraoral surface scans (IOS) combined with the use of CAD software allow the simplification of workflows including diagnostic facially driven mock-ups, restoration-driven implant treatment planning and the design and fabrication of surgical guides. The design of the temporary and permanent prosthesis and the design of the master die model can all be done on CAD software and then manufactured either with 3D printing or milling. The prosthetic design can be visualized, planned and even designed prior to the patient even attending for the surgical phase of treatment.

An accurate and predictable outcome of the implant surgery as well as the restorative rehabilitation are realised this way.

The following case study demonstrates a scenario where a complete digital workflow was utilised with two provisionalisation phases to rehabilitate the full upper arch.

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Case report

Diagnostic Record Collation and Treatment Planning Phase

A 79-year old patient presented with an unremarkable health history.

Chief complaint:

- mobile teeth
- occasional discomfort from the areas around his existing upper fixed partial denture

Examination (both clinical and radiographic) indicated the following (Fig. 1):

- moderate to advanced bone loss affecting many of his upper and lower teeth.

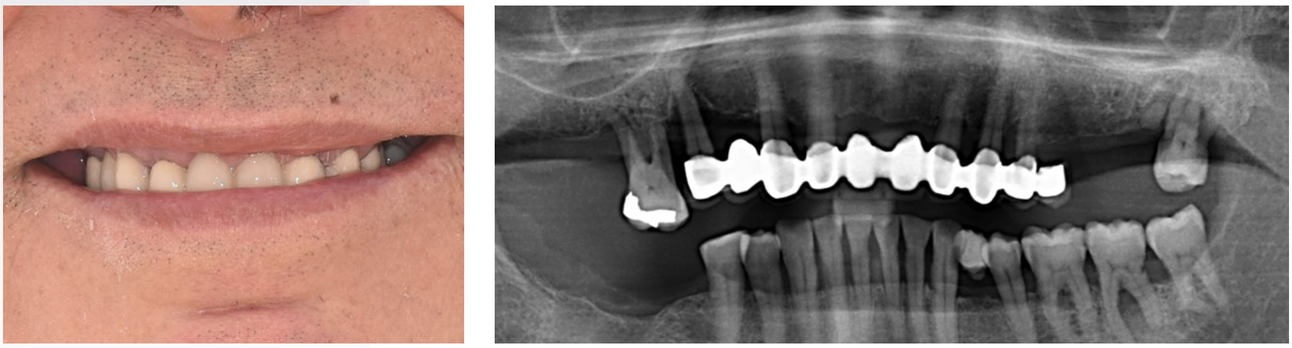

Figure 1: Pre-operative smile and orthopanthomogram.

Figure 2: Occlusal and lateral view after periodontal treatment and extraction of tooth 16 and 28.

Figure 3: The accuracy of image registration between the CBCT and IOS scans can be improved with radiographic markers (composite blobs). Removing sources of radiographic scatter (in this case, the PFM bridge) also improves the accuracy.

- secondary decay was diagnosed on the abutments of his fixed dental prosthesis.
- Teeth 15, 16 and 28 had a poor prognosis and were planned for extraction.

The goal of the treatment was to rehabilitate the upper arch with a combination of crowns and implant retained restorations to provide the patient with a fixed solution.

In the initial treatment phase, teeth 16 and 28 were extracted and the remaining dentition was periodontally treated (Fig. 2).

After the initial clinical examination and treatment, further information was collated. This included:

- 3D CBCT scanning for the presurgical planning.
- Intra-oral scans (IOS): digital impressions before and after removal of the original PFM bridge were taken, as well as the patient's occlusion (bite). Rough preparation of the tooth abutments were also completed prior to the acquisition of the subsequent IOS scan.

Tip: the accuracy of image registration (superimposition of the IOS and CBCT data) can be enhanced by (Fig. 3):

- the use of radiographic reference markers: a composite such as G-ænial Universal Injectable with a radiopacity of 250% Al, does not result in radiographic scattering during CBCT scans.
- prior removal of the porcelain-fused-to-metal (PFM) bridge: reduction of radiographic scatter caused by the metallic components of the prosthesis

Treatment Plan

Following the collation of the information, the initial treatment plan was formulated and involved:

- Guided surgical placement of implant fixtures in the 16, 14, 11, 21 and 25 sites. A bone graft was also planned in the 11 site due to bony defects. A two-stage surgical protocol was chosen for proper integration of the implants in the 11 and 21 site.
- Immediate provisionalization with a 3D-printed temporary bridge (GC Temp PRINT) from 15 to 24. The existing shape and contours of the current failing bridge were copied from the pre-operative IOS to create the temporary bridge.

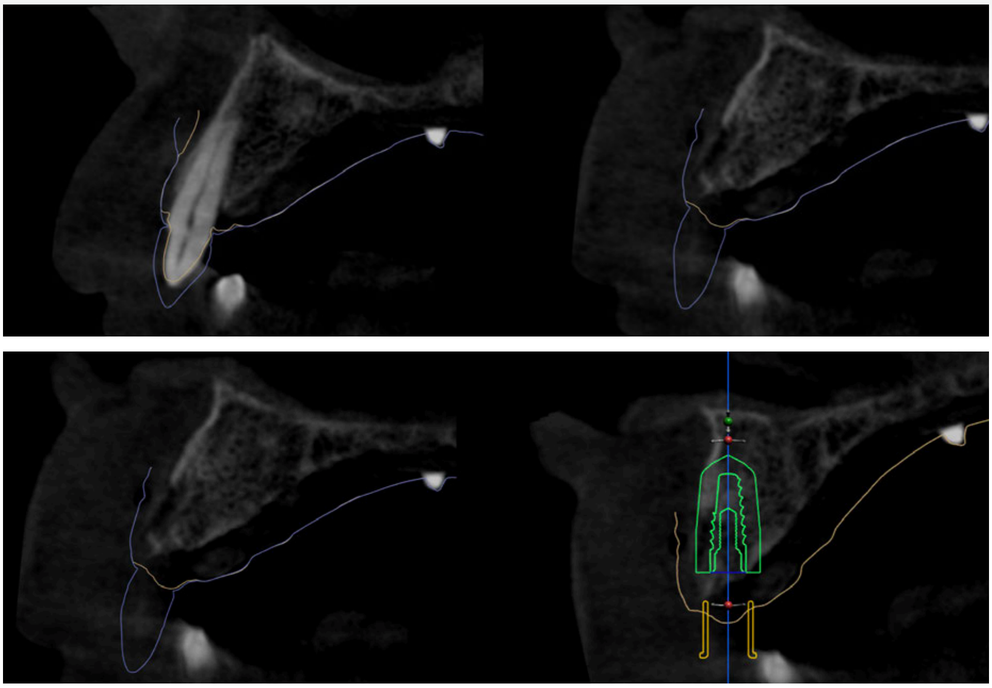

Figure 4: Intraoral surface scans (IOS) before and after removal of the original PFM bridge superimposed on the CBCT scan: this facilitates the planning of implant placement from a restorative perspective (restoration driven implant placement).

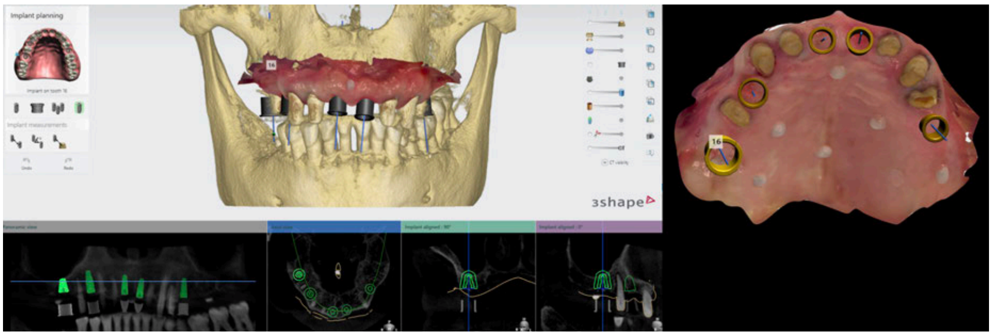

Figure 5: Planning of implant placement. A surgical guide is designed based on the desired implant position.

- After implant integration, a second phase of provisionalization was foreseen with individual temporary restorations (GC Temp PRINT) on the implants and natural teeth. This allowed:
  - Verification of aesthetics and occlusion
  - Soft tissue management
  - Extraction of tooth 15.
  - It was planned to use lithium disilicate and monolithic zirconia for the permanent restorations on both the natural teeth and implant abutments.

Digital Implant Planning and Surgical Guide Fabrication

Digital data from the three scans – the CBCT and the IOS before and after bridge removal - were accurately merged. This enabled virtual planning of the number, position, angulation and access position of the implant fixtures following a restoratively driven protocol (Fig. 4).

Based on the planned implant positioning (Fig. 5), a surgical guide was designed with the dedicated software. Master sleeves from the guided surgical system were placed

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Stephan Botha

TECHNICIAN

Stephan has been in the Dental industry since 2009. Mainly specializing in handpieces, curing lights, scalers and other small dental equipment repairs. Stephan has many years' experience in other dental equipment installation and repairs for example dental chairs, autoclaves etc.

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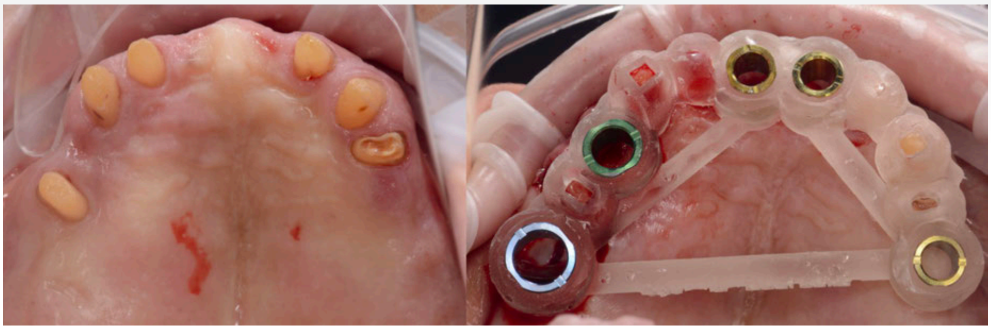

Figure 6: Five implant fixtures were placed using a fully guided surgical protocol.

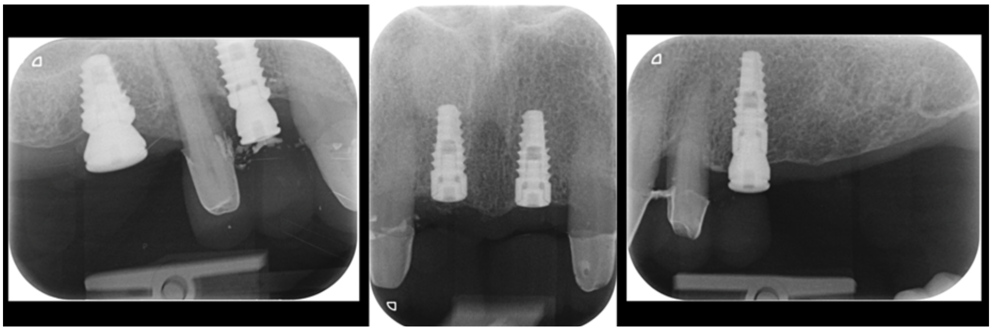

Figure 7: A flap was raised in the 11 region as buccal bone grafting was required due to a bony defect.

and fixed to the printed guide/framework.

The design of the previous PFM was also copied and replicated in the digital planning of the temporary bridge. It was then printed using the Asiga Max UV and GC Temp PRINT (medium shade) set at 50µm on the 3D printer.

Guided Implant Surgery and First Provisionalization Phase

The following clinical procedures were then completed on the day of implant surgery:

- All five implant fixtures were placed following a fully guided surgical protocol with the surgical guide (Fig. 6) and primary stability was confirmed.
- A flap was raised in the 11-21 region, a bone graft with bovine cancellous particulate was placed and covered with a porcine collagen membrane. Cover screws were placed and primary closure was established after a relieving incision and closed with PTFE sutures. At the other implant sites (16, 14 and 25), healing abutments were placed (Fig. 7).
- The 3D-printed temporary bridge was then cemented with GC Fuji TEMP LT on the remaining natural teeth (Fig. 8).

A healing period of 16 weeks allowed complete osseointegration of the implant fixtures. During this period, tooth 24 (upper left first premolar) developed signs and symptoms of pulpal necrosis. Hence, it was endodontically treated (Fig. 9).

Figure 8: Immediate post-operative following guided implant surgery and temporary cementation of the provisional fixed bridge printed from GC Temp PRINT (medium shade).

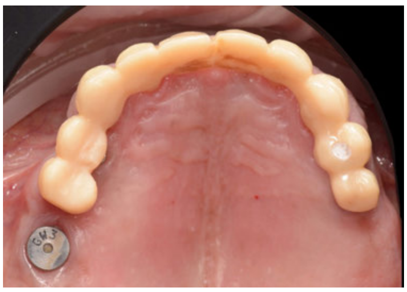

Figure 9: During the healing phase, tooth 24 developed pulpal necrosis and was endodontically treated.

Figure 10: View at 10 days after implant surgery.

Figure 11: Pre-operative surface scan.

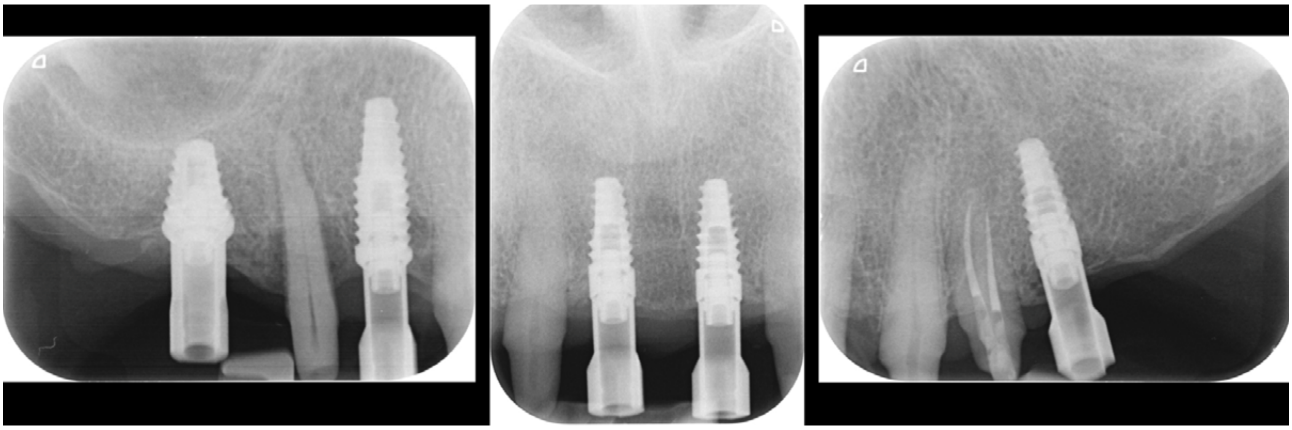

Figure 12: Periapical radiographs to verify the seat of the digital scan bodies.

Second Provisionalization Phase after Implant Integration.

Once the 16-week healing phase was completed and the fixtures were integrated, the restorative phase could be initiated. The patient confirmed that he was happy with the shape and occlusion of the initial temporary bridge (Fig. 10). The aesthetic and occlusal scheme could therefore be replicated in the second phase of provisionalization.

A pre-preparation IOS was taken with the healing abutment and temporary bridge in situ (Fig. 11).

The temporary bridge was then removed and preparation of the abutment teeth finalized and re-margined to the healed gingival tissue levels.

Stage 2 implant surgery on the 11 and 21 sites was completed using a soft tissue diode laser. The implants were exposed and cover screws removed.

An emergence profile scan was taken immediately after the healing abutments were removed to record gingival contours around the implant before any collapse of the tissues. Next, the full upper arch was scanned with digital scan bodies in place to capture the implant position accurately (Fig. 12).

All other prosthodontic records including the bite registration and the opposing arch were also captured with the intra-oral scanner before placing the temporary bridge back. All IOS were taken following the "Mak optimised scan strategy" (MOSS), allowing accurate stitching of IOS images. In soft tissue "pink" areas, the availability of landmarks is often limited; MOSS uses a specific scan path with or without markers for an enhanced scan accuracy and was especially designed for cases with few teeth to correlate to.

All the digital data was then sent to the ceramist for the fabrication the second set of provisional restorations.
Provisional restorations were printed with GC Temp PRINT and characterised with OPTIGLAZE color (GC). Temporary abutment cylinders were utilised for the implant-retained restorations. The contours of the 11 and 21 implant-retained provisionals as well as the pontic of 15 were designed and fabricated to shape the soft tissues for optimal support and

Figure 13: Second set of provisional restorations printed with GC Temp PRINT (medium shade) using the Asiga Max UV 3D printer.

Figure 14: Completed provisional crowns, implant retained crowns and bridge, characterised with OPTIGLAZE color (GC) – Dental technician: Brad Groblar, Oral Dynamics, New Zealand.

(Figs. 13-15).

Following removal of the temporary bridge, all the abutments were cleaned and the tooth 15 was extracted (Fig. 16). The provisional implant restorations, fabricated with direct screw access were torqued to the manufacturer's recommendation. All other temporary printed restorations were cemented with FujiTemp (GC) (Figs. 17-19).

The soft tissues were prosthetically shaped and allowed to

Figure 15: Completed provisionals fitted onto the printed models to allow the refinement of the contact points and occlusal contacts.

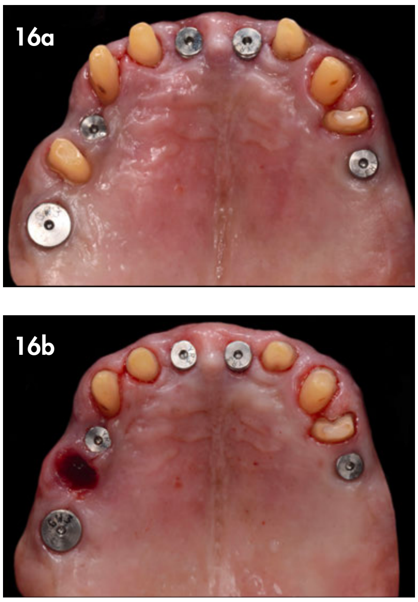

Figure 16: (a) After removal of the temporary bridge from the first provisionalization phase. (b) Tooth 15 was extracted.

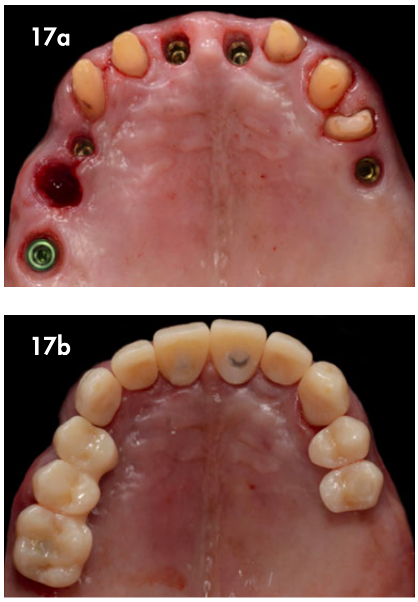

Figure 17: (a) Healing abutments were removed and (b) the second set of temporary restorations was placed.

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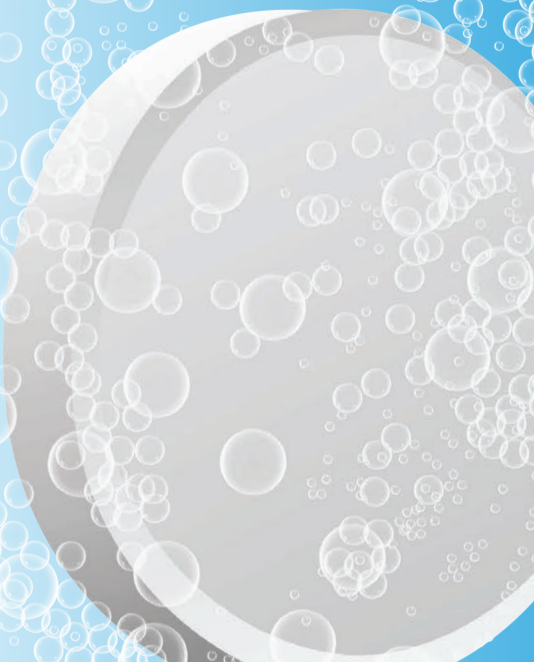

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ONLY R11,50 PER LITRE

24 Tablets make 24 Litres of Waterline Treatment Solution

*When following the instructions correctly

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12 Tablets make 30 Litres of Sterilizer Solution
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Product Code	Price Incl VAT	
WAY1000	R690.00	12 Tablets

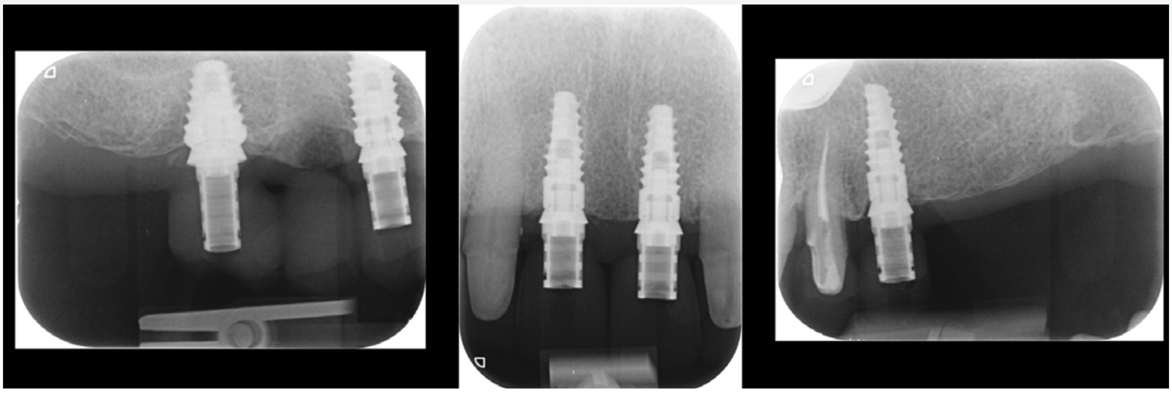

Figure 18: Periapical radiographs to verify the seat of the implant-retained provisional restorations.

Figure 19: Immediate post-operative view of the inserted provisionals.

heal for a period of 3 months before the finalisation of the rehabilitation with the definitive restorations.

Conclusion

The case presented illustrates how advances in digital technologies can provide clinicians with the tools for diagnosis, treatment planning, the execution and provision of dental restorative procedures in a truly transformative way.

Simplification of clinical protocols, increased accuracy over conventional analogue techniques and improved patient comfort and outcomes are compelling reasons of the benefits of a full digital workflow in the field of restorative and implant dentistry.

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Henry Schein Dental Warehouse helps dental professionals expand access to care with telehealth offerings amid COVID-19 outbreak

Henry Schein Dental Warehouse today announced the expansion of the company's service portfolio with the addition of a teledentistry offering, developed by Medpod Inc. Medpod is an expert in digital health and a trusted health care solutions partner with extensive clinical research and medical technology expertise.

The new offering is a clinical decision tool that allows dentists to provide critical patient communication and monitoring as the COVID-19 outbreak continues. The cloud-based software platform gives providers the ability to conduct remote consultations for patients so that they can continue to operate their practice, while delivering virtual care to patients who may not have access to a physical office visit, or choose not to visit a clinical setting as a safety precaution.

"Oral health and overall health are closely connected, and we want to ensure that patients' oral care is not neglected during this global pandemic and have therefore expanded our solutions offerings to teledentistry," said Leigh Spamer, Marketing and Sales Director, Henry Schein Dental Warehouse South Africa. "As we continue to practice social distancing to slow the spread of the coronavirus disease, access to remote patient care is critically important. By incorporating a teledentistry solution into the practice, it can help to monitor the health and welfare of a patient, during this challenging time, while also maintaining a close, personal contact. This new offering reinforces our commitment to deliver the solutions our dental customers rely on."

With Medpod's cloud-based software enabling teledentistry, dental practices can offer remote consultations, triage dental emergencies and any further investigations to be performed in person, and ensure post-procedure follow-up via a web-based platform on any smartphone, tablet, or computer. This also allows dentists to determine the patient's level of discomfort, prioritize cases, and makes it easy for patients to access their dentist in a more effective way than a phone call. For dental practitioners, Medpod's software offers live, two-way video communication, and integrates live-streaming of HD audio/video, and a highly flexible user interface into one easy-to-use, care delivery and patient management system.

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Stratified layering of composite restorations after the use of orthodontic aligners

Linda Greenwall[1] and Robert Katz[2]

There is a trend towards minimally invasive aesthetic dentistry and ensuring that no healthy enamel is cut in the preparation of an enhanced smile.

This case illustrates the use of orthodontic aligners, whitening treatment in the aligners, and composite bonding using a stratified layering technique and the placement of glass ionomer restorations on the cervical erosion areas.

The use of aligners in orthodontics

The use of removable aligners has increased greatly over the last 18 years. In 1999, Align Technology addressed the demand for an aesthetic alternative to braces by developing an 'invisible' method of orthodontic treatment (Invisalign) that uses a series of computer-generated, clear, removable aligners to move the dentition (Kunicio et al, 2007). Align Technology reports that, since then, more than four million Invisalign cases have been undertaken worldwide.

Aligner popularity has increased in adult patients who do not want to wear fixed braces, as they find them more difficult to tolerate, due to their effect and impact on daily life (Bernabe et al, 2008). The simple idea that a clear aligner can be used to align and reposition teeth is appealing to adult patients.

Patients can remove the aligners for eating, brushing, flossing and important meetings, but can wear the aligners for most of the day (Joffe, 2003).

The aligners are usually comfortable and offer ease of use. They are made of polyurethane and are normally 0.75mm thick. Patients are asked to wear the aligners for two weeks and then change to the next number in the sequence of aligners.

Patient assessment

The orthodontist will normally undertake a full assessment of a new patient. Treatment options are enumerated and discussed.

While fixed orthodontic braces may move the teeth more predictably and quickly, many patients do not want to wear braces. They want the effects of the treatment without having fixed braces. It is often the preference of orthodontists to undertake fixed appliance therapy because it can be more predictable and, in some cases, the teeth can move quicker. However, patients are given all the treatment options to align their teeth and many choose to have clear aligners. There are now several aligner brands on the market that the orthodontist can choose.

A recent systematic review of Invisalign research by Lagravere and Flores-Mir (2005) found that no strong conclusions could be made regarding the treatment effects of Invisalign appliances. It is the personal selection of the orthodontist and their patient.

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[2] Dr Robert Katz, Specialist - Orthodontics, London UK

Figure 1: Retracted smile before treatment commenced. The patient was unhappy with the overlapping of the anterior teeth and wanted the teeth to be whiter.

Figure 2: The results after Invisalign, whitening and restorative bondings.

Figure 3: Patient commenced upper and lower Invisalign treatment with orthodontist Dr Katz to improve the positioning of the teeth.

Figure 4: While wearing the Invisalign aligners, the patient bleached with 10% carbmide peroxide to improve the shade of her teeth. This photo illustrates the whitening gel has started to work and starts on the incisal edges first and moved up to the neck of the tooth.

The computerised Clincheck

With Invisalign treatment, the number of aligners needed is assessed with a computer scan called Clincheck (Align Technology).

Each aligner is programmed to produce a precise movement on a tooth of about 0.15- 0.25mm (Vlaskalic et al, 2001).

The stereolithographic technology is used to fabricate custom aligners from an impression or an intraoral digital image scanned in the dental practice.

Patient compliance is mandatory to achieve good results with Invisalign. It is important for patients to wear their aligners for 22 hours a day or more (Malik et al, 2013).

Once the Clincheck is undertaken, the number of aligners needed is calculated and the position and location of the attachments determined. The attachments are fabricated from clear composite resin and are transferred onto the teeth with an attachment template. The attachments are removed at the end of treatment. Where interproximal enamel reduction (IPR) is necessary, this is calculated in the Clincheck.

Studies have been undertaken to assess the accuracy of the computerised Clincheck assessment. In a study by Houle et al (2017), the mean accuracy of posterior expansion planned with Invisalign for the maxilla was 72.8% and 87.7% in the mandible.

There are limited data on the amount of discrepancy between predicted and actual achieved movements with Invisalign (Krieger et al, 2012). In a prospective clinical study by Kravitz et al (2009), the mean accuracy of tooth movement in the anterior region was found to be 41% with Invisalign.

An internal study from Align Technology found that one should expect about 80% of tooth movement seen on Clincheck (Tuncay and Orhan, 2006).

A multidisciplinary case – which treatment first?

This case involved multidisciplinary treatment including orthodontic treatment, restorative treatment and aesthetic

Figure 5: Study models used to make the retainer after Invisalign treatment was completed. The aligner had to be fitted immediately after treatment started and before undertaking the restorative bonding to lengthen the upper right anterior. The technician made a stent so we knew how much length we needed to add.

Figure 6: SDI Aura is applied onto the tooth to check the shade of the composite against the tooth after whitening. A test composite is placed onto the tooth at the very beginning of the bonding procedure prior to isolation so that the correct shade of composite is selected before the tooth dehydrates to a lighter shade. The translucent enamel shades are tested first. Here Aura E1 and E2 are being tested onto the transluscent incisal tip

Figure 7: SDI Aura is built-up in layers to look like natural enamel, starting with the placement of the enamel layer on the incisal and palatal edge. Lobes are created to give the effect of the mamelons and the translusceny at the tip. The lobes also help to determine the secondary anatomy and correct form and shape. The composite is always over built and the restoration reshaped and polished afterwards.

Figure 8: The results after Invisalign, whitening and restorative bondings with SDI Aura on the upper right and left centrals. The composite is shaped and polished with discs, rubber wheels and then final polish with felt wheels and SDI polishing paste for the enamel lustre. As the Aura has the enamel as a microfill it can be polished to a high gloss afterwards. The dentine layer is a nanohybrid.

home whitening treatment (Figures 1 and 2).

Invisalign treatment was commenced first (Figure 3). After the teeth had moved significantly, when the central incisors had straightened and towards the end of treatment, tooth whitening was undertaken in the upper and lower aligners (Figure 4).

Once whitening was satisfactorily completed, new retainers were made from new study casts (Figure 5). Composite bonding was undertaken (Figures 6-8) to repair the worn and shorter incisal edges of the upper central incisors. This was followed by glass ionomer treatment placed in the lower cervical areas to reduce sensitivity.

Normally, class V glass ionomer restorations are placed first prior to commencing any treatment as this helps to reduce sensitivity during whitening and also reduce sensitivity of the orthodontic tray rubbing against the cervical area of the tooth.

However, it was decided that the erosion of the cervical areas was not an area of concern and so Invisalign 'Each aligner is programmed to produce a precise movement on a tooth of about 0.15-0.25mm' treatment was started first.

Whitening treatment was next followed by composite bonding and class V restorations. The cervical areas of the lower premolars became extremely sensitive during whitening, so after whitening and waiting for the bond strength to improve, the areas were restored with a light-cured glass ionomer restoration.

Orthodontic treatment

In this case, the patient's main concerns where the uneven smile and the shortened upper central incisor teeth.

The characteristics of the malocclusion were as follows:

- Class I molar and canine occlusion
- 5mm overjet
- Proclination of the upper and lower incisor teeth
- Mild lower anterior crowding
- Upper incisor irregularity.

After a new patient consultation and a treatment planning discussion where all the options were discussed with the patient, she elected to have an orthodontic assessment to explore the options to move and align the teeth.

She was presented with two options, that of fixed braces or aligning treatment.

She requested that aligning treatment was undertaken. PVS impressions were sent to Align Technology for conversion into 3D study models using the company's software.

The Clincheck Pro software was used to modify the initial set-up (Figures 10 and 11). When finalised, 20 upper and lower aligners were prescribed, giving a treatment duration of about 10 months (Figures 12 and 13). IPR, totalling 1.2mm in the lower arch and 2.4mm in the upper arch, was prescribed. IPR was necessary to make space to correct the crowding the decrease the incisor protrusion.

Treatment proceeded as expected with no complications, or need for refinement. The patient was compliant and wore the aligners 22 hours per day.

When treatment was finished and the restorative treatment completed, fixed retainers were bonded upper (palatal) and lower (lingual) on the incisors and canines.

The retention phase

Normally, the final aligner acts as the retainer in most cases of Invisalign treatment.

Despite extensive research, the various elements leading to relapse of treated malocclusions are not completely understood, which makes retention one of the most challenging aspects of orthodontic treatment (Kuncio et al, 2007).

However, in this case, immediately after composite bonding, the upper retainer was cut in the incisal area to allow for the increased incisal length. New impressions were taken after completion of the restorative treatment and new retainers were made to ensure that the occlusion was well maintained. It is essential to stress that patients should wear their Invisalign retainers as prescribed by the orthodontist to ensure stability of the occlusion and correct alignment of the teeth.

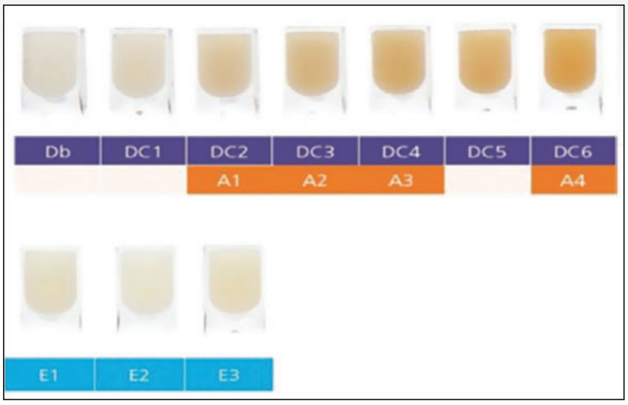

Figure 9: Shades of Aura composite.

In a comparative study of the retention of fixed braces versus Invisalign retainers, Kuncio et al (2007) found that, in many cases, aligner treatment can relapse more than fixed braces, and so patients are instructed to continue to wear their retainers for maintenance treatment.

However, the total number of patients in each group was 22, which is a very small number and further research is necessary.

Whitening in Invisalign aligners

Using the Invisalign aligners as whitening trays has become a viable treatment option for patients.

The recommendation is to wait for a month after the first aligners are placed and after the initial discomfort has settled down. The patient applies the whitening gel directly into the aligners.

A similar Van Haywood protocol can be adopted, namely to whiten the upper teeth first followed by the lower teeth.

The upper teeth whiten quicker and have fewer side effects and so the first stage of whitening is relatively simple. The lower whitening normally takes longer. It is thought that this is due to the wash-out effect of the salivary glands.

Due to the rigid nature of the aligner, it seems that whitening may occur quicker than a normal bleaching tray, but this has not been studied significantly.

Most aligners do not reach over the gingivae, so the gingivae may be less irritated during whitening.

There is no effect of whitening around the orthodontic attachments, and the whitening occurs in a multidirectional way and can whitening around the attachments.

Whitening and composite bonding

It is essential after completion of home whitening treatment

Figure 10: Initial centre view using Clincheck software.

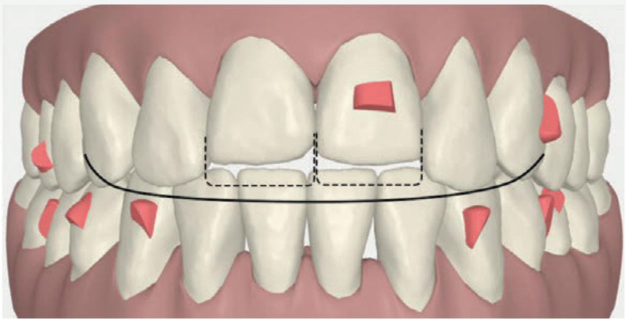

Figure 11: Final centre view.

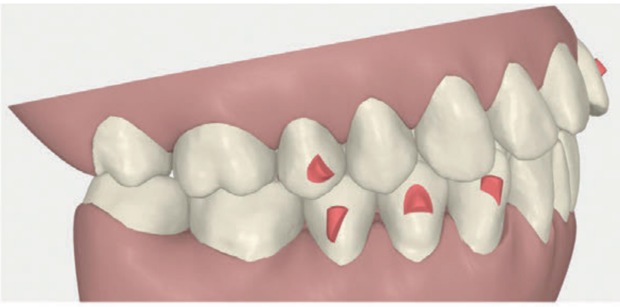

Figure 12: Initial right buccal view.

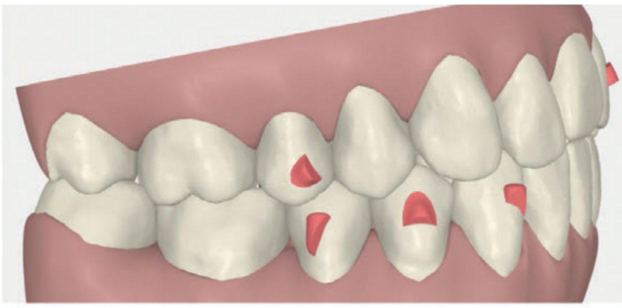

Figure 13: Final right buccal view.

to wait for a period of two weeks to allow all the oxygen to be dissipated from the tooth and for the shade to settle to the actual shade.

After tooth whitening, there is maximum saturation of oxygen inside the enamel. This causes a reduction in bond strength of 20%. It is thus essential to wait for two weeks for the enamel bond strength to recover back to the normal levels prior to commencing direct bonding onto the surface of the tooth.

Stratified layering technique

With the introduction of multiple component composite systems, it is now possible to create beautiful natural restorations using multiple layers of composite using their different optical and material properties. The Aura composite system is ideal as it contains both enamel and dentine shades (Figure 9).

The enamel shades are a microfill composite, which give the properties of a glass-like appearance of natural enamel (Figure 5). The dentine shades are a nanohybrid material (Figure 6), which gives extra strength for occlusal build-ups and they can be used as a bulk-fill material. There are separate bulk-fill syringes available for this purpose.

Shade selection of composite resin

According to Vanini (1996), it is essential to undertake a detailed evaluation of hue, chroma, opalescence, and fluorescence of the tooth in order to simplify the composite stratification technique.

This is done early in the clinical procedure to ensure that there is no dehydration of the tooth when the tooth is fully isolated (Figure 5).

Once the tooth is fully isolated, it dehydrates and lightens and this can result in the selection of a shade that is too light. Blends of composite colours are normally used and, after selection of the transluscent enamel shade (Dietchi, 2008), the dentine shade is used (Figure 6).

The hue is given by the dentine. The hue remains the same, although the greater thickness of the enamel interferes in its perception, giving it a less saturated aspect. Therefore, the hue of the tooth is given by the dentine and influenced by the enamel. The enamel does not change the hue, but only confers a greater or lesser saturation or chroma according to its thickness (Franco et al, 2007).

This is applied from darkest to lightest to give the restoration a lifelike appearance. Different translucencies may be selected for the mesial corners as, often, these are more translucent than the distal corners (Figure 7).

Used with an understanding of tooth morphology, restorative material selection, colour options, and the physical properties of light, these layering techniques allow optimally aesthetic restorations to be predictably achieved (Terry, 2003).

Applying the composite resin

A test run is undertaken first using a variety of composite shades. A clinical photograph is taken after the first test to review how the shades appear on a digital photograph. A polarised light photograph can also be taken to understand the nuances of the existing anatomy of the tooth, which needs to be copied.

As the teeth have been bleached, the bleaching composite shades can be used. In Aura composite, the DB shade blends very well to the bleached enamel (Figure 8). The enamel shades are tested first and light-cured followed by the dentine shades.

Placing the layers

Normally, the tooth is built-up from the palatal part first. A clear matrix is adapted to help form the shape of the missing incisal edge.

A wax-up can be used and a silicone stent can be made for ease of placement and for patient and dentist visualisation of the final outcome. The clear matrix is curved and rolled in the operator's gloved hand to form a curve. This is placed on the missing incisal edge and bonded into place using a dentine bonding agent. This helps to keep the hands free so that the layering of the composite can commence.

The layers are placed into the area with a flat plastic tool and then sculpted into place and refined with a fine haired brush dipped into bonding liquid or a rubber sculpting instrument.

The tooth is built-up in layers and light-cured (Figures 6 and 7). Each layer is checked after placement and modifications made as the restoration takes shape. Once the layering is completed, the final form is created with finishing instruments.

Sof-lex polishing discs (3M Espe) are used first to remove any bulk excess and then fine flame finishing burs are used.

After the form is completed, the patient is asked to sit up so that the incisal edges can be checked from the front of the patient. When the dentist is in a working position behind the patient, there is tendency to build the incisal edge restorations too long. This final length of the incisal edge is checked when the patient is supine in the chair.

The occlusion is checked and the final polishing can commence with the use of rubber wheels and a felt tip rubber wheel and polishing paste. The final glossy layer is created with a special rotary rubber wheel and polishing paste.

Conclusion

A multidisciplinary case such as this requires essential communication between the specialists undertaking the treatment, and also between the dentist and the patient, so that the patient is fully aware of the risks and the benefits of the different treatment procedures, and what is involved in each treatment so that an ideal outcome can be achieved.

The patient also needs to be fully aware of the retention phase needed to maintain the teeth in the same position, and to maintain a beautiful smile and when further whitening may be needed. In addition, any repairs to composite need to be detailed and occlusal checks need to be made regularly to maintain a beautiful smile. From time to time, during recall appointments, further polishing of the composite may be required, including retention recall evaluations.

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Posterior restoration with a universal adhesive and nano-hybrid composite

Tomislav Skrinjaric[1]

Figure 1: Initial situation: Insufficient composite filling, tooth 47.

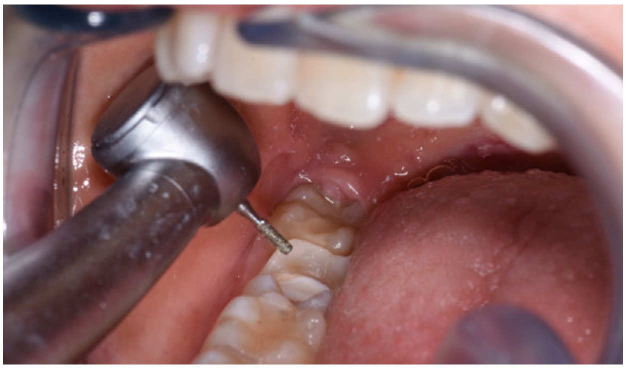

Figure 2: Removal of the defective composite filling.

Figure 3: Cavity lining for pulp protection with Calcimol LC and Ionoseal (VOCO). For creating a dry working field is recommended the use of a rubber dam.

Figure 4: Hold the SingleDose blister between thumb and forefinger and, by pressing on the area marked "press here", so that the liquid contained in the blister flows into the mixing and dispensing chamber.

Figure 5: Put the enclosed Single Tim applicator in the centre of the coloured circle in order to pierce through the film of the mixing and dispensing chamber. By stirring thoroughly with the applicator, create a homogeneous, streak-free mixture of the two liquids.

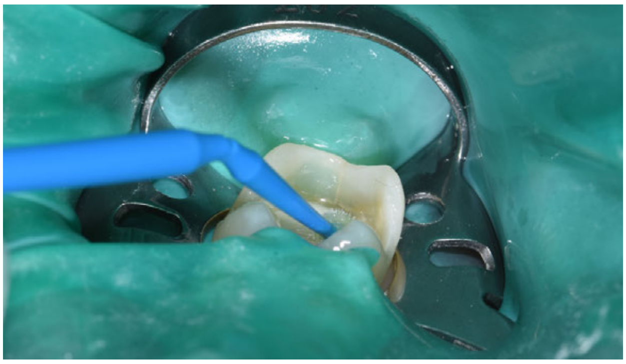

Figure 6: Apply the adhesive homogeneously to all cavity surfaces and rub in for 20 seconds using the SingleTim.

[1] Dr. Tomislav Skrinjaric, Croatia

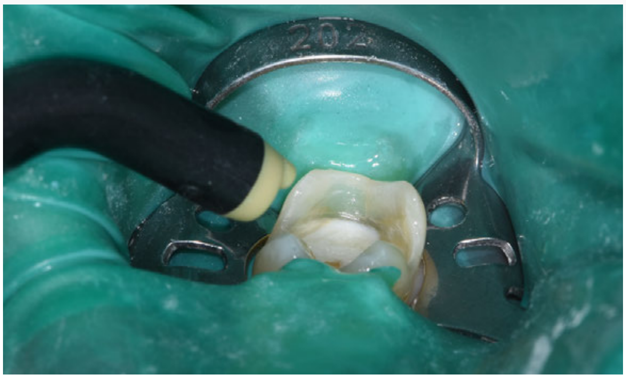

Figure 7: Dry off the adhesive layer with dry, oil-free air for at least 5 s in order to remove any solvents.

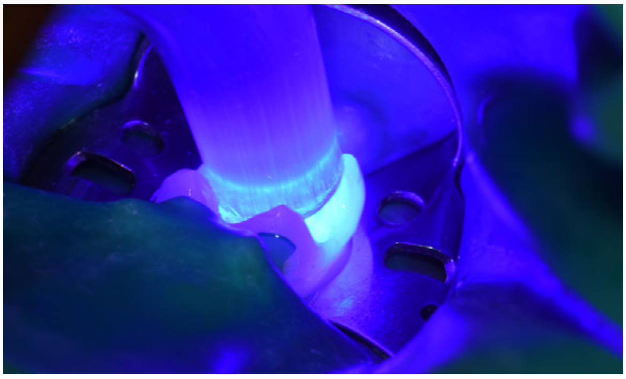

Figure 08: Cure the adhesive layer for 10 s using a commercially available polymerisation device (LED or halogen light with an output of > 500 mW/ cm²).

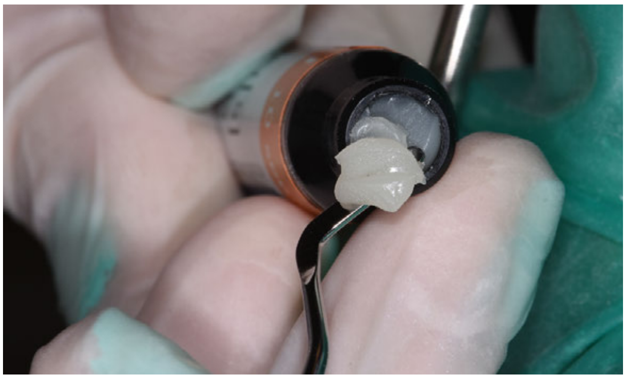

Figure 9: Taking the light-curing material for the posterior bulk filling (4mm) off the rotary syringe.

Figure 10: The light-curing posterior bulk-fill material (4mm) x-tra fil.

Figure 11: The cavity will be filled with x-tra fil (universal colour) by using the incremental technique.

Figure 12: Polymerise each increment for 10 seconds.

Figure 13: Filled cavity with x-tra fil before preparation.

Figure 14: Finishing and polishing of the composite filling.

Figure 15: Finishing and polishing of the composite filling.

Figure 16: Final result: Finished restoration with x-tra fil, tooth 47.

ETHICS 2020 SUPPLEMENT

In response to our readers' requests, International Dentistry - African Edition is pleased to annouce the publication of our Ethics 2020 Supplement.

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Article: Guided full arch implant surgery - a novel approach using a chrome cobalt bone reduction guide: A case report. Sauer et al, page 6

1. *Bone Density can accurately be assessed and measured in Houndsfield units by:*
   - a Cone beam CT Scan
   - b Panoramic X-Ray
   - c Medical CT Scan
   - d Periapical Radiograph

2. *Bone reductions are performed to:*
   - a Reduce inter arch space
   - b Hide the transition zone between the upper border of the denture & the gingival tissue
   - c Make space available for implant placement

3. *Stabilizing pins are used to:*
   - a Improve stability of bone & mucosa supported guides
   - b. Improve the stability of teeth
   - c Improve final aesthetics of the patient

4. *The Minimum Composite torque for a four-implant approach with immediate loading is:*
   - a 220 Ncm
   - b. 30 Ncm
   - b 120 Ncm

5. *Guided implant surgery presents several advantages, including:*
   - a Lower cost to patient
   - b Lower risk of complications
   - c Less Treatment planning

Article: Unilateral Class II treatment using fixed orthodontic appliances with open coil spring, sliding hook and light Class II elastics. Coetsee Jnr & Coetsee Snr, page 18

6. *A Class II type 2 subdivision describes the:*
   - a Mesial positioning of the maxillary first molar on the Class II side and a maxillary midline deviation to the Class I side
   - b Unilateral distal positioning of the mandibular first molar in relation to the maxillary first molar on the Class II side as well as a mandibular midline deviation to the Class II side.
   - c Mesial drifting of the maxillary first molar due to early loss of teeth

7. *Which arch wire is used in combination with the sliding hook, open coil spring and Class II elastic to distalize the 16?*
   - a 0.014 x 0.025 CuNiTi
   - b 0.019 x 0.025 SS
   - c 0.016 x 0.025 SS

8. *The specifications of the Class II elastic in use were:*
   - a 2oz 4.76mm
   - b 3.5oz 6.35mm
   - c 3.5oz 3.18mm

9. *According to the authors the main components of asymmetric Class II subdivision is of which origin?*
   - a Dentoalveor
   - b Skeletal
   - c Combination of dentoalveolar and skeletal

10. *The effect of inter-arch Class II mechanics such as elastics or fixed functional appliances are:*
   - a Creation of an open bite
   - b Proclination of mandibular incisors
   - c Arch expansion

CPD QUESTIONNAIRE 10.4.2

Article: A full digital workflow with 3D-printed temporary restorations. Mak and Chio, page 32

11. *Which statement is correct: the design of the master die model can all be done on CAD software and then manufactured with:*
a 3D printing
b Milling
c Neither of the above
d Both of the above

12. *In the case described, which teeth had a poor prognosis and were planned for extraction.*
a Teeth 25, 26 and 18
b Teeth 13, 14 and 18
c Teeth 15, 16 and 28
d Teeth 14, 11 and 21

13. *It was planned to use which material for the permanent restorations on both the natural teeth and implant abutments:*
a *Monolithic zirconia*
b *Lithium disilicate*
c Neither of the above
d Both of the above

14. *During the healing period, which tooth developed signs and symptoms of pulpal necrosis?*
a *Tooth 14 (upper right first premolar)*
b *Tooth 24 (upper left first premolar)*
c *Tooth 34 (lower left first premolar)*
d *Tooth 44 (lower right first premolar)*

15. *The restorative phase was initiated after a healing phase of:*
a 16 weeks
b 12 weeks
c 20 weeks

Article: Stratified layering of composite restorations after the use of orthodontic aligners. Greenwall and Katz, page 42

16. *According to Houle et al, what is the mean accuracy of posterior expansion planned with Invisalign?*
a 78.2% for the maxilla and 87.7% in the mandible
b 78.8% for the maxilla and 82.7% in the mandible
c 72.8% for the maxilla and 87.7% in the mandible
d 87.7% for the maxilla and 72.8% in the mandible

17. *According to the authors, why are Class V glass ionomer restorations usually placed prior to commencing any treatment?*
a To reduce sensitivity of the orthodontic tray rubbing against the cervical area of the tooth
b To reduce sensitivity during whitening
c Neither of the above
d Both of the above

18. *The study stating that aligner treatment can relapse more than fixed orthodontic treatment was authored by:*
a Bernabe et al (2008)
b Lagravere and Flores-Mir (2005)
c Kuncio et al (2007)

19. *In the case described, the characteristics of the malocclusion included:*
a 5mm overjet
b Class I molar and canine occlusion
c Mild lower anterior crowding
d None of the above
e All of the above

20. *According to Malik et al, 2013, the recommended minimum number of hours per day aligners should be worn is:*
a 12 hours
b 8 hours
c 18 hours
d 22 hours

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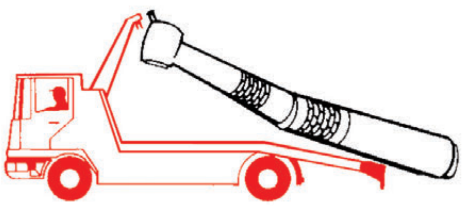

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