Straumann® Pro Arch

Importance of Prototype use for Implant-Supported Complete Fixed Dental Prosthesis (ICFDP)

JONATHAN H DAWSON, DMD, MSD

GRADY DIX, CDT

BRYAN T HARRIS, DMD

WEI-SHAO LIN, DDS

Jonathan Hunter Dawson attended the University of Louisville School of Dentistry (ULSD), graduated in 2014 and continued to complete a Prosthodontic Residency in 2017. During residency his research interest was focused on implant abutment design and materials for which he received an ITI research grant. Currently, he is in Private Practice limited to Prosthodontics in Greensboro, NC at Triad Prosthodontic Specialists where he focuses on Implant Prosthodontics. Photography is both a personal and professional passion, which is an invaluable tool for interdisciplinary diagnosis, treatment planning, and communication for dental implant therapy.

As restorative material selection becomes less forgiving, the need for obtaining accurate clinical records and effective communication to the dental laboratory technicians becomes more important for the dental clinician. The options of restorative materials for implant-supported complete fixed dental prosthesis (ICFDP, or commonly referred to as full arch implant hybrid prosthesis) have evolved recently from traditional metal-acrylic or metal-ceramic combinations to monolithic zirconia or high performance polymer designs. When treating patients with ICFDP, an interim removable denture is often converted into an interim ICFDP. [1] This interim ICFDP can be utilized throughout the healing period of dental implants, and provide a reference for the diagnostic tooth arrangement of definitive ICFDP. After obtaining the definitive impression, and facebow and maxillomandibular relation record, a trial insertion of the diagnostic tooth arrangement is then completed prior to the fabrication of the definitive framework and ICFDP.[2,3]

Throughout the aforementioned process, possible errors may be introduced in different steps, such as inaccurate maxillomandibular relation record or denture teeth movement in the diagnostic tooth arrangement. To provide a more predictable clinical outcome on the definitive ICFDP fabricated by new, less forgiving restorative material, a clinical protocol of using prototype prosthesis is described in this report.

In this report, maxillary and mandibular definitive monolithic zirconia ICFDP were planned.[4-6] Most zirconia prosthesis (as a monolithic design or framework for veneered prosthesis) are milled from the pre-sintered ceramic blanks, and the milled restorations are sintered at high temperature to the final state. In addition, stabilizing oxides such as 3mol% yttria (Y_2O_3) is usually added in biomedical grade zirconia as a stabilizer (3Y-TZP), which allows the control of the stress-induced transformation, and efficiently arresting crack propagation of the zirconia prosthesis.[7] The excessive adjustment after sintering of zirconia can induce damage to the prosthesis, and create surface flaws that initiate crack propagation and dramatically reduces strength and fatigue life of the zirconia prosthesis.[8] The prototype prosthesis can be designed as an exact copy of the proposed definitive prosthesis and provided to the patient for clinical trial insertion. By using the prototype prosthesis, the resulting definitive prosthesis can be fabricated without significant need for post-sintering modifications in its contour and occlusion.

The implant surgery was completed with delayed placement and immediate loading protocol. The patient presented to the prosthodontics clinic after implant surgery to begin the clinical appointments for the definitive prosthesis. The verification devices were made with pattern resin (GC America) and allowed to polymerize for 24 hours prior to the definitive impression appointment.[9] The segmented verification devices were inserted intraorally with 15 Ncm onto screw-retained abutments, and re-connected together with pattern resin (GC America) (Figures 1 – 4). A custom tray was then used to make an abutment-level definitive impression with polyvinyl siloxane material (Virtual XD; Ivoclar Vivadent). Verified master casts were poured with type IV dental stone (ResinRock; Whipmix). Clear duplicates of the interim ICFDP prostheses were replaced on the verified master casts, and used to articulate these casts using the facebow and maxillomandibular relation records (Figure 5). By using duplicate prostheses,

the proposed changes to tooth position and occlusal plane were communicated to the laboratory for a wax trial insertion to verify those changes (Figure 6). With patient's approval of functional and esthetic outcomes, the wax trial insertion can be rearticulated with a new occlusal record, if necessary and sent back to the dental laboratory for CAD/CAM prototype fabrication.

The dental laboratory technician can host a virtual internet-base meeting for clinicians' review and approval of the CAD/CAM prototype design prior to the milling of polymethyl methacrylate (PMMA) prototypes (Figure 7). At this stage, it is the goal of the dental technician to provide all of the details required on the definitive prostheses, such as convex-shaped soft tissue contours necessary for the patient to maintain optimal oral hygiene. After obtaining clinician's approval, the dental technician milled the PMMA prototypes in the desired shade and finished the milled prototypes with layered pink composite resin to mimic soft tissue (Figures 8 – 10). The completed prototypes were delivered after occlusal adjustments were made to achieve desired occlusal contacts. Not only were the centric occlusal contacts achieved, all the eccentric occlusal contacts achieve the preferred occlusal scheme (Figure 11). The patient was dismissed to function with the prototypes for 4 weeks to allow any possible wear patterns introduced onto the occlusal surfaces of the prototypes. After 4 weeks of occlusal function, the prototypes were removed and the previous interim ICFDPs were replaced. The prototypes were sent back to the dental laboratory for the fabrication of the monolithic zirconia definitive prostheses. The dental laboratory technician then scanned the occlusal surfaces of the prototypes, which were modified by the clinical occlusal adjustments and/or the patient's occlusal functions (Figure 12). Once the changes were made in the CAD software (Zirkahnzan), the full contour monolithic zirconia definitive prostheses were milled.
The final prosthesis has a highly polished intaglio tissue surface and convex contours were maintained from the design (Figure 13 and Figure 14). Insertion of the definitive prostheses were completed by torqueing the prosthetic screws to 15 Ncm, and sealing the screw access with teflon tape and composite resin (Figure 15 and Figure 16). Final occlusal check was completed with shimstock to validate the occlusion desired occlusal contacts. Homecare oral hygiene regimens was reviewed with the patient utilizing a number of adjunctive hygiene aides including an interproximal brush (Figure 17 and Figure 18).[10] Final post-insertion panoramic radiograph was made as a baseline status and to validate the complete seating of the prostheses (Figure 19). The patient was satisfied with the clinical outcomes of the definitive prostheses (Figure 20 and Figure 21).

When choosing restorative materials, it is important to consider the necessary workflow in order to achieve predictable and accurate prosthetic outcomes. The use of prototypes has benefits to the clinician, dental technician, and patient in providing high level of predictability and accuracy.

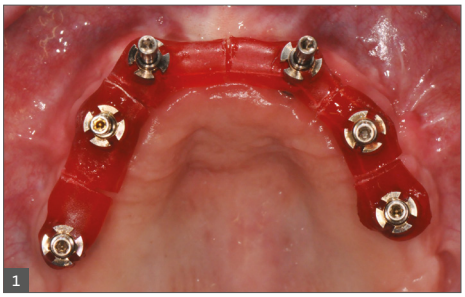

Fig. 1 The Maxillary segmented verification device was inserted intraorally with 15 Ncm onto screw-retained abutments.

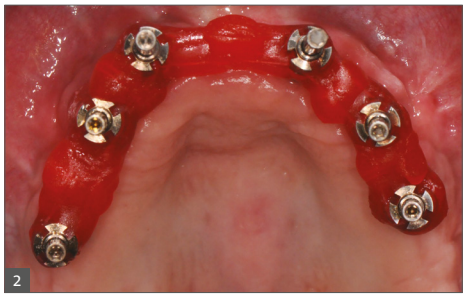

Fig. 2 Re-connected verification device together with pattern resin (GC America)

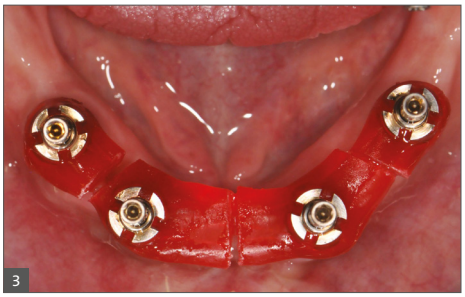

Fig. 3 The Mandiblar segmented verification devices were inserted intraorally with 15 Ncm onto screw-retained abutments.

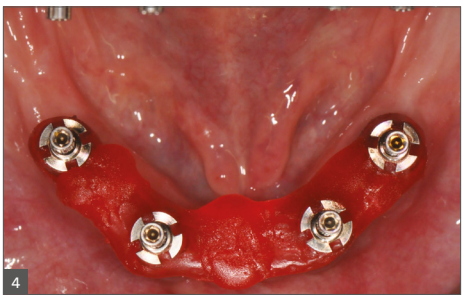

Fig. 4 Re-connected verification device together with pattern resin (GC America)

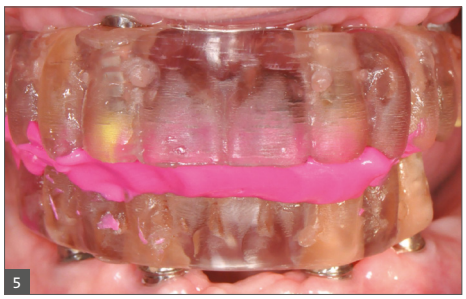

Fig. 5 Clear duplicates of the interim ICFDP prostheses were replaced on the verified master casts, and used to articulate these casts using the facebow and maxillomandibular relation records

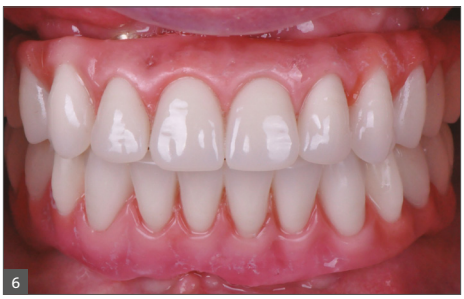

Fig. 6 Wax Trial Insertion

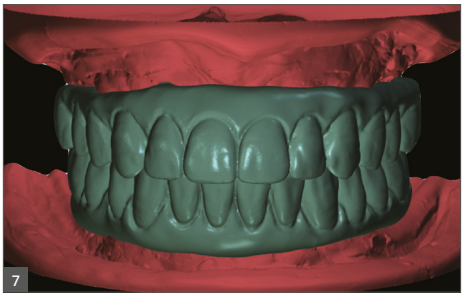

Fig. 7 Virtual CAD/CAM Prototype file for virtual meeting and Clinician approval

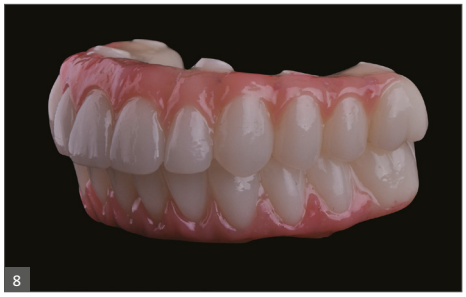

Fig. 8 Milled PMMA Prototype

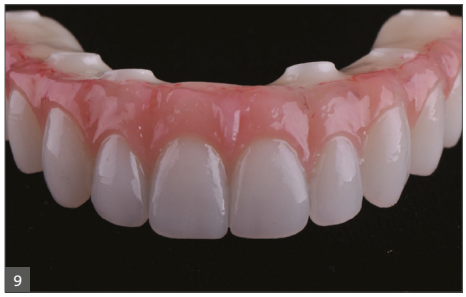

Fig. 9 Milled Maxillary PMMA showing Convex Contours

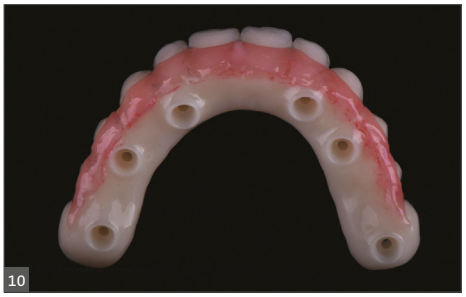

Fig. 10 Maxillary Milled PMMA showing Hygienic Contours

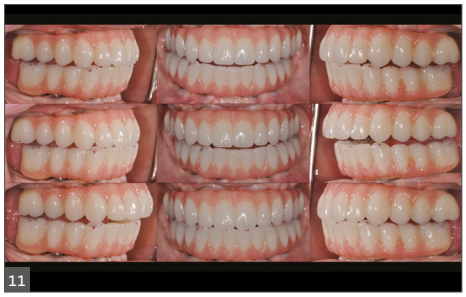

Fig. 11 Evaluation of all functional movements to ensure desired occlusal scheme

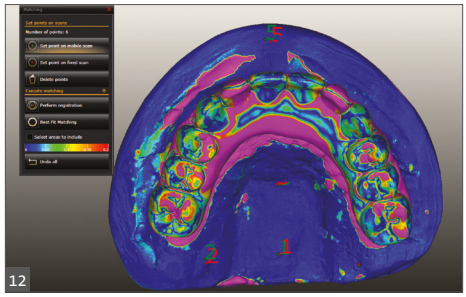

Fig. 12 The highlighted pink areas show either occlusal adjustments or functional wear created by the patient during the 4 week period

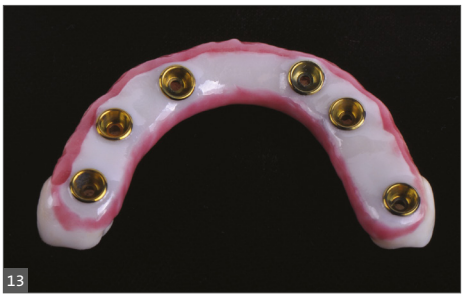

Fig. 13 Maxillary definitive prosthesis with highly polished convex intaglio surface

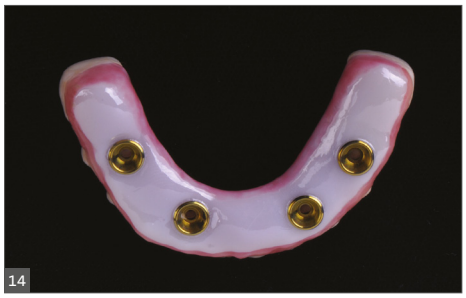

Fig. 14 Mandibular definitive prosthesis with highly polished convex intaglio surface

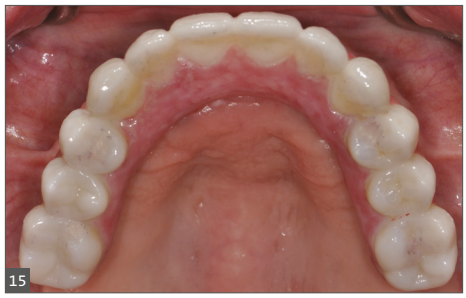

Fig. 15 Maxillary definitive prosthesis occlusal view

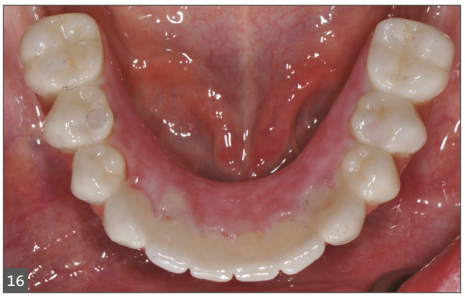

Fig. 16 Mandibular definitive prosthesis occlusal view

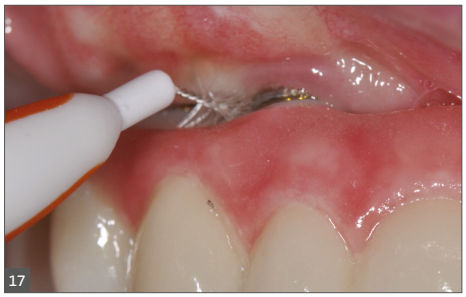

Fig. 17 Demonstrating use of hygienic aide for home care

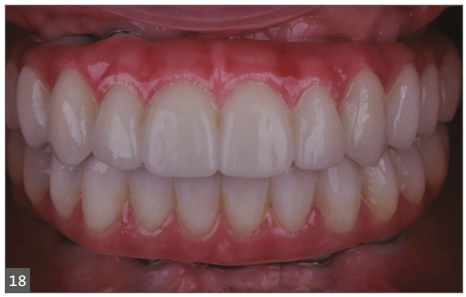

Fig. 18 Frontal View post-insertion of definitive Prostheses

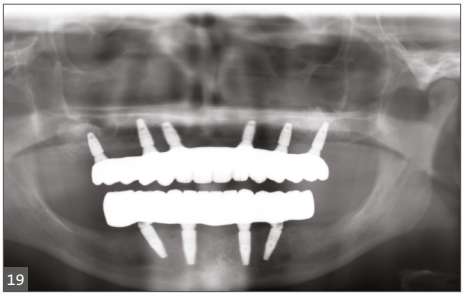

Fig. 19 Final Radiograph

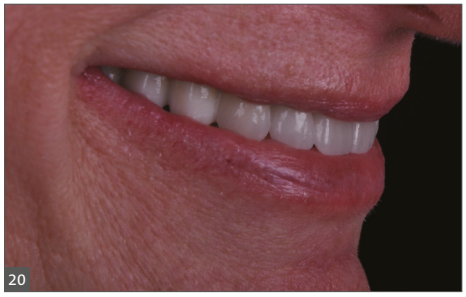

Fig. 20 Patient was pleased with esthetic and functional result

Fig. 21 Final Esthetic Results

References

1. Balshi TJ, Wolfinger GJ. Conversion prosthesis: a transitional fixed implant supported prosthesis for an edentulous archda technical note. Int J Oral Maxillofac Implants 1996;11:106-11.
2. Zhang, X.-X., Shi, J.-Y., Gu, Y.-X. and Lai, H.-C. (2016), Long-Term Outcomes of Early Loading of Straumann Implant-Supported Fixed Segmented Bridgeworks in Edentulous Maxillae: A 10-Year Prospective Study. Clinical Implant Dentistry and Related Research, 18: 1227–1237.
3. De Bruyn, H., Raes, S., Östman, P.-O. and Cosyn, J. (2014), Immediate loading in partially and completely edentulous jaws: a review of the literature with clinical guidelines. Periodontol 2000, 66: 153–187. doi:10.1111/prd.12040
4. Maló P, de Araújo Nobre M, Lopes A, Francischone C, Rigolizzo M. "All-on-4" immediate-function concept for completely edentulous maxillae: a clinical report on the medium (3 years) and long-term (5 years) outcomes. Clin Implant Dent Relat Res 2012;14(suppl 1):e139-50.
5. Rojas Vizcaya, F. (2016), Retrospective 2- to 7-Year Follow-Up Study of 20 Double Full-Arch Implant-Supported Monolithic Zirconia Fixed Prostheses: Measurements and Recommendations for Optimal Design. Journal of Prosthodontics. doi:10.1111/jopr.12528
6. Abdulmajeed, A. Lim, K. Narhi, T. Cooper, L Complete-arch implant-supported monolithic zirconia fixed dental prostheses: A systematic review Journal of Prosthetic Dentistry , Volume 115 , Issue 6 , 672 - 677.
7. Denry I, Kelly JR. State of the art of zirconia for dental applications. Dent Mater. 2008 Mar;24(3):299-307.
8. Rekow ED, Silva NR, Coelho PG, Zhang Y, Guess P, Thompson VP. Performance of dental ceramics: challenges for improvements. J Dent Res. 2011 Aug;90(8):937-52.
9. Ercoli C, Geminiani A, Feng C, Lee H. The influence of verification jig on framework fit for nonsegmented fixed implant-supported complete denture. Clin Implant Dent Relat Res. 2012 May;14 Suppl 1:e188-95.
10. Heitz-Mayfield, L. Needleman, I. Salvi, G. Pjetursson, B. Consensus statements and clinical recommendations for prevention and management of biologic and technical implant complications.International Journal of Oral and Maxillofacial Implants, The 29 Suppl 2014

http://ifu.straumann.com/

Straumann North American Headquarters
Straumann USA, LLC
60 Minuteman Road
Andover, MA 01810
Phone 800/448 8168 (US) • 800/363 4024 (CA)
Fax 978/747 2490
www.straumann.us • www.straumann.ca

V1 10/17