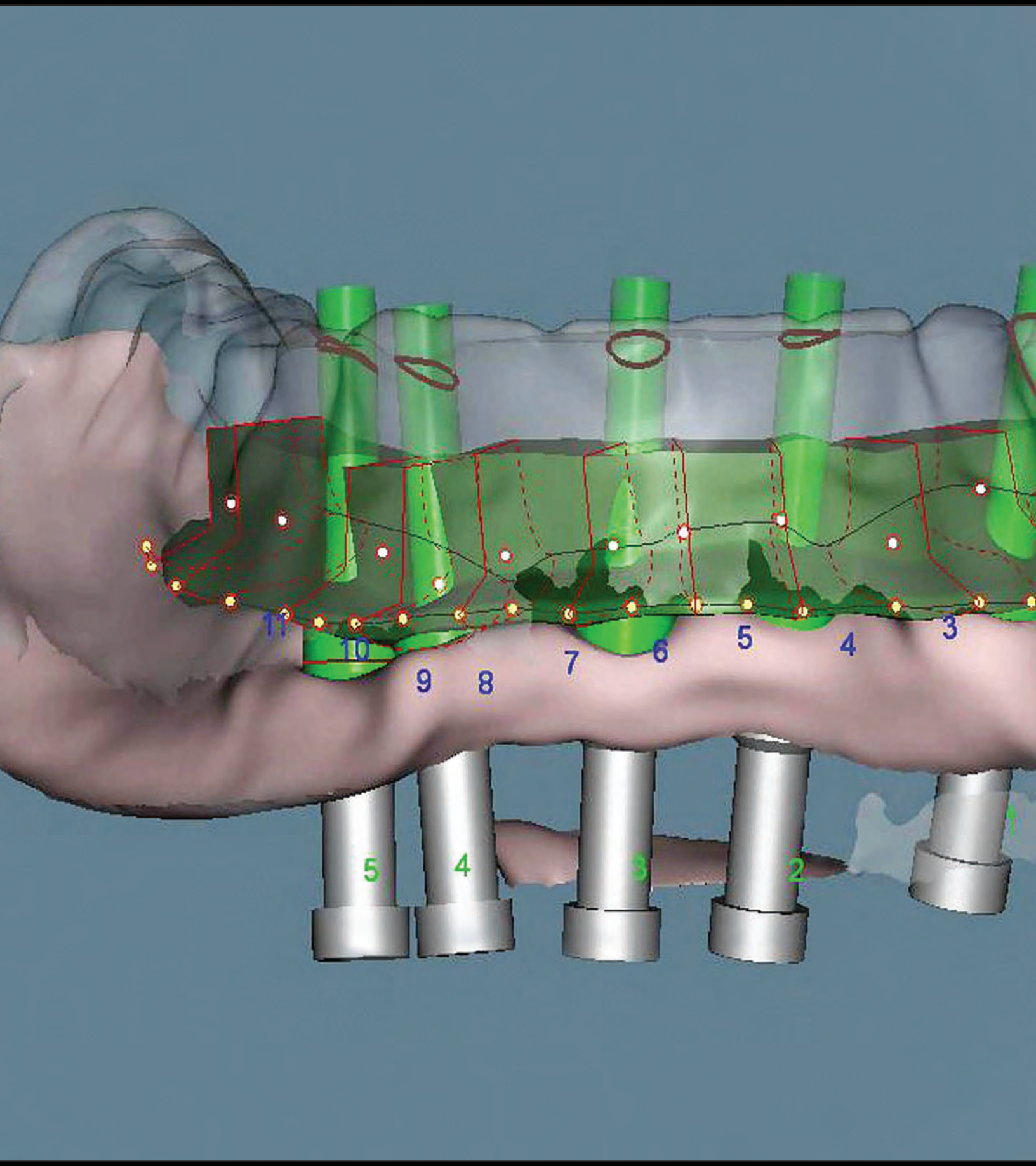
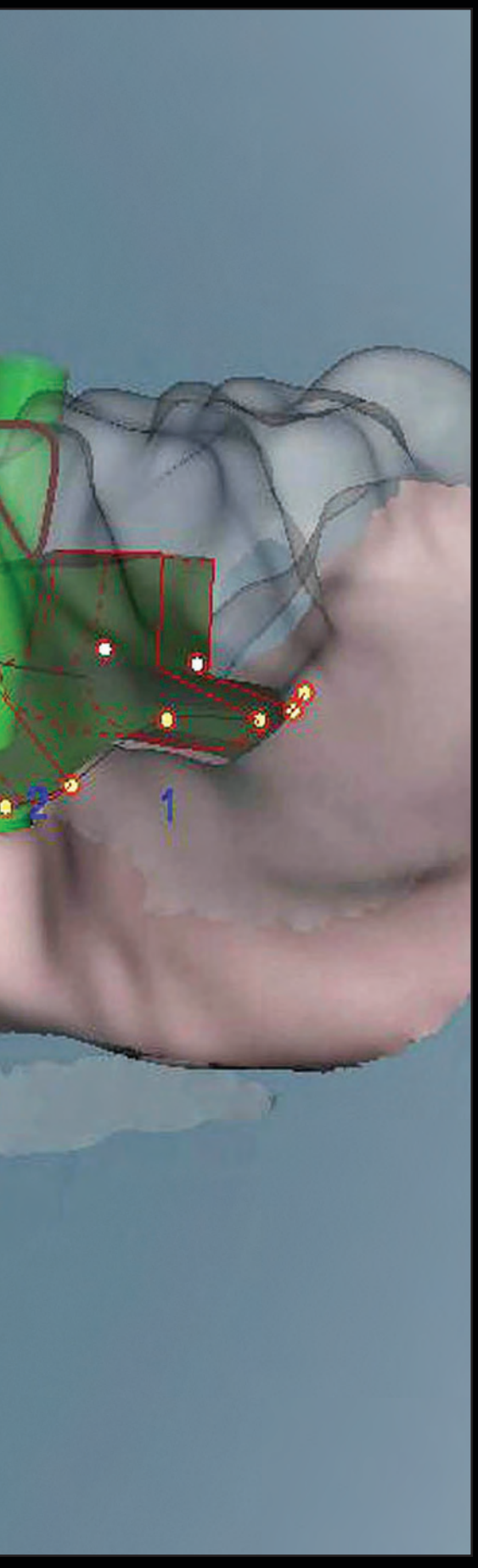

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A technique for fabricating a milled titanium complete-arch framework

using a new CAD/CAM software and scanner with laser probe

Ilser Turkyilmaz, DDS, PhD; and Neset Volkan Asar, DDS, PhD

INTRODUCTION **Implant dentistry has come a long way since 1982 when Per-Ingvar Brånemark first presented his work on osseointegration of endosseous dental implants (1). In the last 3 decades, the use of dental implants has increased exponentially (2). As the treatment became more predictable, the benefits of therapy became evident. The tremendous demand for implants has fueled a rapid expansion of the market.**

Abstract

By using traditional casting procedures, accurately fitting of complete-arch frameworks that are screwed on multiple implants is difficult to achieve. The introduction of computer-aided design and manufacturing (CAD/CAM) techniques for fabricating custom 1-piece titanium frameworks simplifies this challenge and reduces time spent by the restorative dentist. This report presents a milled titanium complete-arch mandibular framework using a new planning software and a new scanner using non-contact laser probe, which eliminates the need for wax pattern fabrication.

Key Words: Implant, Cad/CAM, titanium, framework, fit, Nobel Procera

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Figure 1. *Mandibular definitive cast was sprayed with zinc-oxide powder and zinc-oxide powder was cleaned from implant platforms before placing scanning abutments.*



Figure 2. *Trial denture was sprayed with zinc-oxide powder after placing it on definitive cast.*

Dental implants can support many types of dental restorations, ranging from a single tooth to a complete-arch fixed restoration (3). The prosthetic design must take into consideration many factors, including number of teeth to be replaced, biomechnical considerations regarding how many implants are necessary to support the restoration, functional considerations such as the occlusal scheme and opposing dentition or restoration, and relative cost of the restorative materials (3).

Traditional castings have a major limitation inherent in the process, which is distortion of the casting with increasing size of the pattern (4). Single implant restorations can be cast within this tolerance, because the distortion is limited based on size. Complete arch restorations, however, are difficult to cast successfully (4). Implant-supported prostheses must have a passive-fit to the implants. A misfit between a metal framework and an implant may cause mechanical and biologic problems, such as screw loosening, implant and prosthesis fractures, and loss of osseointegration (5,6). Complete passive-fit of a metal framework is rarely seen, especially, when fabricating complete-arch 1-piece frameworks using a traditional casting method (5).

CAD/CAM technology has significantly enhanced both surgical and restorative aspects of implant dentistry (7,8). CAD/CAM fabrication of bars and frameworks has resulted in elimination of distortion, better fit, fewer fabrication steps, and faster turn-around (4,9). Other advantages of a CAD/CAM titanium framework include its light weight, biocompatibility, and low cost (10).

There are few 3-D planning softwares to design and to fabricate frameworks and surgical guides available (8,11). A company (NobelBiocare USA, Yorba Linda, Calif) recently launched a new software (Procera, version 4.0.10.5, NobelBiocare USA, Yorba Linda, Calif) and a new scanner (Procera Forte, NobelBiocare USA, Yorba Linda, Calif) that are quite different from previous versions. The former version of the scanner required wax pattern fabrication for each framework before scanning (8). The probe of the scanner, a 2 mm ball, touched the wax pattern during scanning, which was one of the drawbacks of this process. However, the new scanner can fabricate most implant-supported framework designs without any wax pattern since it uses a non-contact laser. No clinical studies have been published regarding this

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new technique yet. This report aimed to introduce the new CAD/CAM software and scanner, and to describe the design and fabrication of an implant-supported screw-retained fixed dental prosthesis (FDP) framework.

TECHNIQUE

A 70-year-old woman with an edentulous maxilla and mandible presented to the Prosthodontic Clinic at the University of Texas Health and Science Center at San Antonio (UTHSCSA) with complete maxillary and mandibular dentures. The patient's chief complaint was the poor retention of her mandibular complete denture. Clinical examination and evaluation of the patient revealed a maxilla that could readily support and retain a conventional complete denture, and a mandibular residual ridge with resorption that would benefit from dental implants. A new maxillary complete denture and a mandibular implant-supported screw-retained FDP were proposed to the patient.

The patient had a cone-beam computerized tomography (CBCT) scan (Ewoo Master 3D CBCT machine, Vatic, Bora-Dong, Giheung-Gu, Yongin-Si, Geeing-Do, Republic of Korea). Five mandibular implants were planned using 3-D implant planning software (Procera, NobelBiocare USA, Yorba Linda, CA). Then, 5 mandibular implants (NobelReplace Straight Groovy, 4×13mm (3), 4×15mm, Nobel Biocare USA, Yorba Linda, CA) were placed uneventfully (2). Healing abutments (Nobel Biocare USA, Yorba Linda, CA) were immediately screwed on the implants. The mandibular denture was relieved in the areas of the abutments and then was lined with a resilient liner (Lynal, Dentsply Caulk, Milford, DL) after implant placement. Three months after implant placement, the patient returned to the Prosthodontics Clinic for a new maxillary complete denture and an implant-supported screw-retained FDP. The maxillary complete denture was fabricated using traditional prosthetic methods. The following steps were followed to fabricate the mandibular implant-supported screw-retained FDP.

1. Make an implant-level impression of the mandible using the custom tray, closed-tray impression copings (Nobel Biocare USA, Yorba Linda, CA), and vinyl polysiloxane impression material (Aquasil, Dentsply Intl, York, PA).
2. Attach implant replicas (Nobel Biocare USA, Yorba Linda, CA) to the impression copings, and pour the mandibular definitive cast using Type IV dental stone (ResinRock, Whip Mix Corp, Louisville, KY).
3. Fabricate maxillary and mandibular trial dentures using traditional prosthetic methods.



Figure 3. *Occlusal view of mandibular cast with implant positions after scanning process.*

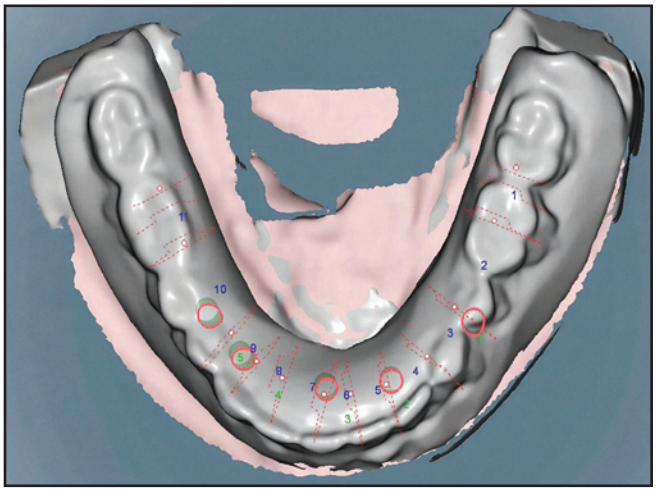


Figure 4. *Occlusal view of mandibular cast and trial denture after scanning process.*

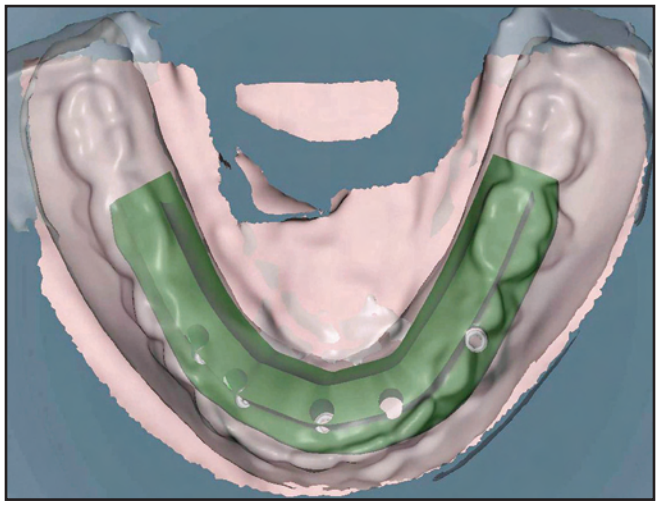


Figure 5. *Occlusal view of final design of mandibular framework. Note that each layer (item) can be easily seen by dentist as each layer has different color.*

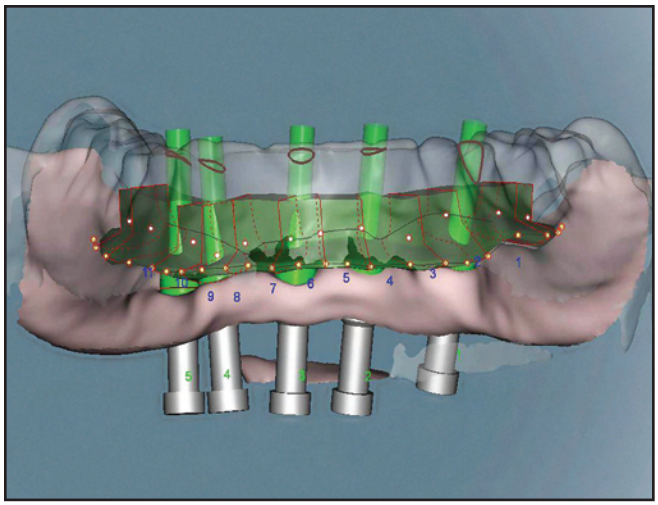


Figure 6. *Frontal view of final design of mandibular framework. Height, width, and shape of framework can be determined according to scan of trial denture using special markers provided by software.*

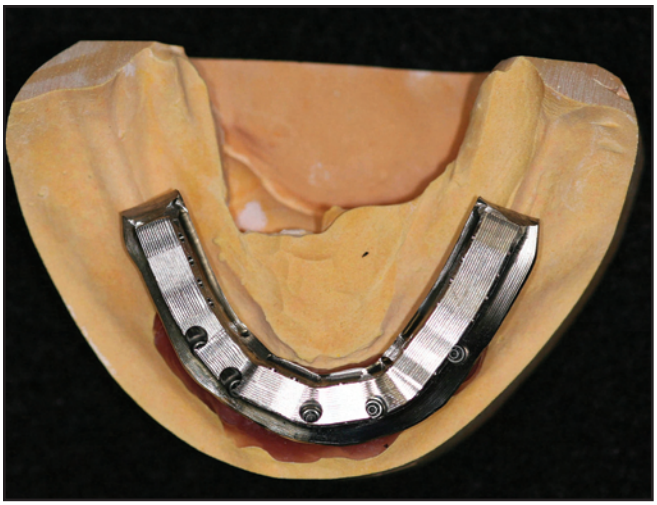


Figure 7. *Occlusal view of CAD/CAM titanium framework screwed on implants.*

4. Perform a trial denture insertion and verify centric occlusion, esthetics, phonetics, and occlusal vertical dimension. After approval by the patient, dismiss the patient.
5. Spray the mandibular definitive cast with zinc-oxide powder (Dr Scholl's Spray Powder, MSD Consumer Care, Inc, Memphis, TN) (Figure 1), and then screw scanning abutments onto implant replicas.
6. Scan the mandibular definitive cast with scanning abutments. This allowed the software to locate the implant platforms.
7. Scan the mandibular definitive cast without scanning abutments. This allowed the software to register the tissue surface.
8. Scan the trial denture after it was sprayed with zinc-oxide powder (Dr Scholl's Spray Powder, MSD Consumer Care, Inc, Memphis, Tenn) and seated on the definitive cast (Figure 2). If the scanning process was performed accurately, the planning software superimposes these different scans without any problems (Figures 3,4). Then, the dentist can see each item (layer) seperately or together, which allows him or her to design the framework.
9. Design a complete-arch framework using the software. The height, width, and shape of framework were determined according to the scan of the trial denture (Figures 5,6). Adequate space was provided, allowing for denture teeth and acrylic resin. This information was sent online to the Production Center in Mahwah, New Jersey.
10. A complete-arch titanium framework was milled from a titanium block using CAD/CAM technology in the Production Center. It was returned to our clinic 3 days after the scanning.
11. Verify the fit of the titanium framework intraorally after confirming it on the definitive cast (Figures 7,8). Position the milled framework and secure with a single screw to an implant and verify accurate fit radiographically.
12. Transfer the denture teeth to the framework from the previously fabricated trial denture. An optional second trial denture insertion may be performed to evaluate centric occlusion, esthetics, phonetics, and occlusal vertical dimension.
13. Process, finish, and polish the mandibular implant-supported screw-retained FDP.
14. Insert the mandibular implant-supported screw-retained FDP on the implants, and tighten the abutment screws using 35Ncm of torque. Cover screw access holes using cotton pellet and composite resin (Figures 9,10).

CONCLUSION

This report describes the fabrication of a CAD/CAM titanium framework using a newly available planning software and a new scanner using non-contact laser. This technique eliminates the need for a wax pattern before fabricating a metal framework as it uses a laser probe. The misfit that often occurs when delivering traditional cast frameworks can be minimized by using scanning and custom-milling technology to fabricate a milled complete arch titanium framework.

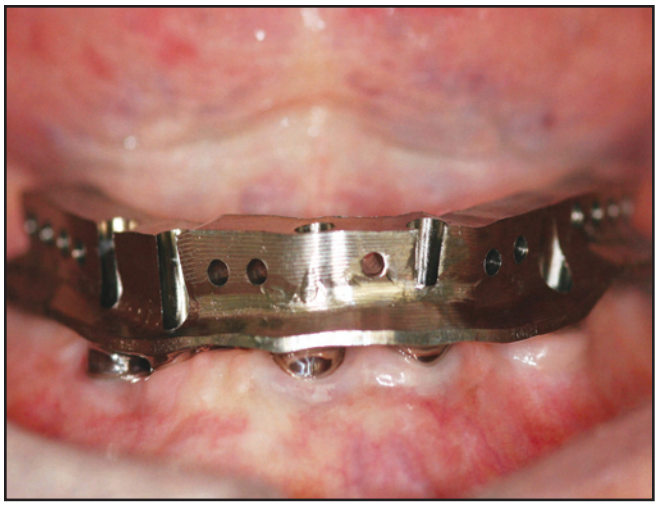


Figure 8. *Clinical fit of mandibular framework was verified. Note striations created during the milling process and resin retention features created after completion of the milling process.*



Figure 9. *Intraoral view after both restorations were inserted. Convex design of the mandibular framework, which was positioned 1mm above the gingiva, allowed easier hygiene.*

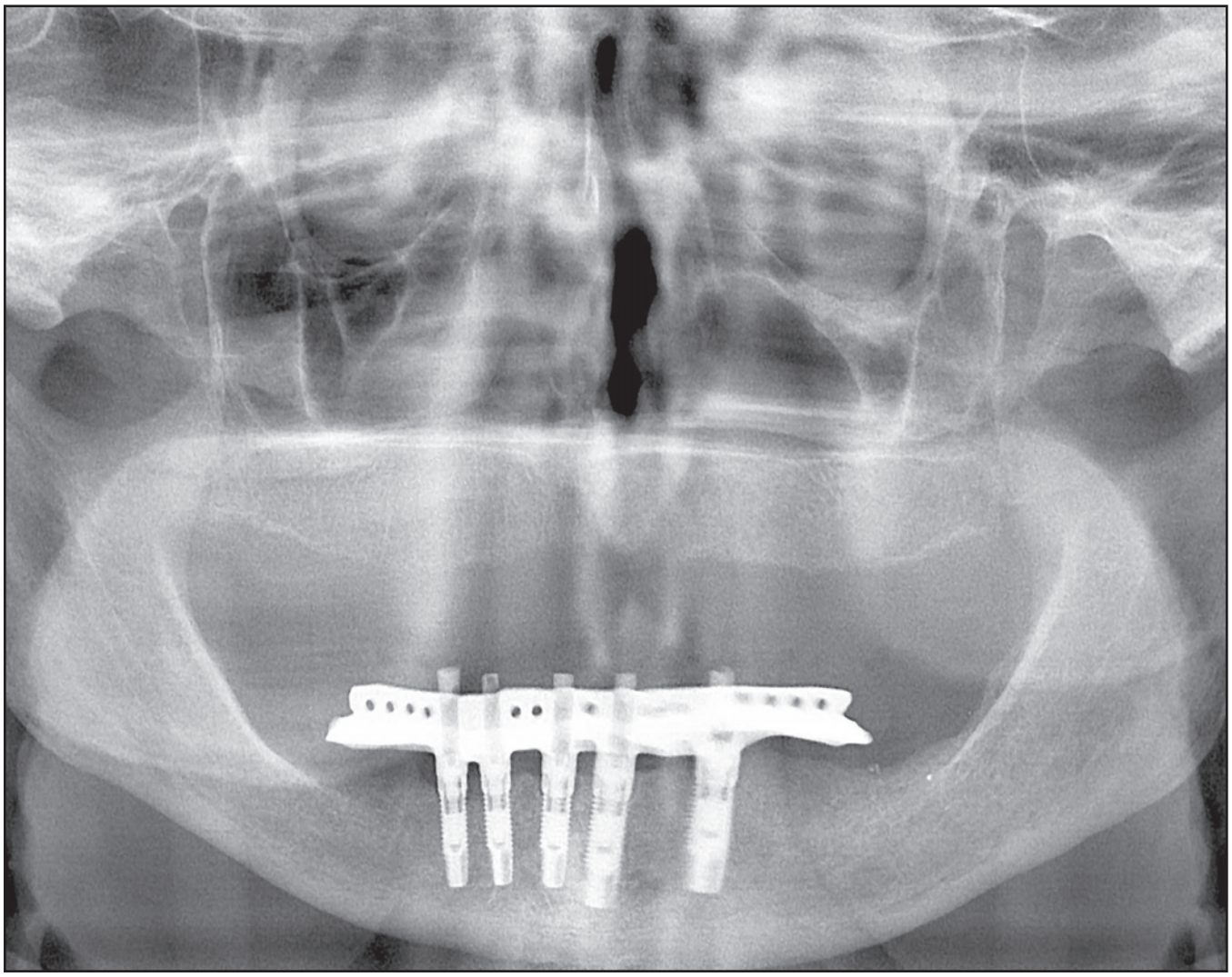


Figure 10. *Panoramic radiograph of the completed mandibular FDP.*

References

1. Brånemark PI, Albrektsson T. Titanium implants permanently penetrating human skin. Scand J Plast Reconstr Surg. 1982; 16:17-21.
2. Turkyilmaz I, Company AM, McGlumphy EA. Should edentulous patients be constrained to removable complete dentures? The use of dental implants to improve the quality of life for edentulous patients. Gerodontology. 2010;27:3-10.
3. Turkyilmaz I, Jones JD. Long term success of 6 implants supporting a mandibular screw-retained fixed dental prosthesis: a clinical report. J Prosthet Dent. 2012;107:280-3.
4. Takahashi T, Gunne J. Fit of implant frameworks: an in vitro comparison between two fabrication techniques. J Prosthet Dent. 2003; 89:256-60.
5. de Aguiar FA Jr, Tiossi R, Rodrigues RC, Mattos Mde G, Ribeiro RF. An alternative section method for casting and posterior laser welding of metallic frameworks for an implant-supported prosthesis. J Prosthodont. 2009;18:230-4.
6. Goodacre CJ, Bernal G, Rungcharassaeng K, Kan JY. Clinical complications with implants and implant prostheses. J Prosthet Dent. 2003;90:121-32.
7. Turbush SK, Turkyilmaz I. Accuracy of three different types of stereolithographic surgical guide in implant placement: an in vitro study. J Prosthet Dent. 2012;108:181-8.
8. Turkyilmaz I, Corrigan CL. A custom-milled titanium complete-arch mandibular framework and a maxillary complete denture fabricated in 3 appointments: a dental technique. Tex Dent J. 2012;129:695-701.
9. Al-Fadda SA, Zarb GA, Finer Y. A comparison of the accuracy of fit of 2 methods for fabricating implant-prosthodontic frameworks. Int J Prosthodont. 2007;20:125-31.
10. Ehrenkranz H, Langer B, Marotta L. Complete-arch maxillary rehabilitation using a custom-designed and manufactured titanium framework: A clinical report. J Prosthet Dent. 2008;99:8-13.
11. Jung RE, Schneider D, Ganeles J, Wismeijer D, Zwahlen M, Hämmerle CH, Tahmaseb A. Computer technology applications in surgical implant dentistry: a systematic review. Int J Oral Maxillofac Implants. 2009;24 Suppl:92-109.

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