

The effect of build orientation on the accuracy of surgical templates for static computer-aided implant surgery

John Lee Smith, Aisha Ali, Rishab Biswas, Georgios Romanos, Seyed Hossein Bassir

Department of Periodontology, School of Dental Medicine, Stony Brook University, Stony Brook, NY

INTRODUCTION

Several factors that are involved in the workflow of static computer-aided implant surgery can affect the accuracy of this treatment modality. This in vitro study aimed to evaluate the effect of print orientation on the accuracy of surgical templates fabricated for static computer-aided implant surgery.

METHODS

Ten partially edentulous reference models were used in this study (**Fig 1A**). These models were scanned using an intra oral scanner (Trios 3Shape, Copenhagen, Denmark), and Standard Triangulation Language (STL) files were generated (**Fig 1B**). In addition, CBCT scans of these models were obtained (CS 3600, Carestream Dental LLC, Rochester, NY). STL and DICOM files were superimposed in a planning software (Implant Studio planning software, 3Shape) (**Fig 1C**). Then, digital treatment planning including implant positioning was performed (**Fig 2**), and surgical templates were designed (**Fig. 3**). STL files of surgical templates were exported for fabrication. Two surgical templates with horizontal and vertical orientations relative to the printer platform were set for printing for each model in the printing software (Preform, FormLabs Inc, Somerville, MA) (**Fig 4**). All surgical templates were printed on a stereolithography printer (Formlab 3B, FormLabs Inc) and processed according to the manufacturer's recommendations. To assess the dimensional accuracy, the printed surgical templates were scanned again using the same intra oral scanner. The STL files of the printed surgical templates and designed surgical templates were superimposed for 3D deviation analysis using a best-fit algorithm (**Fig. 5**) in Geomagic Control X software (3D Systems, Rock Hill, SC). The deviations between the printed surgical templates and designed surgical templates were then quantified by the Root Mean Square (RMS) using 3D comparison tools in the software.

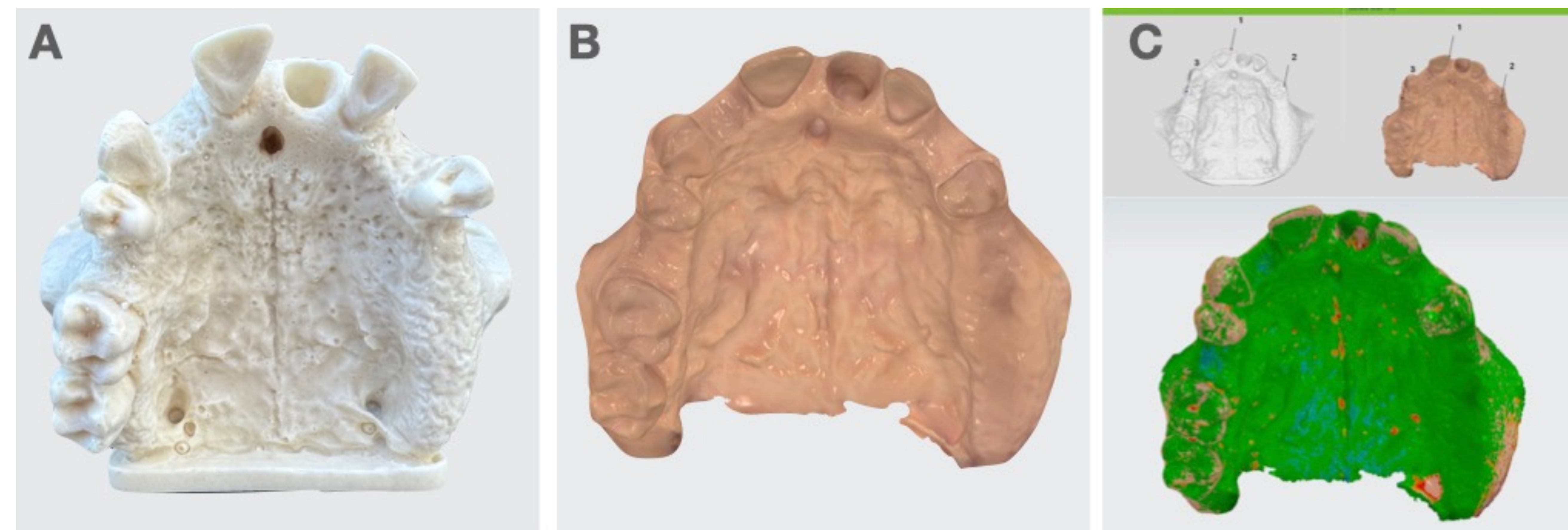


Figure 1: (A) Reference model; (B) Digital impression of the reference model; (C) Superimposition of CBCT scan and STL model

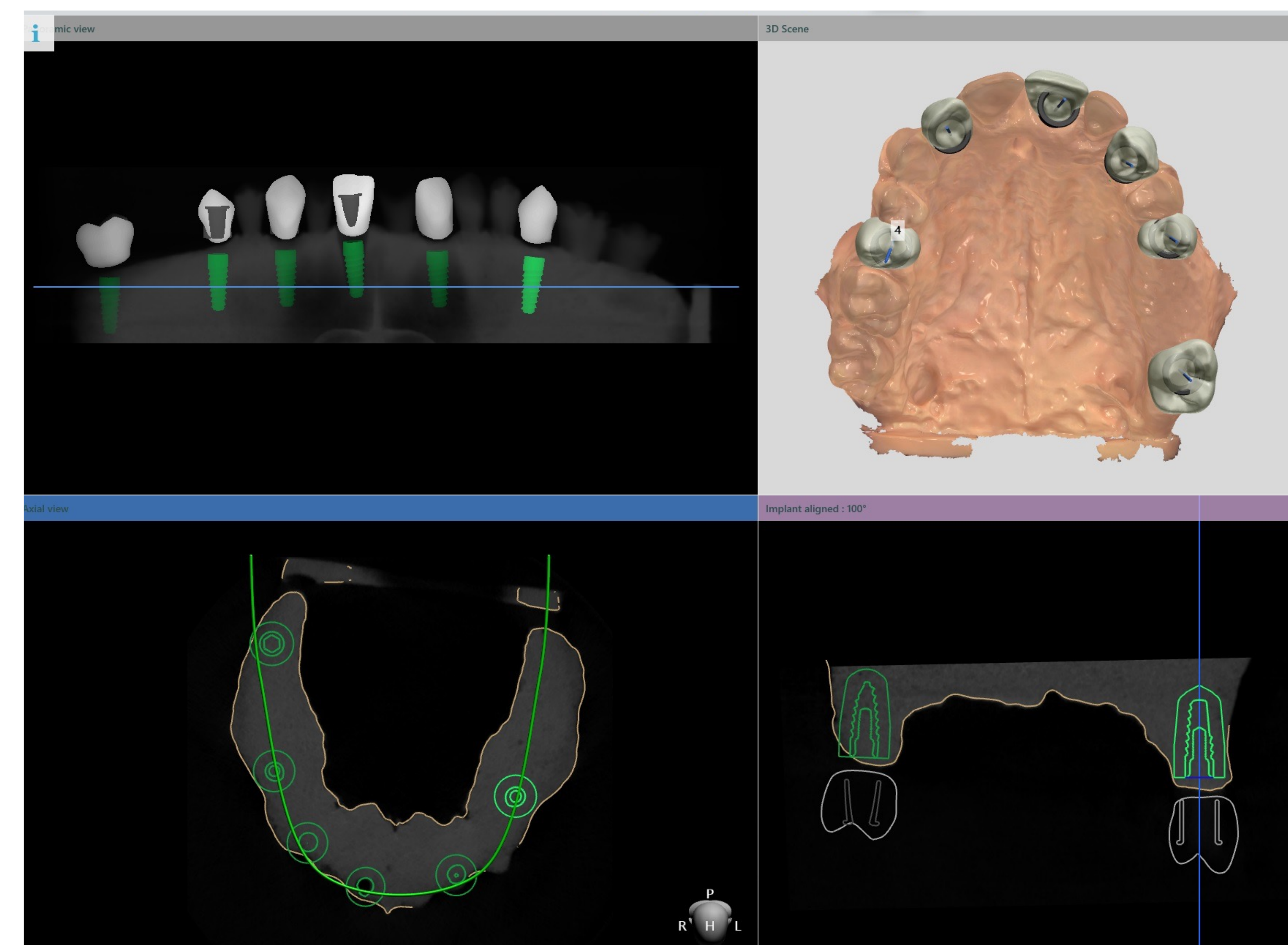


Figure 2: Digital planning of implants and prostheses positions

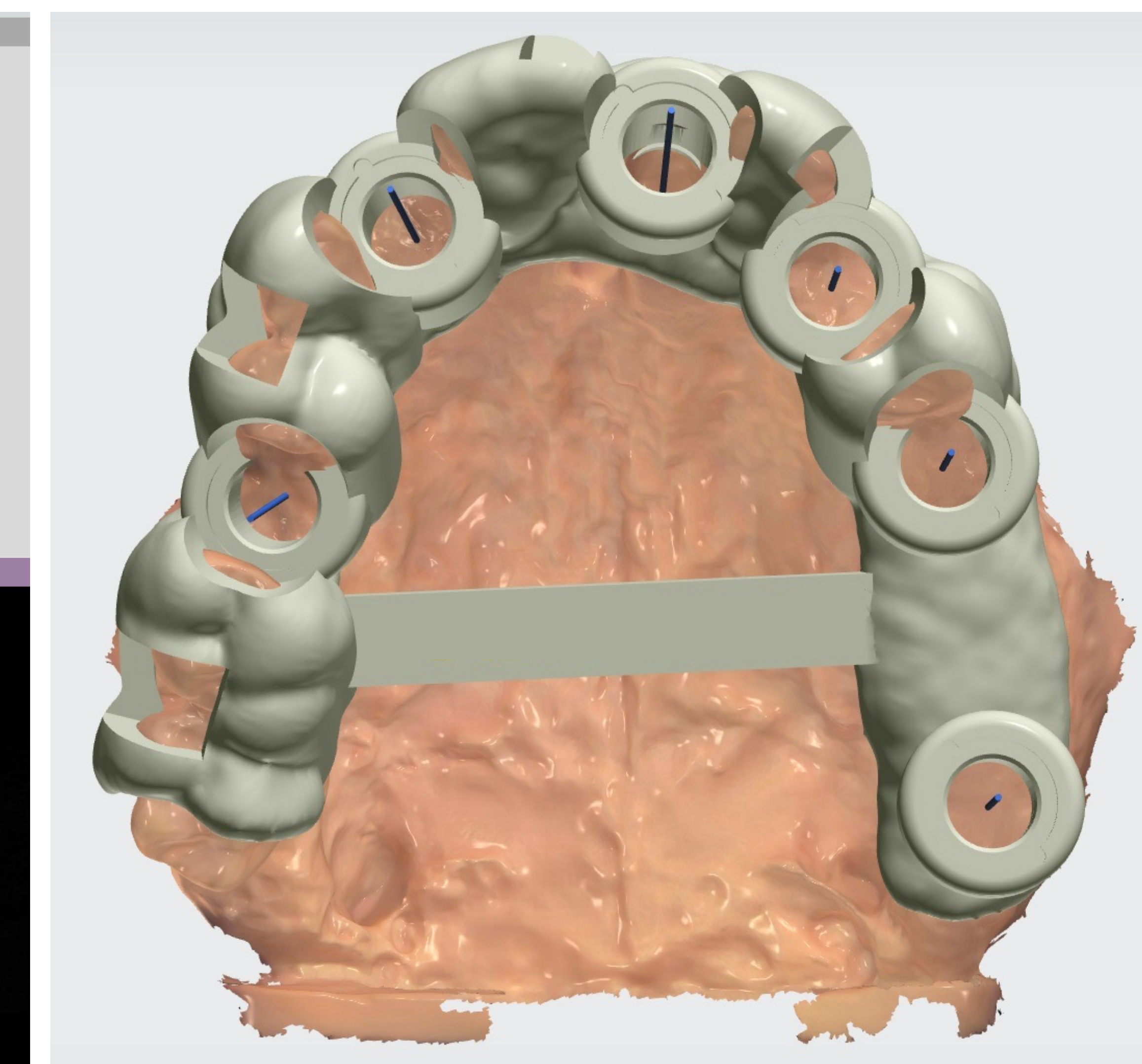


Figure 3 : Design of surgical guide

The effect of build orientation on the accuracy of surgical templates for static computer-aided implant surgery

John Lee Smith, Aisha Ali, Rishab Biswas, Georgios Romanos, Seyed Hossein Bassir
Department of Periodontology, School of Dental Medicine, Stony Brook University, Stony Brook, NY

INTRODUCTION

Several factors that are involved in the workflow of static computer-aided implant surgery can affect the accuracy of this treatment modality. This in vitro study aimed to evaluate the effect of print orientation on the accuracy of surgical templates fabricated for static computer-aided implant surgery.

METHODS

Ten partially edentulous reference models were used in this study (**Fig 1A**). These models were scanned using an intra oral scanner (Trios 3Shape, Copenhagen, Denmark), and Standard Triangulation Language (STL) files were generated (**Fig 1B**). In addition, CBCT scans of these models were obtained (CS 3600, Carestream Dental LLC, Rochester, NY). STL and DICOM files were superimposed in a planning software (Implant Studio planning software, 3Shape) (**Fig 1C**). Then, digital treatment planning including implant positioning was performed (**Fig 2**), and surgical templates were designed (**Fig. 3**). STL files of surgical templates were exported for fabrication. Two surgical templates with horizontal and vertical orientations relative to the printer platform were set for printing for each model in the printing software (Preform, FormLabs Inc, Somerville, MA) (**Fig 4**). All surgical templates were printed on a stereolithography printer (Formlab 3B, FormLabs Inc) and processed according to the manufacturer's recommendations. To assess the dimensional accuracy, the printed surgical templates were scanned again using the same intra oral scanner. The STL files of the printed surgical templates and designed surgical templates were superimposed for 3D deviation analysis using a best-fit algorithm (**Fig. 5**) in Geomagic Control X software (3D Systems, Rock Hill, SC). The deviations between the printed surgical templates and designed surgical templates were then quantified by the Root Mean Square (RMS) using 3D comparison tools in the software.

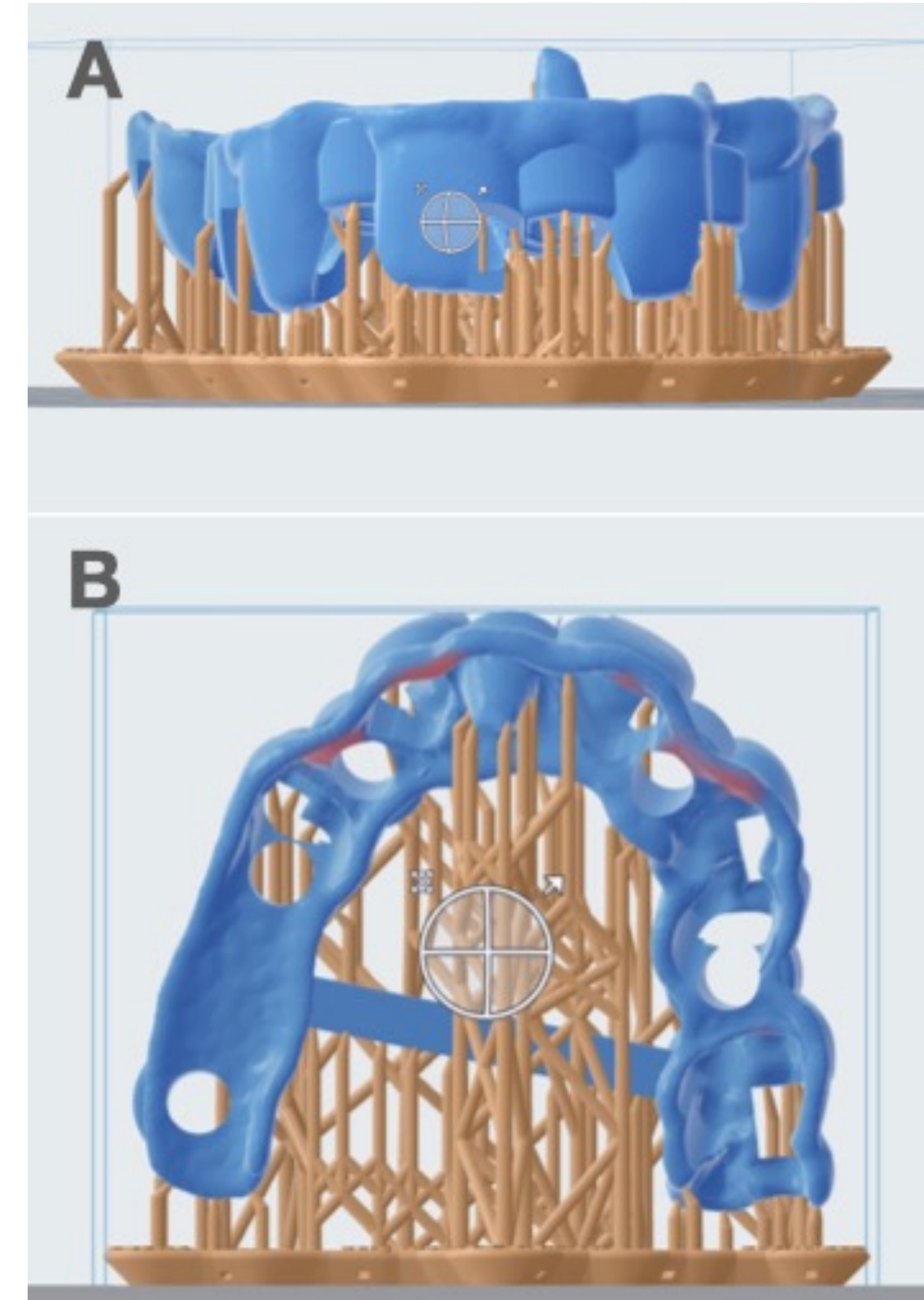


Figure 4 : Fabrication of surgical guide with horizontal (A) and vertical (B) orientations

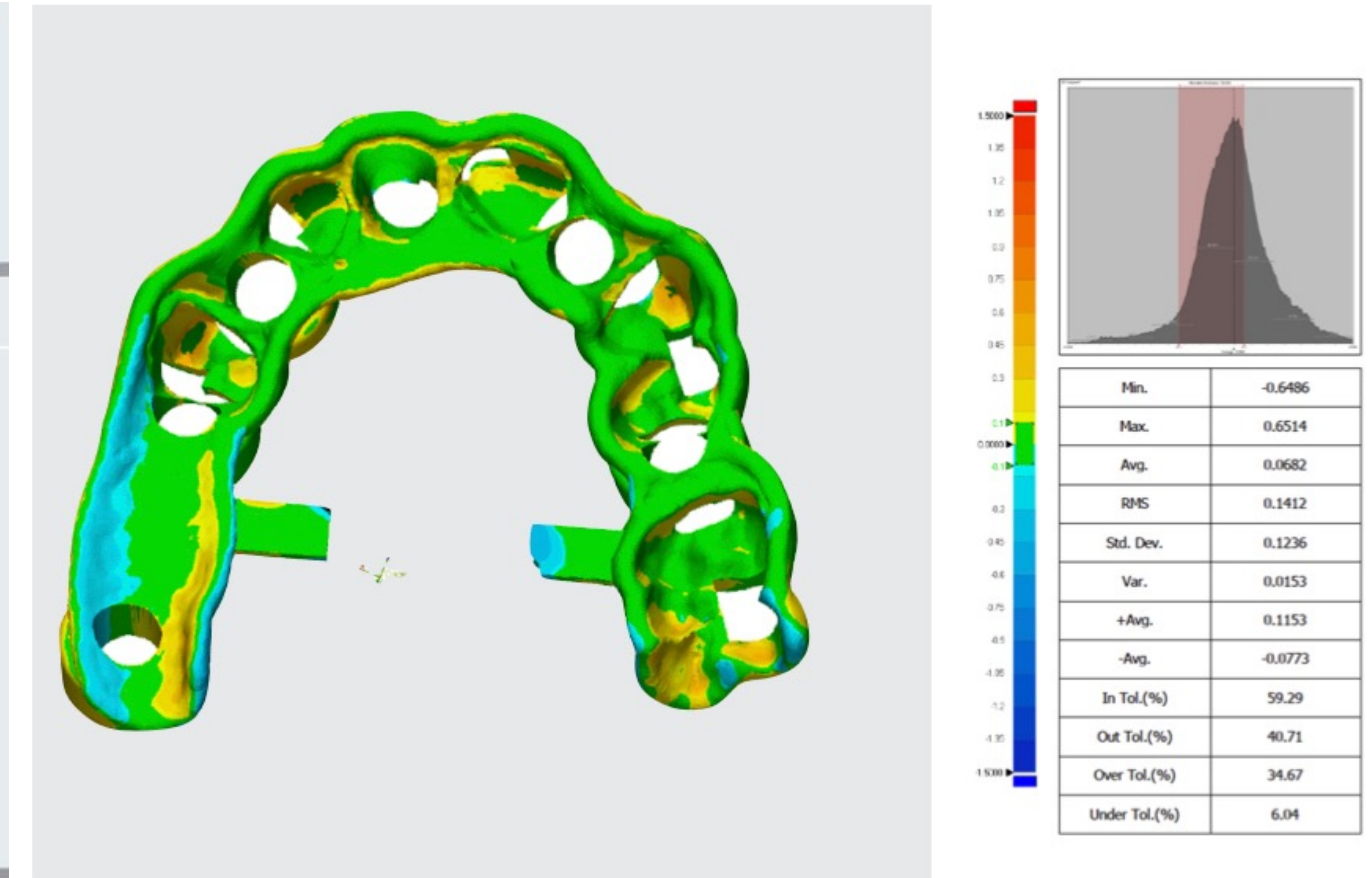


Figure 5 : Superimposition of designed and printed surgical templates and calculation of the deviation between the templates

RESULTS

RMS values were 0.146 ± 0.019 for vertical orientation group (n=10) and 0.199 ± 0.166 for horizontal orientation group (n=10). No significant differences were found between the two groups for RMS values (p= 0.337).

CONCLUSIONS

Within the limitations of the present study, it was concluded that the fabrication of surgical template in vertical or horizontal orientation relative to the printer platform results in similar dimensional accuracy of surgical templates for static computer-aided implant surgery.