Case Report

The conometric concept – definitive rehabilitation with immediate implant and provisionalization by cone-in-cone abutments (Acuris): a clinical report

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Abstract

Cement- and screw-retained implant prostheses are commonly used. The conometric concept is a paradigm shift in prosthetic retention of single crowns that are fixed but retrievable by the clinician. Friction-based retention offers a fixation mode that provides the esthetics of a cement-retained crown while maintaining retrievability and excluding the submucosal residual cement risk. In this case report, we show the clinical feasibility of full mouth rehabilitation of a 44-year-old patient using a cone-in-cone abutment for the immediate implant and provisionalization with an Ankylos implant system (Dentsply Sirona, NY, USA).

Key words: immediate implant, cone-in-cone abutment, conometric concept, virtual design

Introduction

Fixed partial implant reconstructions such as single implant crowns and multiple-unit fixed dental prostheses are well documented in the literature. They have been accepted as suitable treatment options for replacing single or multiple missing teeth.[1] However, their clinical success can be further improved by considering the associated technical and biological aspects, such as using optimal fixation methods between the implant and restoration.

Recently, Bressan and Lops reported favorable results in a study using conic coupling abutments for full-arch fixed prostheses supported by four implants.[2] Bressan et al. also concluded in a recent article that a Morse taper using the conometric concept provided a fixed connection between the implant and dental prostheses upon application of adequate insertion force.[3] Marco et al. also showed the feasibility of using conic coupling connections of immediately loaded temporarily fixed partial restorations.[4]

This case report shows the clinical feasibility of using the conometric concept with the Acuris abutment for immediate provisionalization of implants with an Ankylos implant system (Dentsply Sirona, NY, USA).

Case Report

A 44-year-old male patient presented with chief complaints of dental cavities and malodor under his fixed prostheses. Comprehensive clinical (Figs. 1A and 1B) and radiographic (Fig. 2) examinations showed multiple missing teeth [18, 25, 26, 36], ill-fitting fixed prostheses in certain areas [11–16, 21–23, 24–27, 33, 34–38], and marginal caries [44–48]. Previous symptomatic root canal treatment of [14, 16, 22, 34, 35, 37, 38, 46, and 47] was also observed. Extra-oral examination showed facial asymmetry and occlusal plane canting (Fig. 3).

Following removal of the ill-fitting prostheses (Figs. 4A and 4B), several teeth [14, 16, 22, 48] were extracted since they were unsuitable for restoration, while others [13, 15, 21, 24, 33, 34, 35, 37, 38, 46, 47] underwent root canal treatment (Fig. 5).

Provisional prostheses were designed digitally (DentalCad; Exocad, Boston, MA, USA) and fabricated by superimposing the intraoral scan (Trios 4; 3-Shape, Copenhagen, Denmark), facial scan (Planmeca ProMax; Planmeca, Helsinki, Finland), and cone beam computed tomography (CBCT) (Planmeca ProMax; Planmeca, Helsinki, Finland) images along the bony and soft tissue landmarks to achieve the ideal facial midline, occlusal plane, and esthetic smile line (Figs. 6A and 6B). Following the delivery of the Cad/Cam PMMA provisional prostheses (Figs. 7A and 7B), mandibular jaw motion was recorded using a jaw movement tracing device (Planmeca 4D Jaw Motion; Planmeca, Helsinki, Finland) for temporomandibular joint (TMJ) analysis, corroborating a clinical setting for anterior guidance and cusp angle.

Following CBCT image analysis and discussion with the patient, the definitive treatment plan included single zirconia crowns and implants as follows: immediate implant placement for 22, delayed implant placement for 14 and 36; delayed implant placement with internal sinus lift for 16 and 26 (Figs. 8A-8E); and single zirconia crowns for 11, 12, 13, 15, 21, 23, 24, 27, 33, 34, 35, 37, 38, 44, 45, 46, and 47.

Figs. 9A and 9B show the abutment teeth and residual ridge condition after disease control. After 12 weeks of adjustments to dynamic equilibrium from TMJ and occlusion, the implant site was prepared for surgery. A surgical guide was designed digitally by superimposing the CBCT images and provisional prostheses.

The implant surgery was performed using the surgical guide and conical connection implant system (Ankylos; Dentsply Sirona, NY, USA). Tooth 22 was extracted, and a ø3.5 × 11 mm implant was placed immediately, while ø3.5 × 9.5 mm and ø3.5 × 11 mm implants were placed flapless over the 14 and 36 areas. The implant sites for 16 and 26 were prepared for sinus elevation using an internal sinus lift kit (Digital Sinus Guide Kit; Avansur Inc, Taichung, Taiwan), and ø4.5 × 8 mm and ø3.5 × 8 mm implants were inserted using the open flap technique (Figs. 10A and 10B).

Following a three-week healing period, the suture was removed, and Acuris abutments (Ankylos; Dentsply Sirona, NY, USA) were chosen sequentially (ø3.3 mm/0°/GH 3.0 mm for 14 and 22; ø4.5 mm/15°/GH 1.5 mm for 16; ø4.5 mm/0°/GH 3.0 mm for 36; and ø4.5 mm/0°/GH 1.5 mm for 26) and delivered using 25 Ncm for one-piece abutment (ø3.3 mm/0°) and 15 Ncm for two-piece abutment torque as recommended by the manufacturer (Figs. 11A and 11B). Then, the temporization caps were set, and provisional crowns were relined and reinstalled for early implant loading (Fig. 12). The temporary cap with a prosthesis can be easily snapped in with friction and is cement-free. Periapical radiographs and panoramic film were used to check the abutments' fit (Fig. 13).

During the one-month adaptation period, appropriate impression caps were aligned for definitive prostheses impressions (Figs. 14A and 14B). The single cord gingival retraction technique and polyether (Impregum Penta Soft Medium Body; 3M ESPE, Minnesota, USA) were used for close tray impressions. Bite registration was determined digitally using intra-oral scans with the laboratory caps applied over implant abutments.

Virtual wax patterns created for the definitive prostheses using the Cad system (DentalCad; Exocad, Boston, MA, USA; Figs. 15A and 15B) showed insufficient restorative space at the 16 implant site (Fig. 16). A new single implant level impression of this region was obtained using polyether (Impregum Penta Soft Medium Body; 3M ESPE, Minnesota, USA) to avoid food impaction caused by a large inter-dental space. The Acuris abutment was replaced with a cement-retained abutment (Ankylos Regular C/ø15°/GH 0.75 mm abutment; Figs. 17A and 17B). Definitive monolithic zirconia prostheses were milled according to the virtual designs and adjusted on the laboratory caps (Fig. 18). After occlusion and passive fit check from laboratory caps, they were removed from the abutment and changed into final caps on the abutment analogs. The final caps were tapped slightly into the abutments before final zirconia crowns for 14, 22, 26, and 36 were

Figure 1. Intraoral view of the old prosthesis. (A) Right side. (B) Left side.

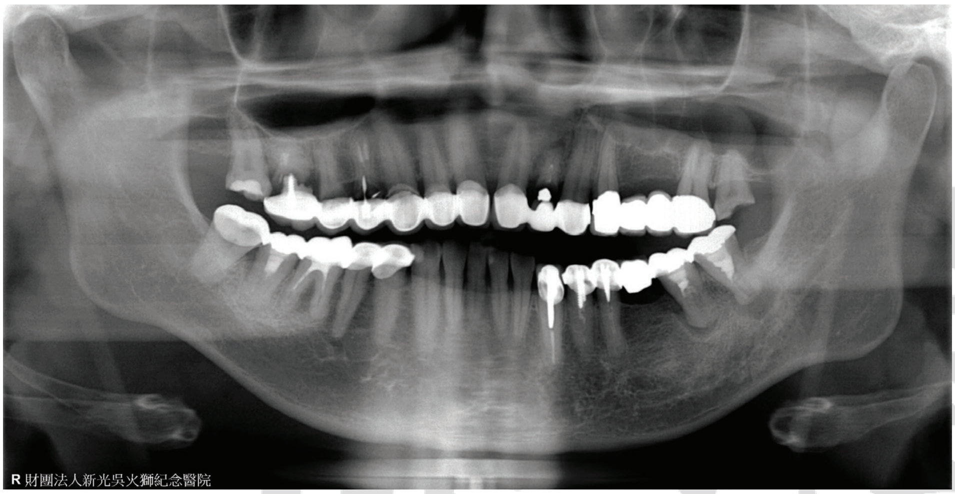

Figure 2. Panoramic film of the original status.

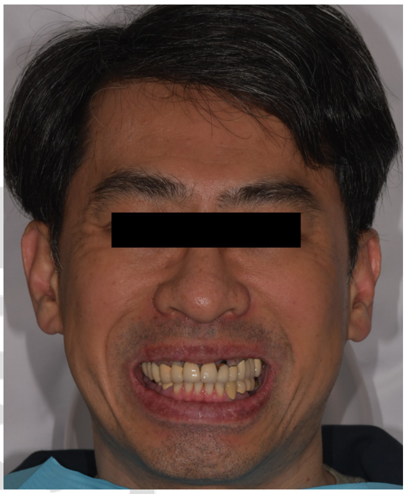

Figure 3. Initial frontal view of the patient.

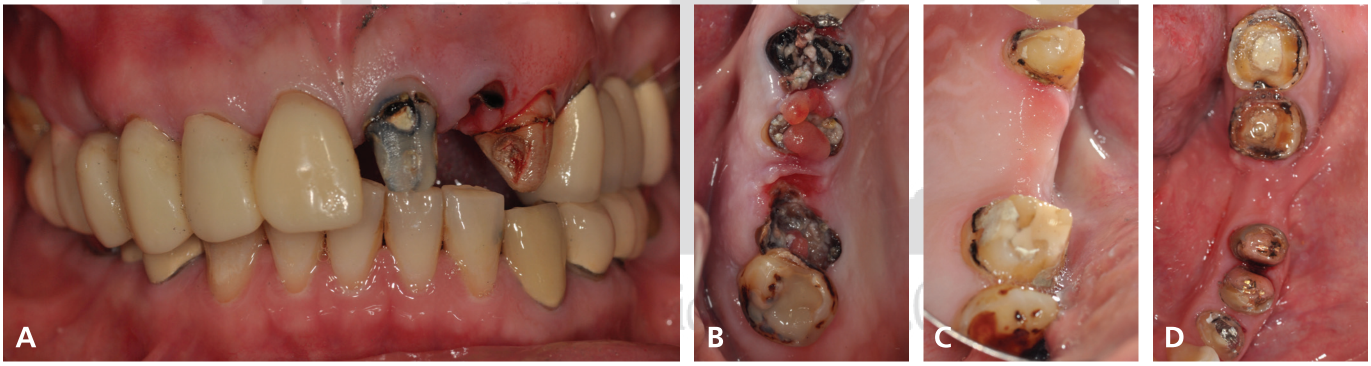

Figure 4. Abutment teeth status following old prosthesis removal. (A) Frontal view. (B) Upper right quadrant. (C) Upper left quadrant. (D) Lower left quadrant.

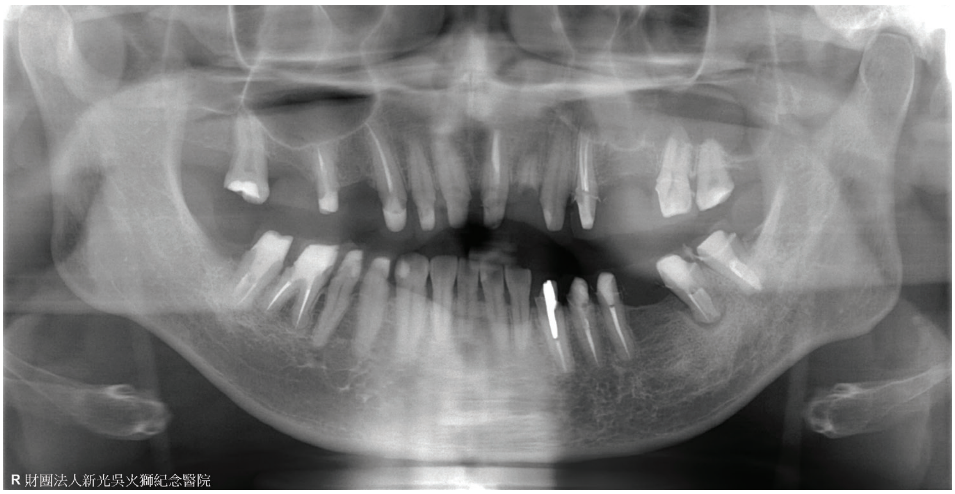

Figure 5. Panoramic film after disease control.

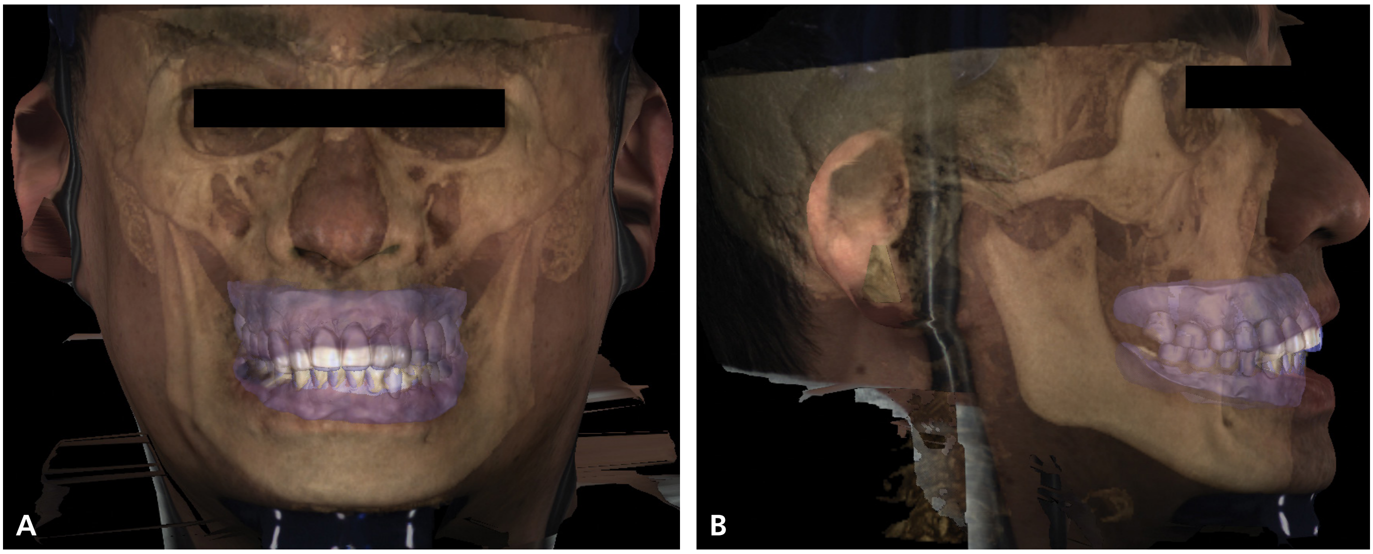

Figure 6. Provisional prosthesis design with facial scan and CBCT along the bony and soft tissue landmarks. (A) Frontal view. (B) Lateral view.

Figure 7. Delivery of the CAD/CAM PMMA provisional prosthesis. (A) Right side. (B) Left side.

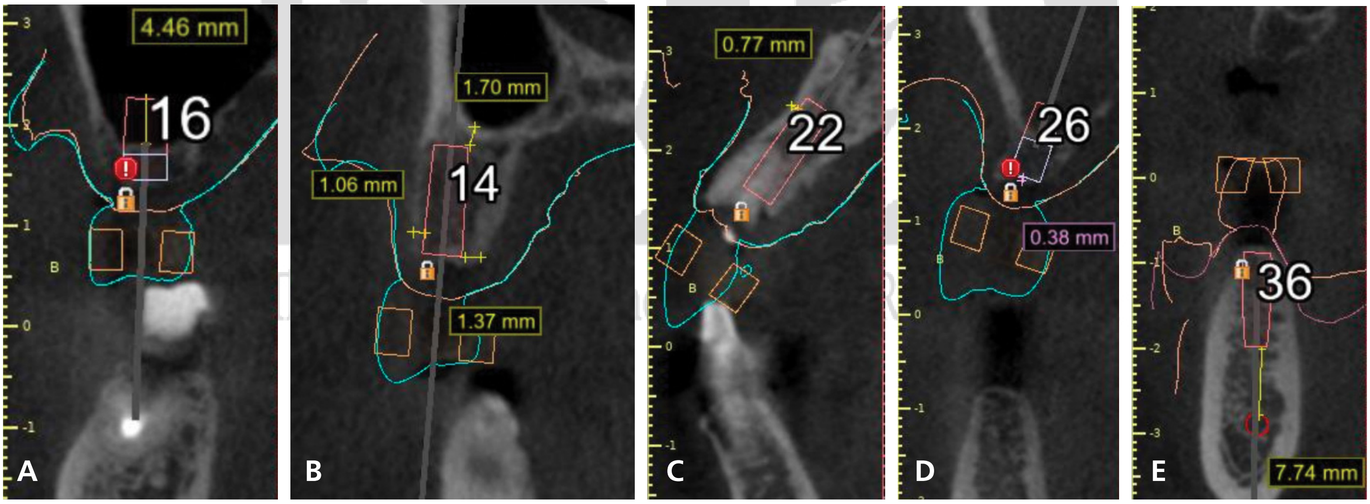

Figure 8. CBCT images analysis of the implant sites bone condition. (A) 16. (B) 14. (C) 22. (D) 26. (E) 36.

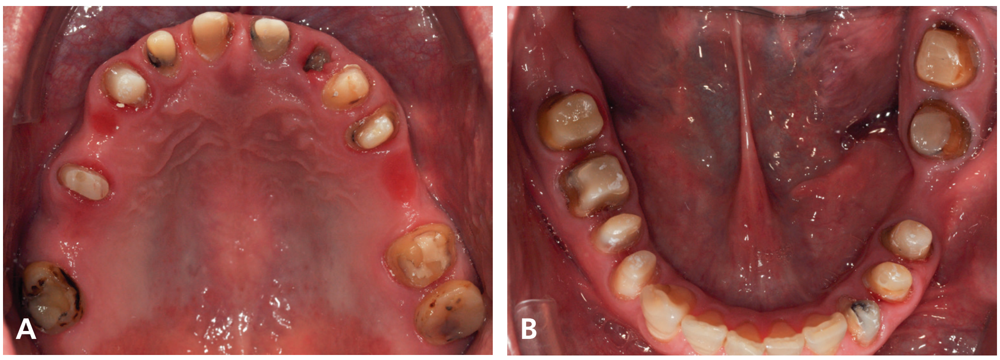

Figure 9. Intra-oral view of the abutment teeth and residual ridge after disease control. (A) Maxillae. (B) Mandible.

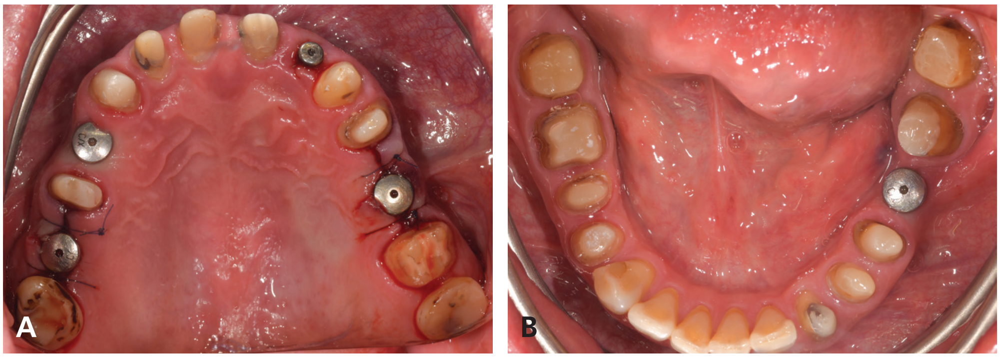

Figure 10. Intraoral view following implant placement. (A) Maxillae. (B) Mandible

Figure 11. Acuris abutments were chosen and delivered. (A) Maxillae. (B) Mandible.

Figure 12. The temporization caps were removed , and provisional crowns were relined and reinstalled for early implant loading. A flowable resin was added for a proper emergence profile.

Figure 13. Panoramic film was used to check the fit of the abutments and the emergence profile.

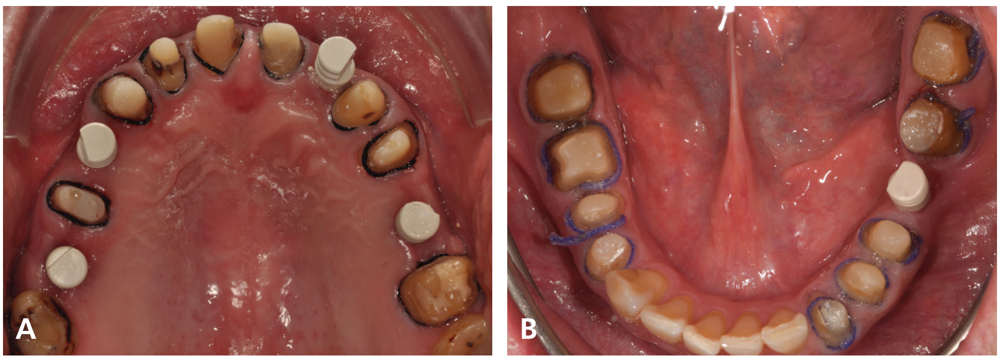

Figure 14. Impression caps try-in. The single cord gingival retraction technique and polyether were used for close tray impressions. (A) Maxillae. (B) Mandible.

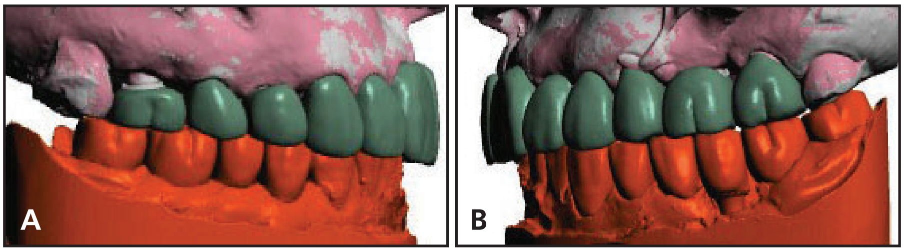

Figure 15. Creation of virtual wax patterns for the definitive prostheses on the lab caps using the Cad system (Exo-Cad).

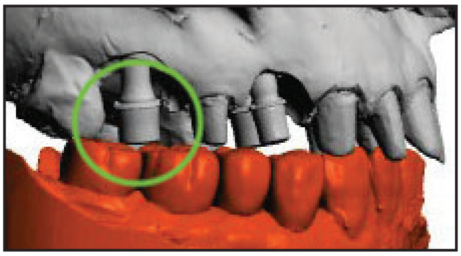

Figure 16. Insufficient restorative space at the #16 implant site. A large inter-dental space will cause food impaction.

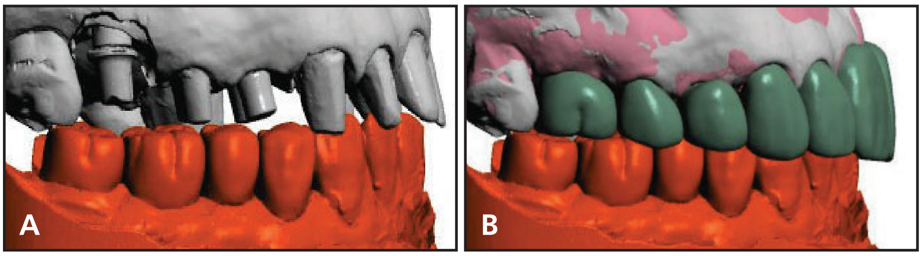

Figure 17. The Acuris abutment was replaced with a cement-retained abutment at the #16 implant site. (A) Abutment level. (B) Virtual wax of the definitive prostheses.

Figure 18. Definitive monolithic zirconia prostheses were milled according to the virtual designs.

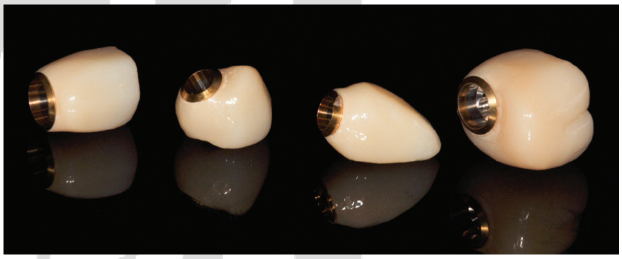

Figure 19. The final caps were tapped slightly into the abutments then the final zirconia crowns for #14, #22, #26, and #36 were cemented onto the final caps using resin cement (RelyX U200, 3M ESPE) on the lab model.

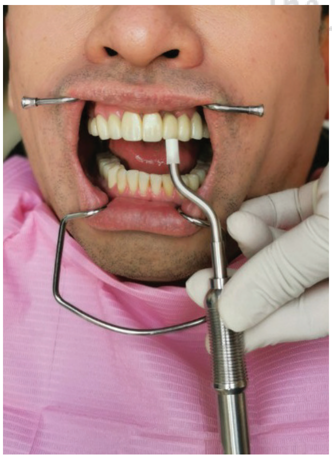

Figure 20. The conometric crowns for #14, #22, #26, and #36 were delivered by the fixation tool.

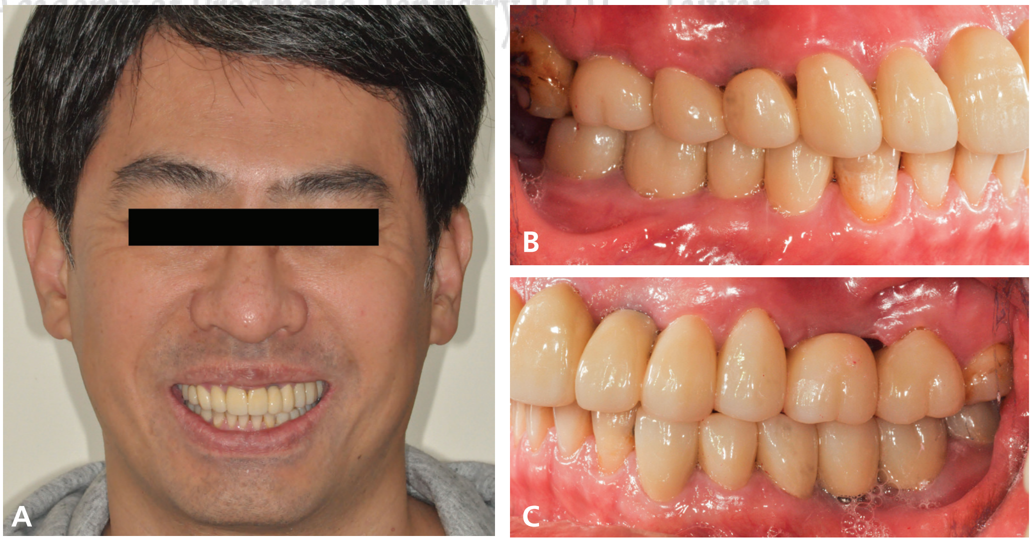

Figure 21. Definitive prosthesis delivery. (A) Fontal view. (B) Intra-oral view of the right side. (C) Intra-oral view of the left side.

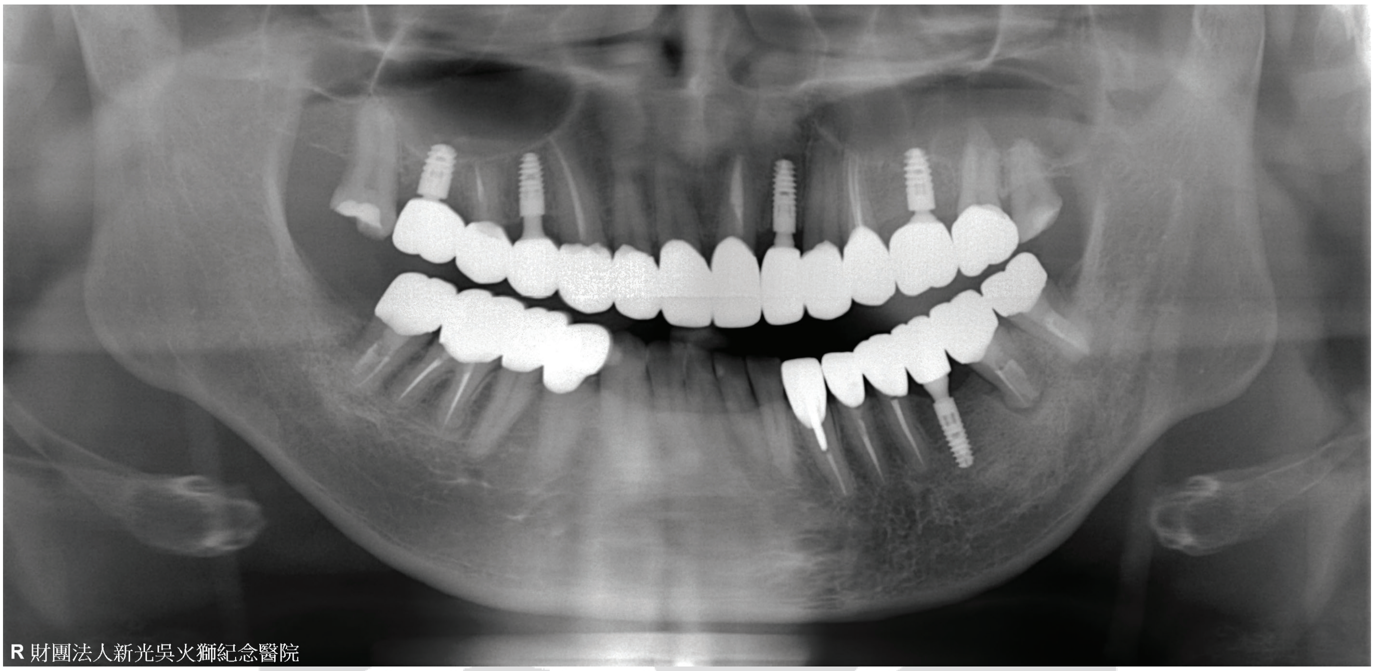

Figure 22. Confirmatory panoramic film following definitive prosthesis delivery.

cemented onto the final caps using resin cement (RelyX U200; 3M ESPE, Minnesota, USA ; Fig. 19) based on the lab model.

After confirmation of each new crown's occlusion and contact, the regular cement-type abutment of 16 was changed clinically using an extraoral cementation technique. The definitive prostheses for 11, 12, 13, 15, 21, 23, 24, 26, 27, 33, 34, 35, 37, 38, 44, 45, 46, and 47 were fixed using resin cement (RelyX U200; 3M ESPE, Minnesota, USA). The fixation tool delivered the conometric crowns for 14, 22, 26, and 36 in only one punch (Fig. 20). A combination of pressure and impulse was used to activate the retention between the Cap/Final crowns and abutments. The prosthesis fit and the precision and achievement of ideal esthetic outcomes were confirmed clinically (Figs. 21A-21C) and radiographically using new panoramic and periapical radiographs (Fig. 22).

Discussion

The conometric concept comprises a cemented tapered coping with a final crown inserted into a tapered abutment. Upon application of an insertion force and activation of the system, the coping's cervical margin is slightly deformed by the wedge effect, and elastic stress fields are created within the coping and abutment. These stresses will partially remain after the removal of the insertion force, providing a retentive capability to the system.[5]

A previous finite element analysis study reported that non-cemented conometric systems showed a range of retentive characteristics depending on the insertion load.[3] Under healthy conditions, mean maximum bite force values of 446 to 1221 N cause retentive forces >150 N, which are greater than the values observed in cemented systems, preventing dislodgment of the prosthetic devices during physiological function.[6] Similar results were also reported by Nardi et al.,[7] who showed that the welding caps' retention strength increased with higher abutment diameters and head heights and was comparable or superior to the values reported for temporary cements used in implant dentistry.

While traditional screw-retained prostheses offer tight retention, they are often associated with more common mechanical complications such as screw loosening and ceramic fractures. Tebbel et al. reported that the conometric connection of the tested samples maintained its stability over time under cyclic loading, and no wear effect was detected.[8] Moreover, another study by Tebble et al. concluded that the conometric mode of retention could withstand lateral forces thought to occur mainly in the anterior incisors region.[9]

The conometric concept is a paradigm shift in prosthetic retention of single crowns that are fixed but retrievable by the clinician. A previous study showed that the removal force increases with increasing pre-load but plateaus at higher loads (400–600 N).[10] This observation supports the assumption that even at higher forces, the retention of the conometric caps is manageable, maintaining the retrievability of the prostheses on the implants.

Using the conometric concept as a fixed connection between the implant and the prosthesis without cement can provide certain biological advantages, such as the decreased risk of compromising peri-implant soft tissues with excess luting agent compared to cemented and screw-retained treatments, resulting in optimal plaque control and frequent peri-implant soft tissue checks. An in vitro study showed that the Acuris conometric interface did not allow bacterial translocation under non-dynamic loading conditions.[11] While the luting gap between the prefabricated TiN-caps and the ceramic crown was within the clinically acceptable range, no microgap could be detected at the cone-in-cone Acuris junction by scanning electron microscopy analysis.

The results of this case report show good clinical feasibility for using the conometric concept on the abutments of immediate implants, providing a clinical cement-free mode of fixed retention, yet retrievable by the clinician. There is no screw hole and fillings on the zirconia crowns. A time-saving and easy-to-use solution for single crowns provides a simplified restorative concept to reduce chair time. Further studies are needed to analyze the long-term success rates of this clinical approach.

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