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DOUBLE DIGITAL SCANNING (DDS) TECHNIQUE FOR MILLED PROSTHESIS PROTOTYPE FABRICATION IN SINGLE VISIT: A PROSPECTIVE STUDY ON 16 EDENTULOUS PATIENTS

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INTRODUCTION

A combination of conventional and digital workflow is the current standard in the full-arch implant rehabilitation, and accurately fitting prosthesis is incumbent for long-term success. Full-arch digital implant scans for completely edentulous patients are technique sensitive procedures mainly due to the absence of anatomical landmarks such as teeth. Recent clinical reports have demonstrated complete digital workflow for the fabrication of prosthesis prototype prior to definitive full-arch fixed implant rehabilitation. The double digital scanning (DDS) technique has been introduced for complete digital workflow for prosthesis prototype fabrication. However, to the authors' knowledge, there are no prospective clinical studies assessing the complete digital workflow for prosthesis prototype fabrication for edentulous patients.

The purpose of this prospective study was the assessment of accuracy of fit of milled prosthesis prototypes fabricated using the Double Digital Scanning (DDS) technique in 16 completely edentulous maxilla



PURPOSE

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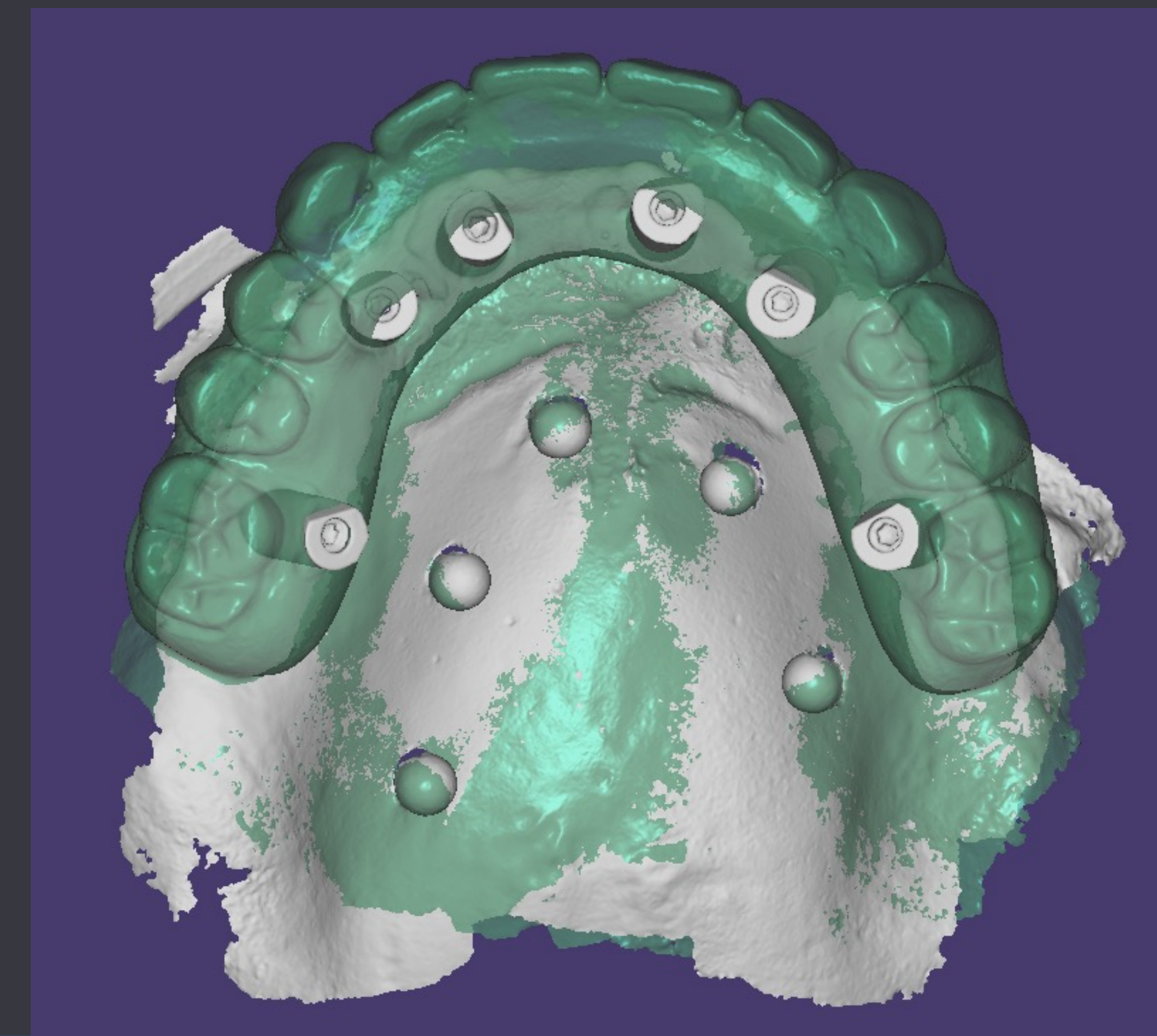
MATERIAL & METHODS

At the interocclusal record and verification appointment, full-arch digital scans for each patient were taken with the dual double scan technique. Five sphere-shaped fiducial markers (CT-SPOT 120, Beekley Medical, Bristol, CT) were glued over the keratinized gingiva of the palate with a tissue adhesive (PeriAcryl Periodontal Tissue Adhesive, GluStitch Inc, Delta, BC, Canada). A full-arch intraoral digital scan that included the interim prostheses and the fiducial markers was obtained with an intraoral scanner. An STL file was generated and saved (STL 1).



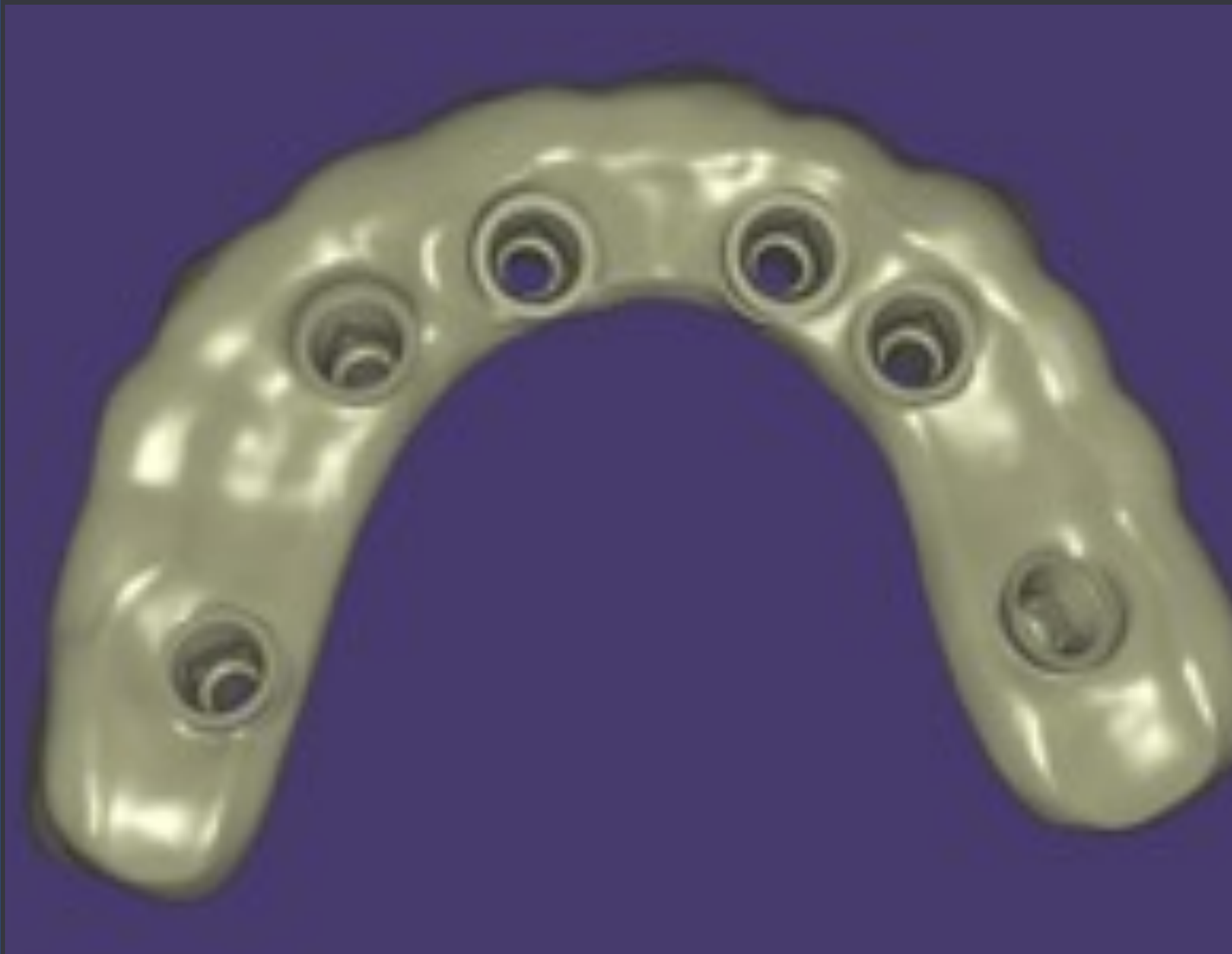
The interim prosthesis was then removed, and implant scan bodies were connected over the SRA abutments and tightened at 15 Ncm using an automatic torque control unit (Implanted, W&H Impex Inc., Windsor Ontario, Canada). A second intraoral scan was taken to register the position of the scan bodies, soft tissue and fiducial markers and the corresponding STL file was obtained (STL 2).

One clinician (DR) recorded all the digital scans. Both STL files were imported in a dedicated software (Exocad DentalCAD, exocad GmbH, Darmstadt, Germany) and an alignment of the files was obtained using the fiducial markers as reference





MATERIAL & METHODS



The master STL file that was generated after superimposition of STL files from scan bodies and interim prosthesis was used to copy-mill a digitally-fabricated prototype prosthesis.



The prototype prosthesis was milled in poly-methyl methacrylate (PMMA) material using a Computer-Aided Design unit (Roland DG60, Roland DGA Corporation, Irvine, CA) Titanium bases (Variobase® for Bridge/Bar, Institute Straumann AG, Switzerland) were cemented to each prototype using cyanoacrylate cement.



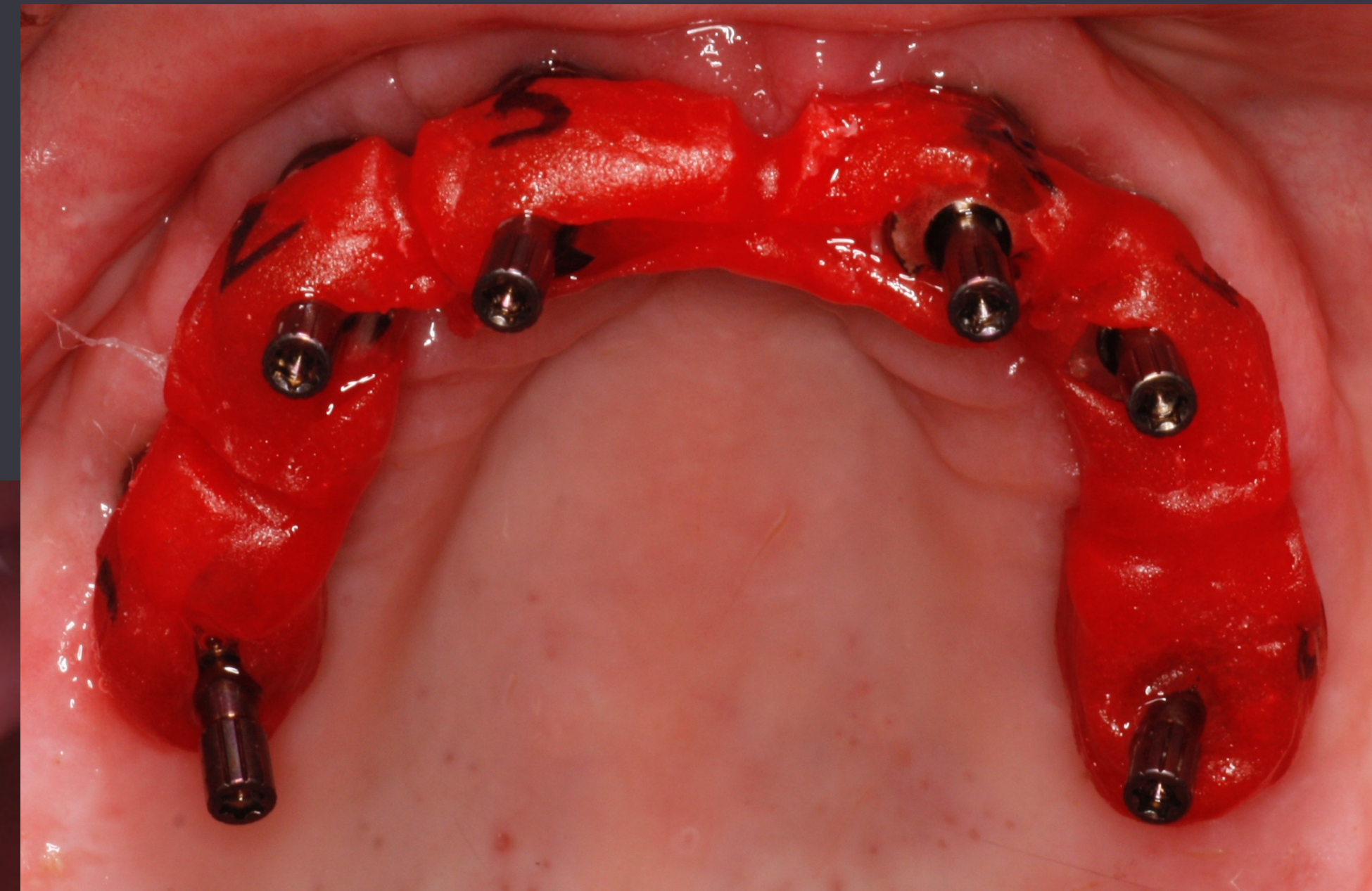
Titanium bases (Variobase® for Bridge/Bar, Institute Straumann AG, Switzerland) were cemented to each prototype using cyanoacrylate cement.



MATERIAL & METHODS

Two experienced clinicians (KC and PP) evaluated the fit and the passivity of the PMMA prostheses over the verified master casts using different techniques. Both evaluations were blinded towards patient identity. First, the prosthesis was placed over the abutment analogues to visually inspect with magnification loupes (SurgiTel Pro Line 10.0x; SurgiTel, Ann Arbor, MI) for macroscopic gaps at the interfaces between the analogues and the titanium bases.

Then, alternate pressure was applied with two fingers on one side of the prosthesis in an area corresponding to at least two implant platforms and the formation of possible gaps at the contralateral side was checked. Lastly, the prosthesis was tightened in a cross-pattern scheme that varied based on the number of implants, but with the main purpose of alternating one anterior and one posterior screw on the opposing side of the prosthesis. Clinician would assess the overall screw resistance during tightening. Any presence of gap between abutment and platform after tightening all the screws was considered misfit. The decision was made to assess the fit of the prototype prosthesis on verified master casts and not in the mouth to visually inspect the abutment platform interface.



RESULTS

A total of 16 patients were consecutively enrolled and treated in the maxillary arch with an implant fixed complete dental prosthesis. Four patients received 4 implants, 5 patients received 5 implants, and 7 patients received 6 implants. No implants were lost and all definitive prostheses have been delivered as planned. The subjective assessment of fit of the milled PMMA prototype/prostheses over the verified master casts was satisfactory for all prostheses using all different techniques. No differences in terms of perception of fit was found with respect of the number of implants. Out the 16 milled prototype prostheses, all 16 (100%) had an acceptable fit.





Advantages of the complete digital workflow include fabrication of the digitally designed prosthesis prototypes directly from the DDS technique simplifying the rehabilitation process and shortening the number of required appointments by skipping the maxillomandibular relationship appointment. Using this digital workflow, there is no verified master cast to ensure the accuracy of fit of the milled PMMA prototypes and the titanium inserts are cemented free-hand inside the prototypes. In order to confirm the accuracy of fit, the immediately loaded conversion prosthesis can be back-poured after connecting analogs and then prosthesis can be seated on this cast and assess the fit. This cast can also be used to cement the titanium inserts on these prototypes. Another approach includes using the STL files from the intraoral scan to fabricate digitally-designed and milled/printed verification jigs for a complete digital workflow. Similar digital workflow can be used during the transition from the prototype to the definitive prosthesis.

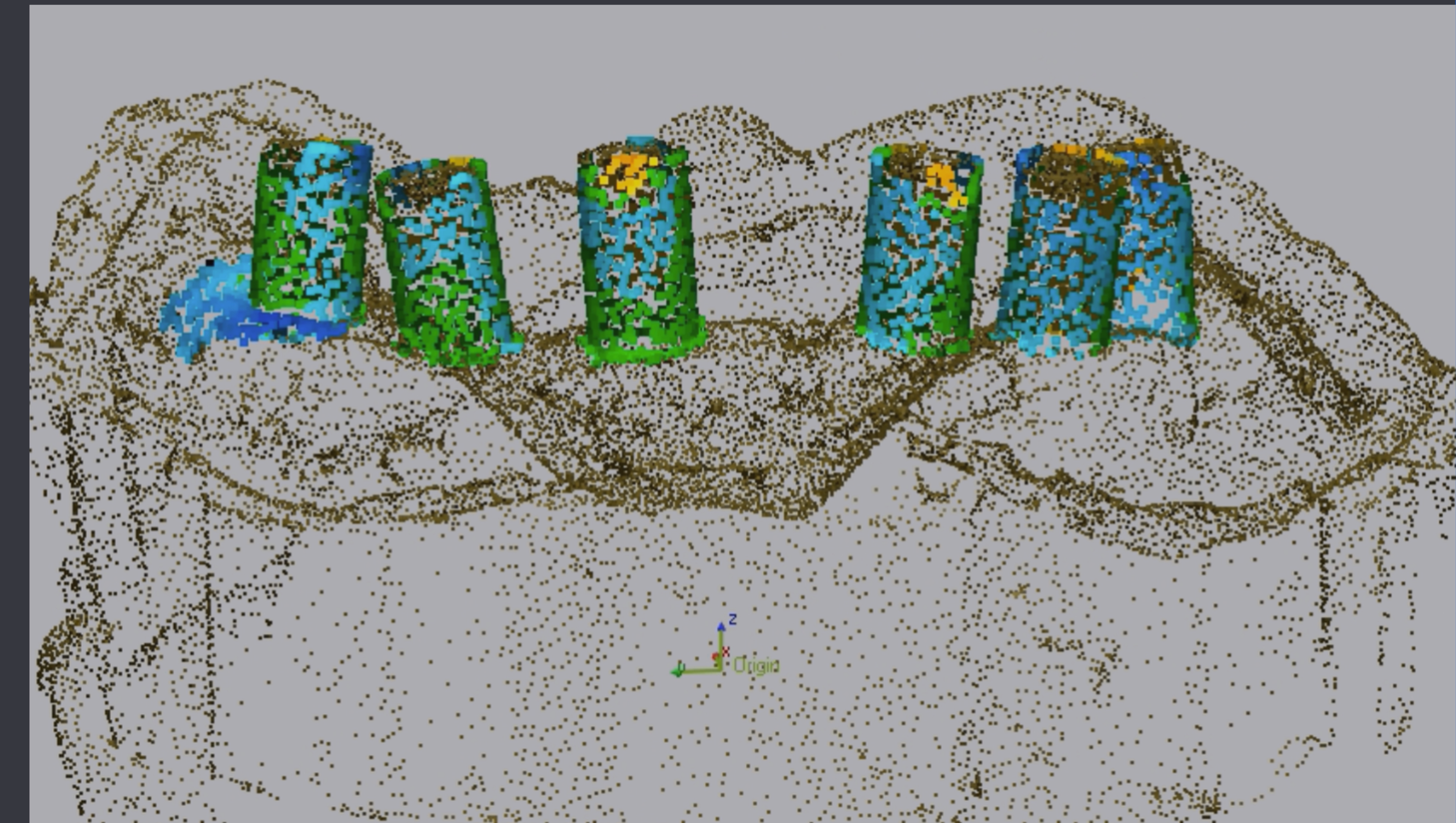


One limitation of the present clinical study includes the limited sample size which was a convenience sample. For this reason, further clinical studies are needed with larger sample sizes to corroborate the findings of the present study. Another limitation of this study was the subjective nature of assessment of the prosthetic fit by the two experienced prosthodontists.



CONCLUSIONS

Within the limitations of this clinical study, the following conclusions can be drawn; out of the 16 digitally fabricated prototypes from intraoral full-arch digital scans, all 16 presented with accurate fit on verified master stone casts. Digitally fabricated prosthesis prototypes can be generated with a complete digital workflow leading to clinically acceptable fit.



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