

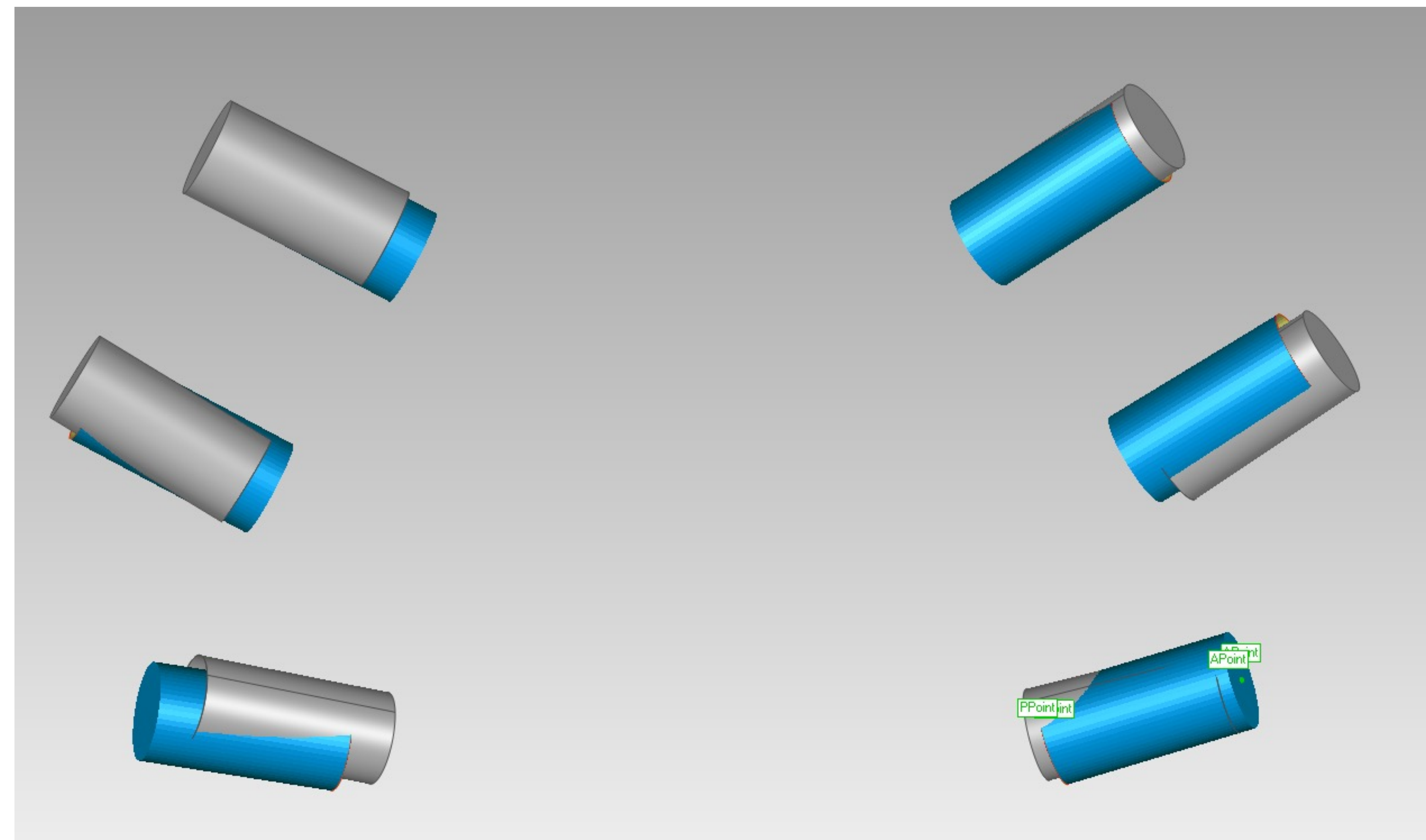
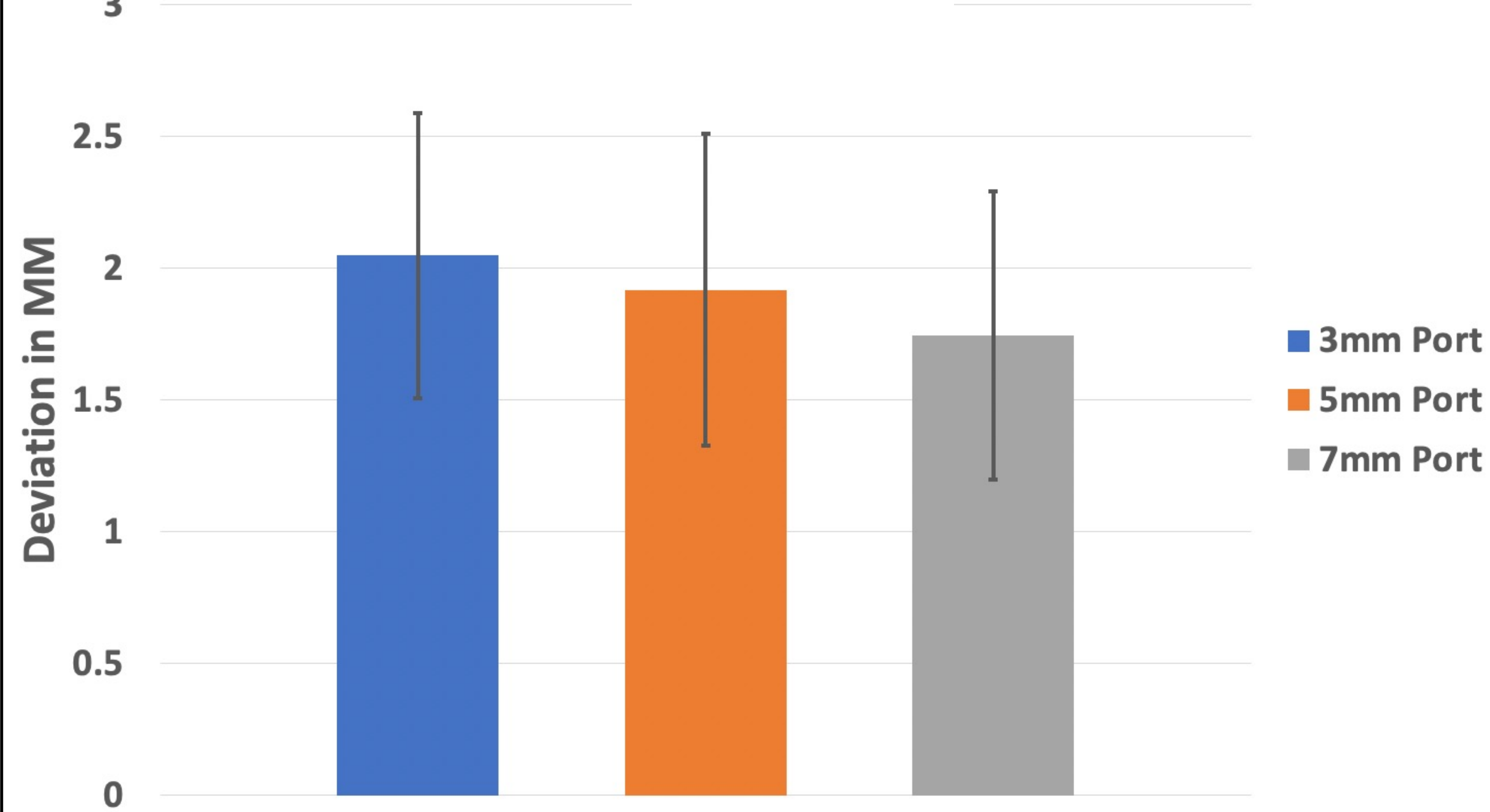
Targeted Endodontic Microsurgery (TEMS) utilizes 3D printed surgical stents to guide trephine burs to perform simultaneous osteotomy and root end resection. Each TEMS guide has a port that guides the trephine bur to the intended surgical site. The purpose of this study is to compare the accuracy of TEMS guides utilizing 3 different port lengths in a simulated model and determine the minimum port length required to maintain accuracy. The null hypothesis: All TEMS guides are equally accurate regardless of port length.

Methods

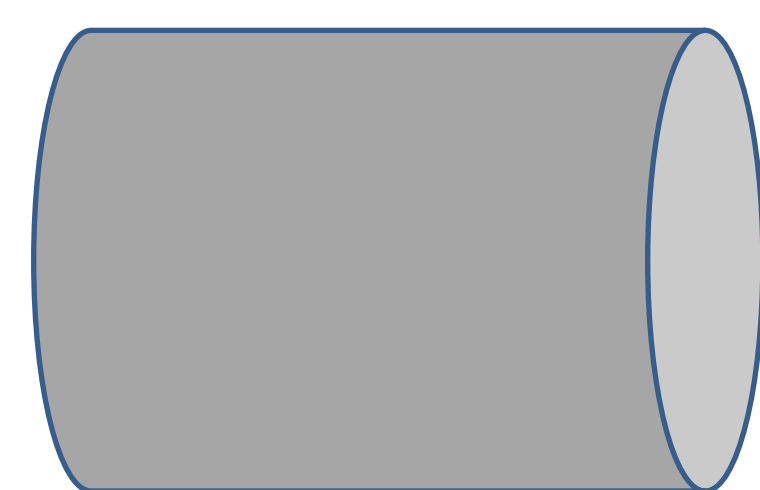
A simulated surgery was conducted involving 3D printed models designed in Mimics software from an 80x80mm CBCT. A Stratasys Objet 260 3D printer produced identical maxillary and mandibular models. TEMS surgical guides were designed with 3mm, 5mm, and 7mm ports and printed, targeting the root ends of 6 maxillary roots and 4 mandibular roots. The guides were organized in 3 groups according to port length (3mm, 5mm, and 7mm). Each group had a total of 28 simulated surgeries. Models were affixed within the oral cavity of a dental mannequin. Two board-certified endodontists performed the simulated surgeries utilizing the TEMS guides. Post-operative CBCT images of simulation models were imported into Geomagic Studio Software and overlaid with the virtual pre-surgical plan. The software calculated the linear deviation of the trephine bur from the planned path. ANOVA with a Tukey's post hoc test was used to compare the mean deviations between the three different groups. A p value less than 0.05 was considered significant.

Acknowledgments

We would like to thank Mr. Daniel Sierra and Mr. James Pizzini of the AFPDS stereolithography lab, Lackland Air Force Base, TX, for their valuable support.

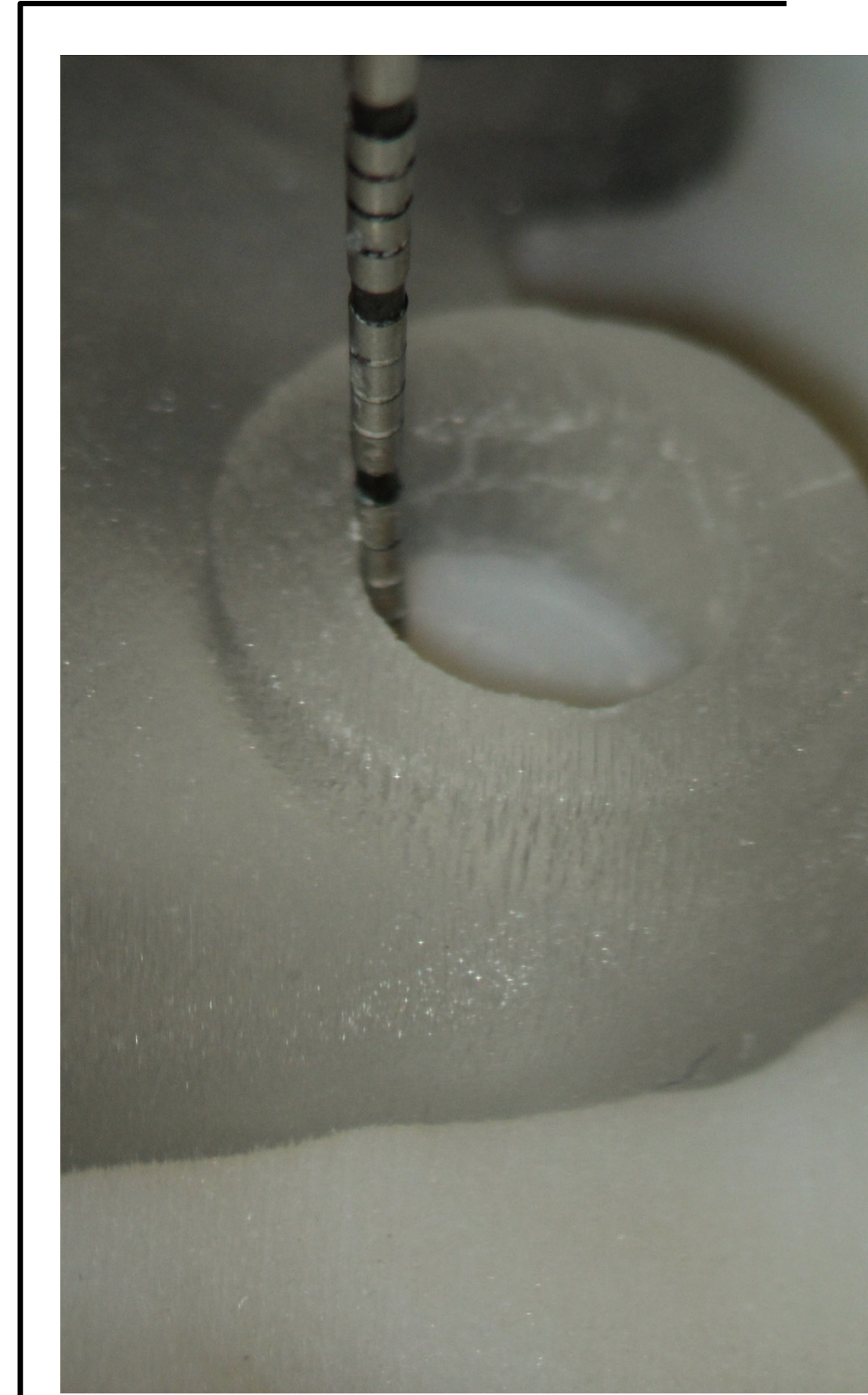


Virtual pre-surgical plan



Actual post-operative pathway

There was no statistical difference between the groups. However, there was a significant difference in accuracy as the length of the port increased. The null hypothesis could not be rejected as the length of the port increased. The hypothesis could not be rejected as the length of the port increased. The deviation was 2.05mm for the 3mm port, 1.9mm for the 5mm port, and 1.75mm for the 7mm port. These deviations were due to the following factors: First, the trephine bur inside the guide was not perfectly aligned, leading to poor accuracy. Second, the ports were not perfectly aligned with their respective groups, which the port extended to the irregular top of the cortical plate we used as a reproducible reference point. The depth of the osteotomy was not consistent, which identifies areas that were not covered in previous studies to create TEMS guides that are accurate and precise.



Key

In this simulated surgery, the accuracy of the TEMS guides was not significantly different. Lessons learned during this study are being going forward in future studies.