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# ACCURACY OF 3-DIMENSIONAL PRINTED SURGICAL GUIDES WITH VARYING TREPHINE PORT LENGTHS IN SIMULATED TARGETED ENDODONTIC MICROSURGERY

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# Disclaimer

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# Targeted Endodontic Microsurgery (TEMS)



Hawkins (2020)

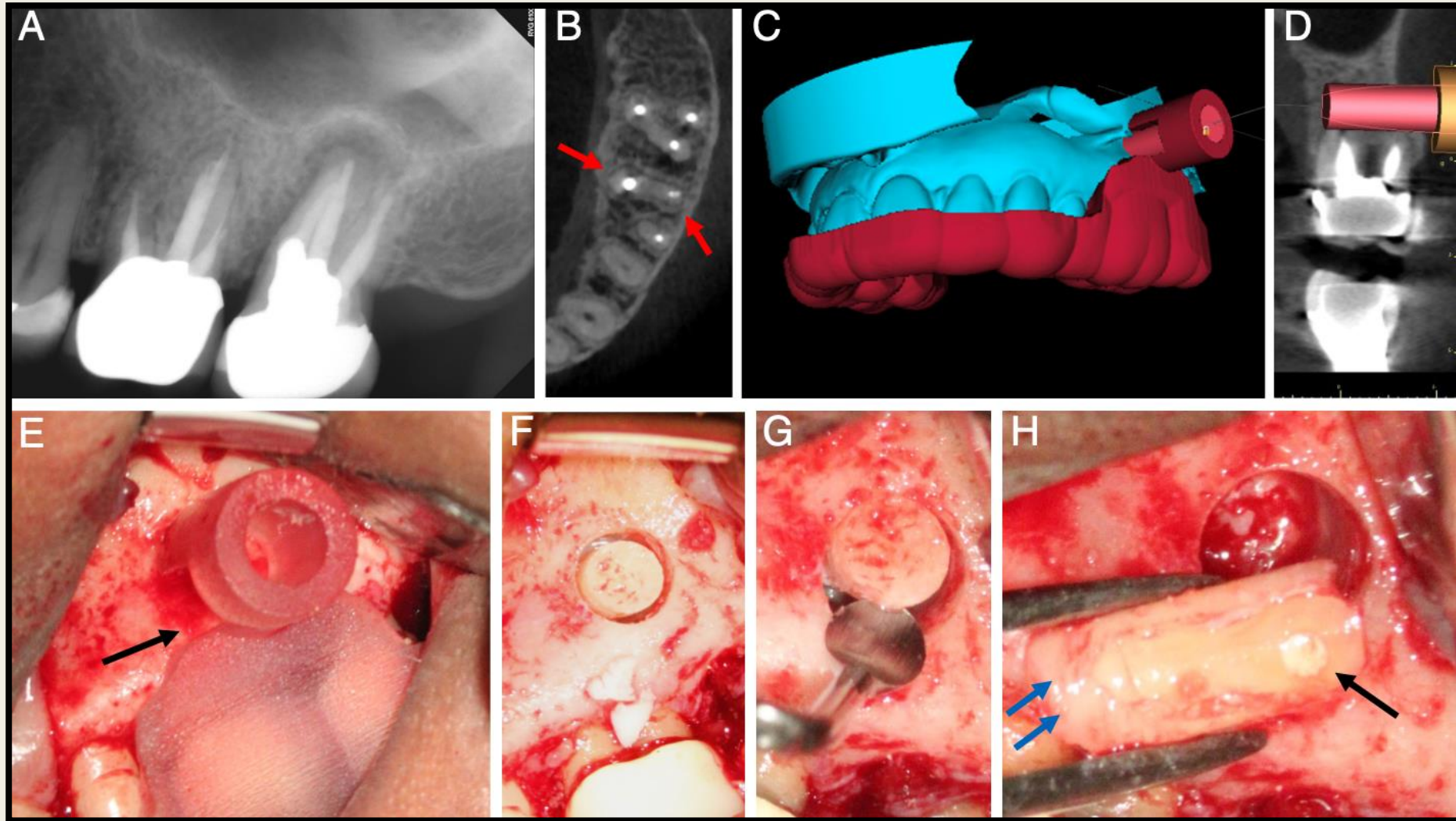


Hawkins (2020)

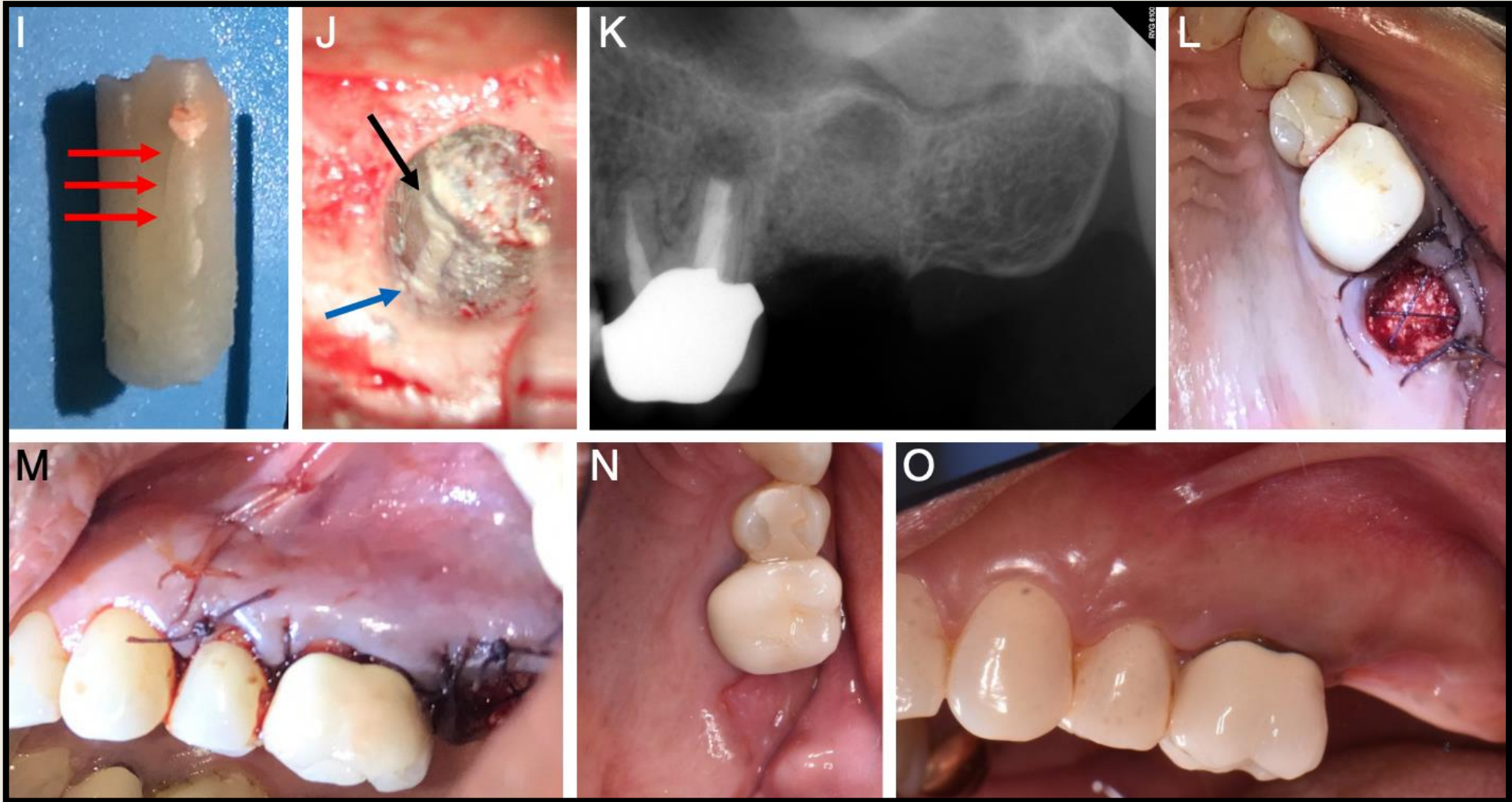


Hawkins (2020)

# Clinical Use of TEMS



# Clinical Use of TEMS

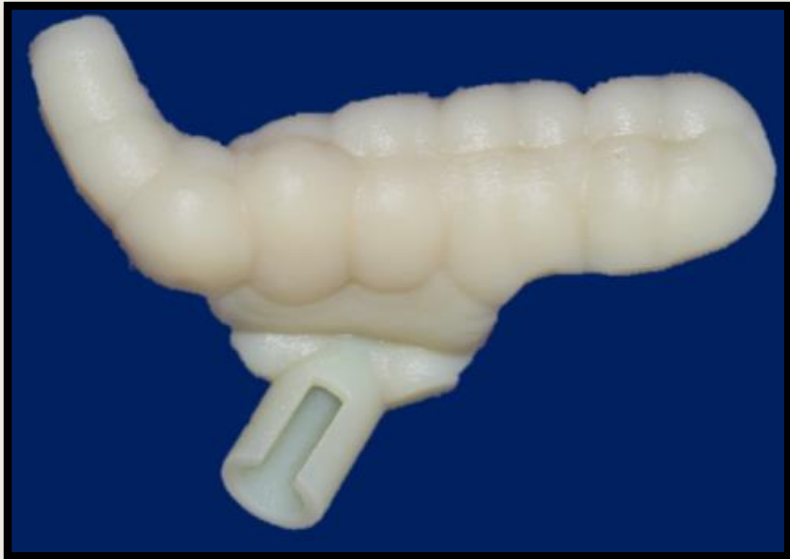


Giacomino (2018)

# TEMS Success

- Targeted Endodontic Microsurgery: A Retrospective Outcomes Assessment of 24 Cases (Buniag 2021)
  - *91.7% success Rate*
    - Follow-up 13-28 months
    - Success based on:
      - *Radiographic (complete healing, reductive healing, or failure)*
      - *Clinical (absence of pain, percussion, palpation, sinus tract; no probing depths indicative of endodontic failure)*

# What PORT LENGTH is required to maintain accuracy?



Giacomino (2018)



Giacomino (2018)



Hawkins (2020)

# Clinical Relevance

- Constricted buccal corridor/small oral cavity
- Palatal tori
- Extra room to insert trephine/operate

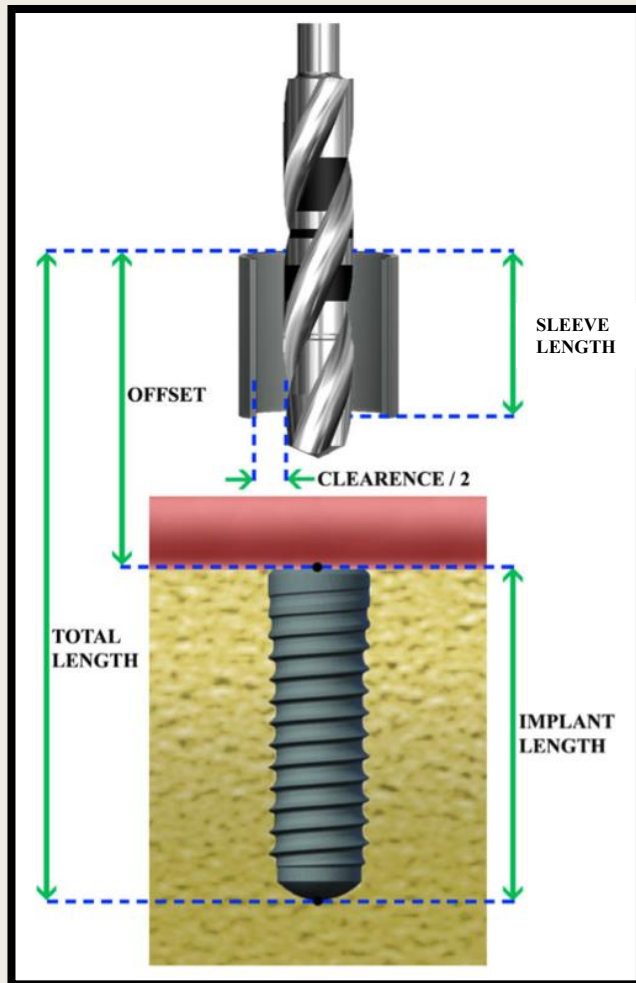


Neville 2009

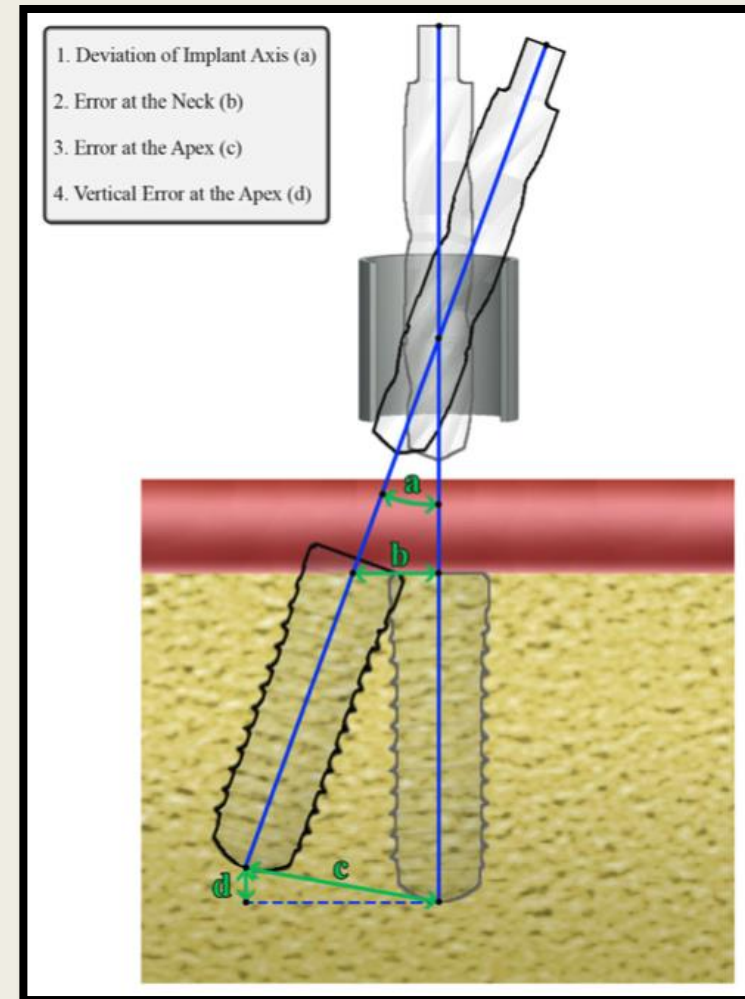


Al Quran (2006)

# Port Length in Implant Placement



Apostolakis (2018)



Apostolakis (2018)

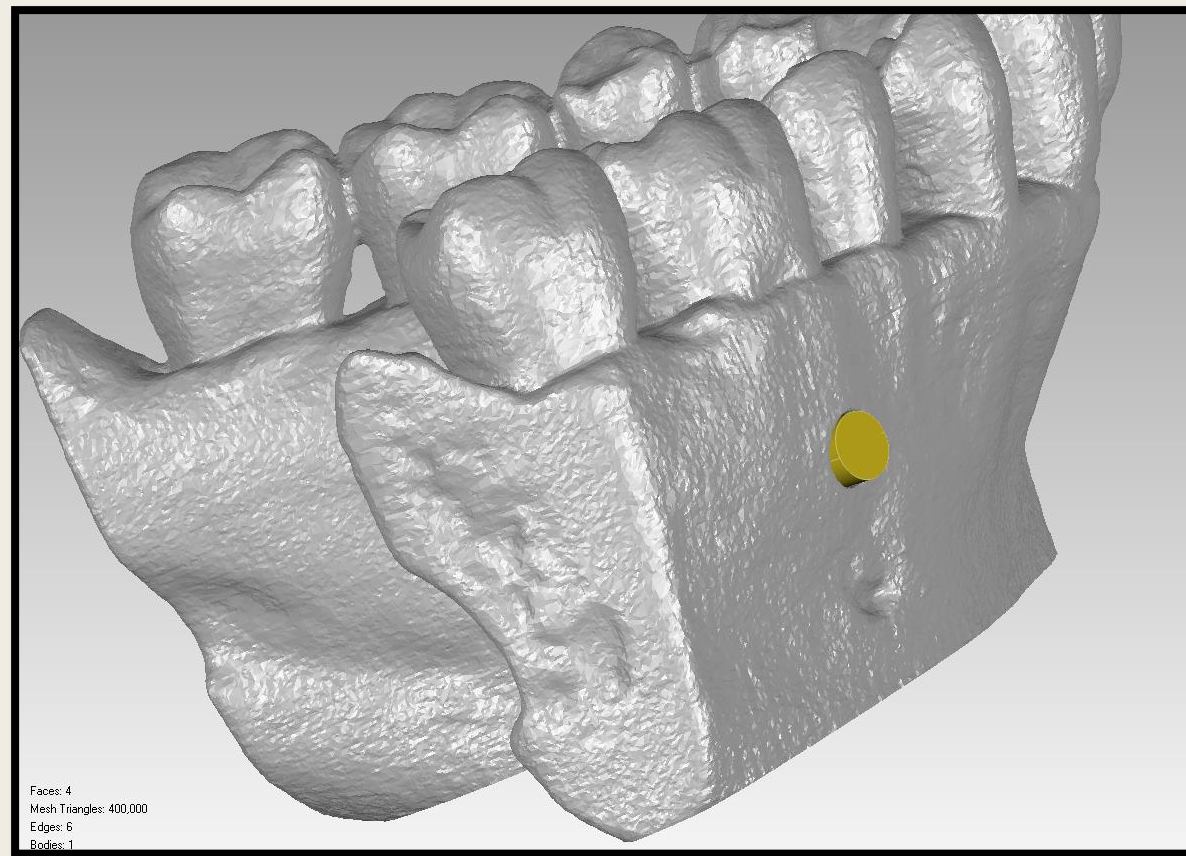
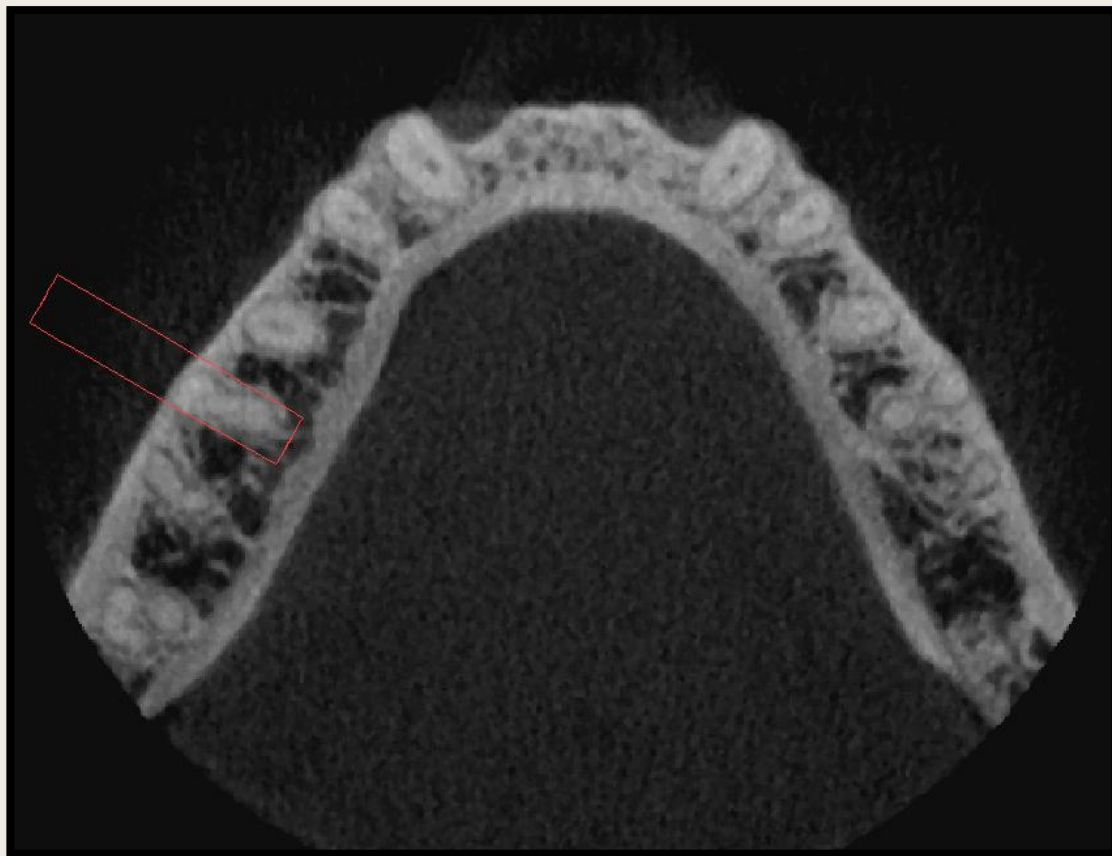
# Gap in Knowledge

- Objective: 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.
- Null hypothesis: TEMS guides are equally accurate regardless of port length

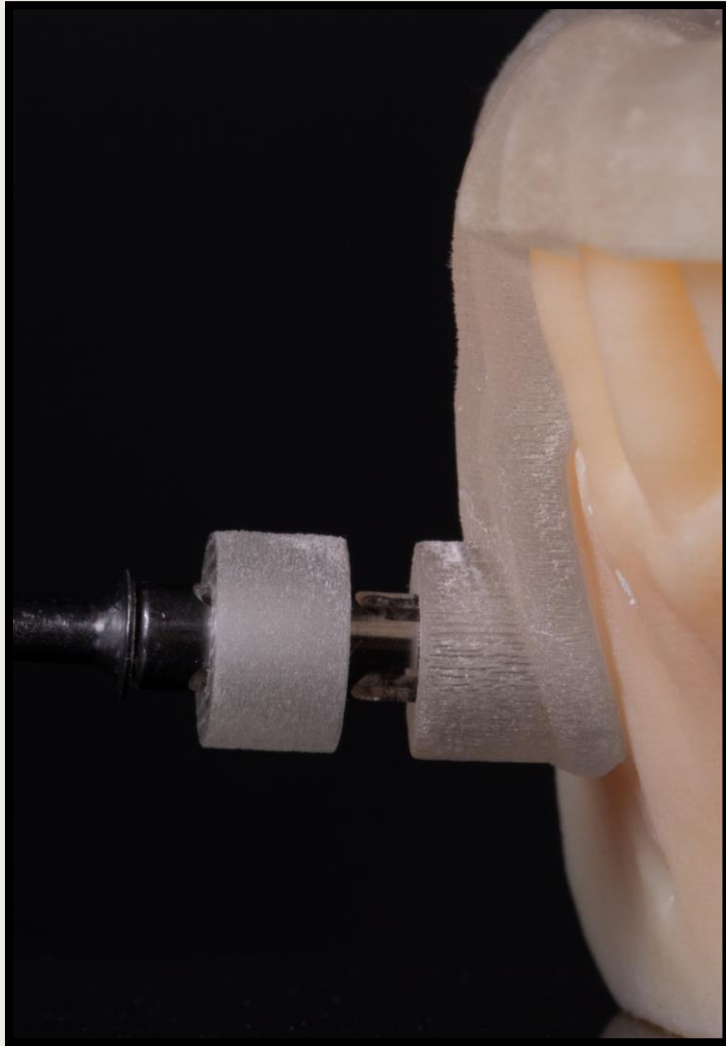
# Summary of Study

- Targeted endodontic microsurgery of #30-mesial root in a surgical simulated model
  - *3 Test Groups*
    - Test Group 1: TEMS guides with 5mm port lengths
    - Test Group 2: TEMS guides with 7mm port lengths
    - Test Group 3: TEMS guides with 10mm port lengths
- 10 total simulated osteotomies per group (30 total)
- All osteotomies are compared with presurgical plan and deviation is calculated

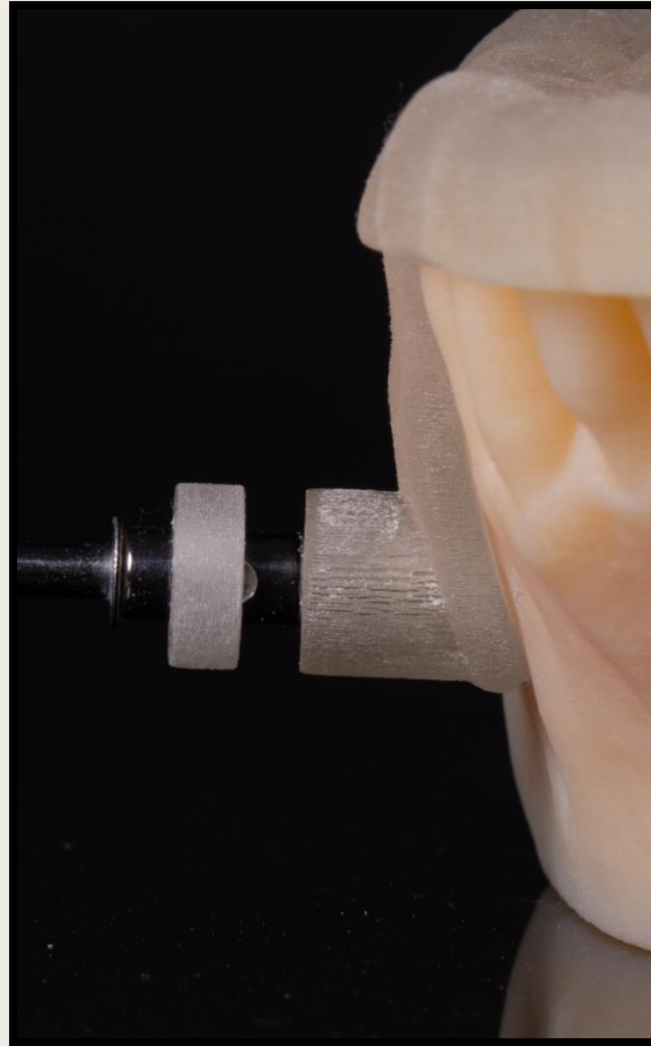
# Proposed Surgical Plan



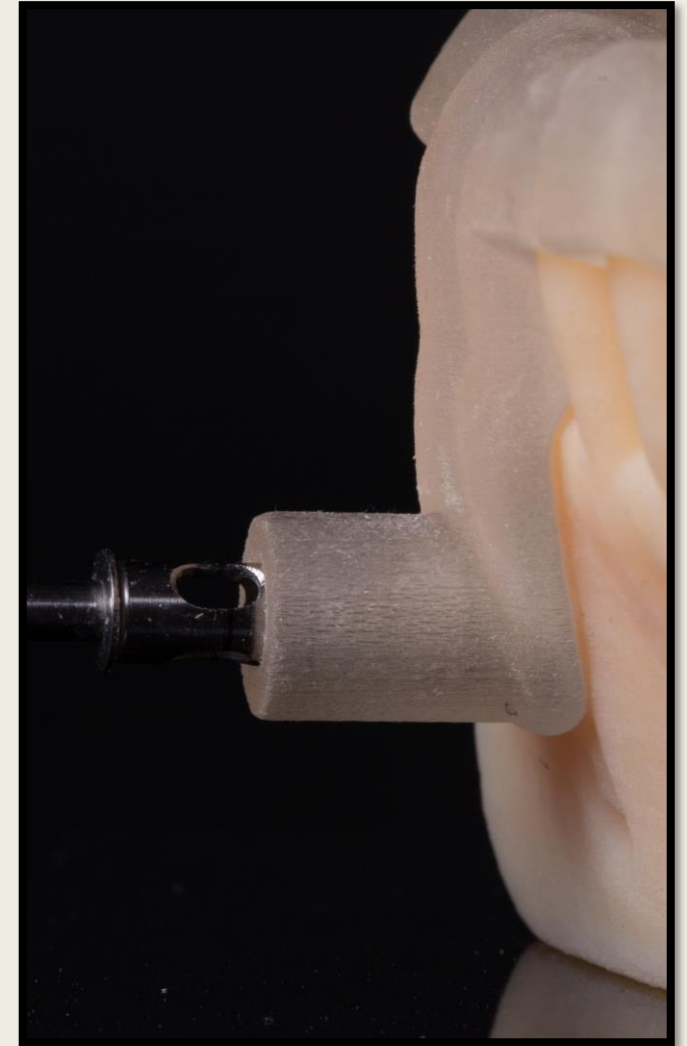
# Port Lengths



5mm

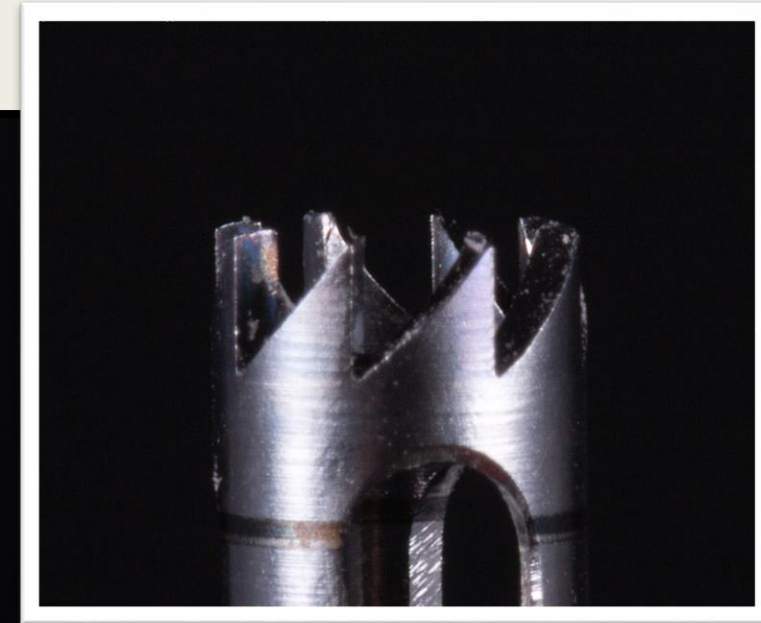
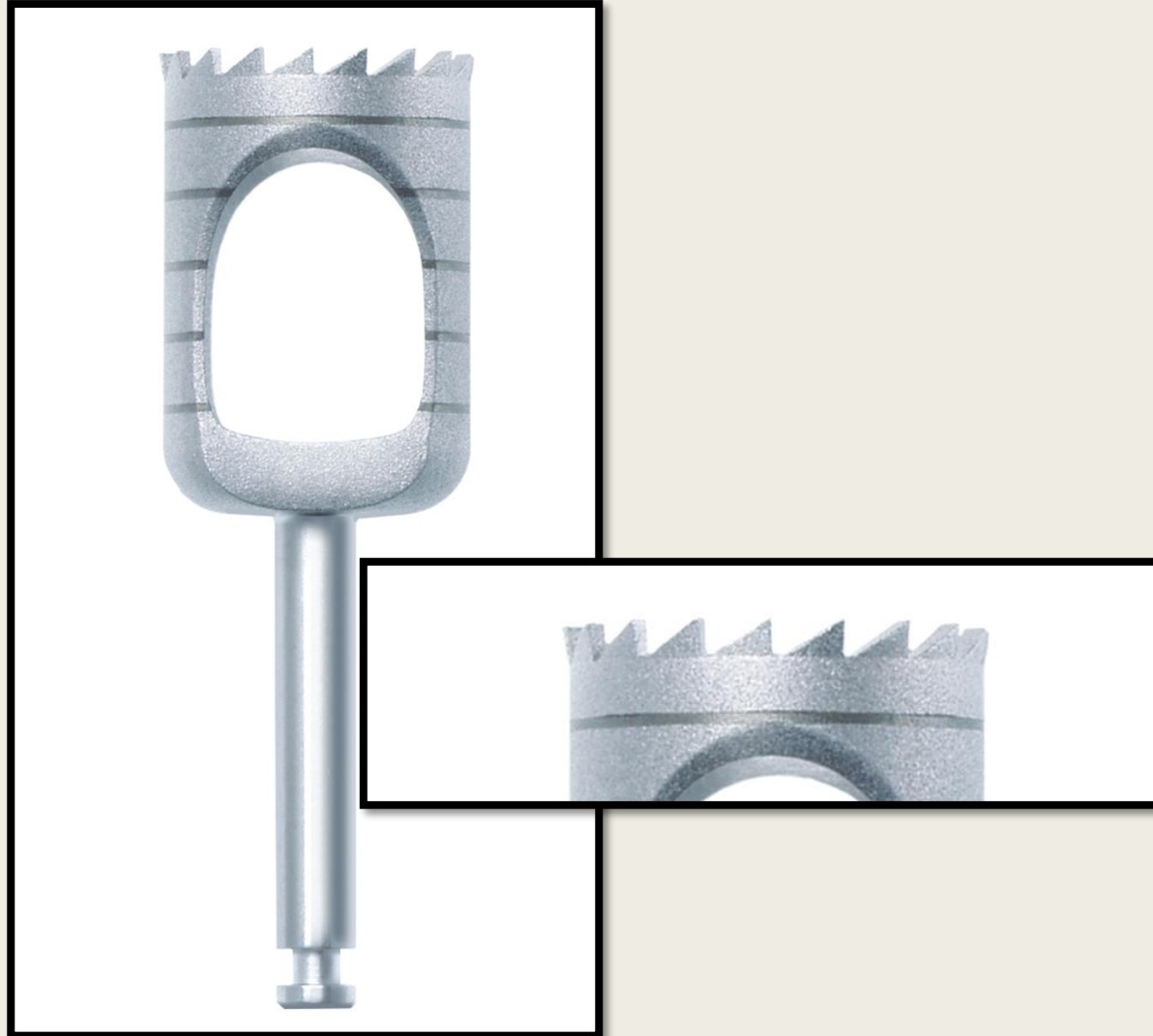


7mm



10mm

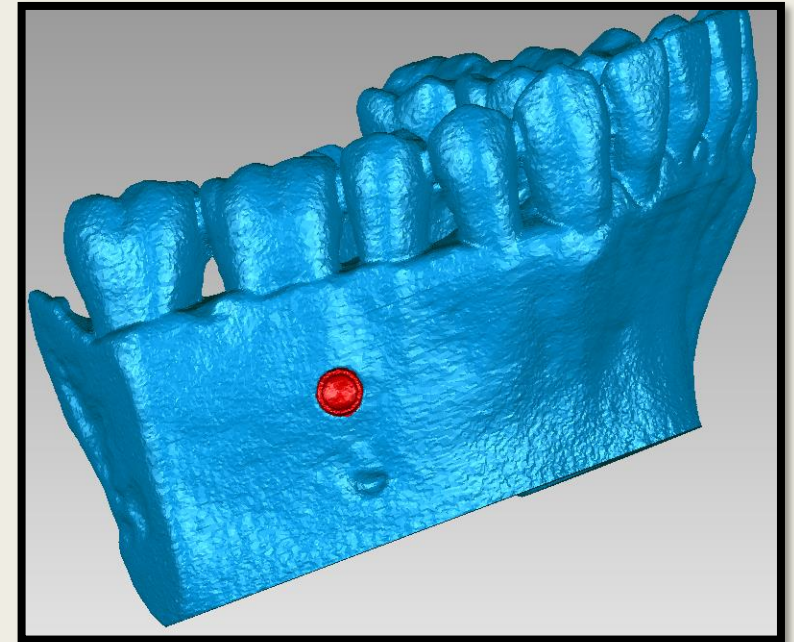
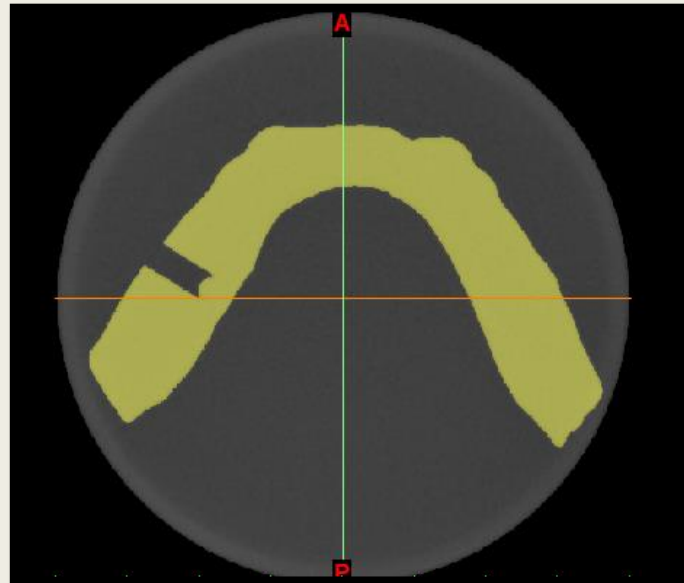
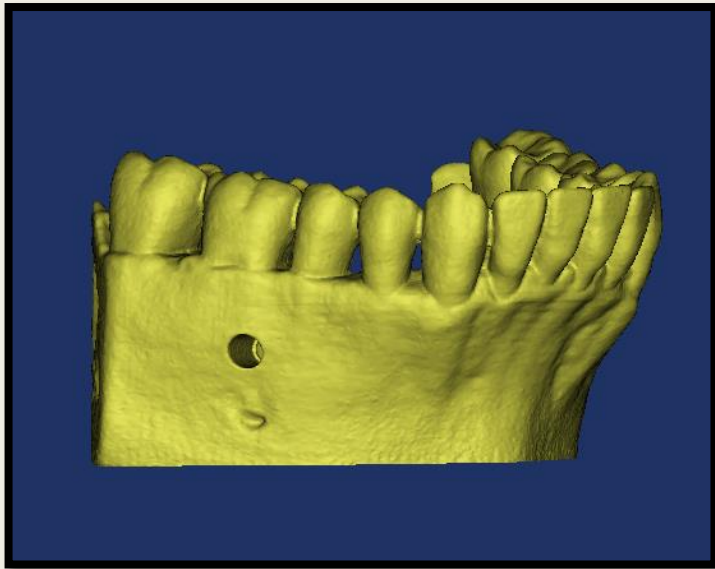
# Trephine Bur



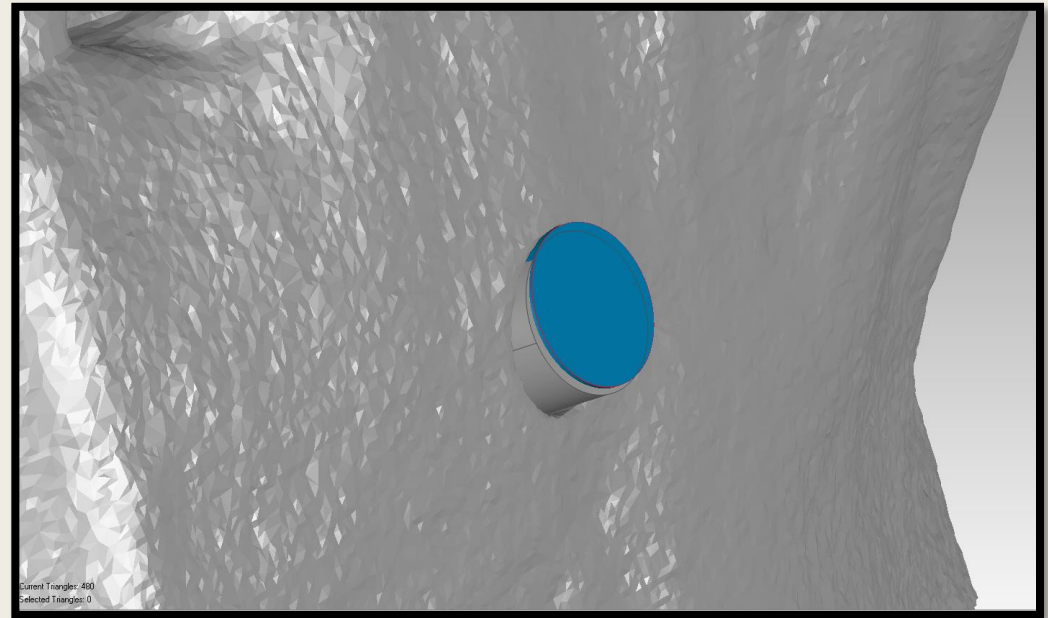
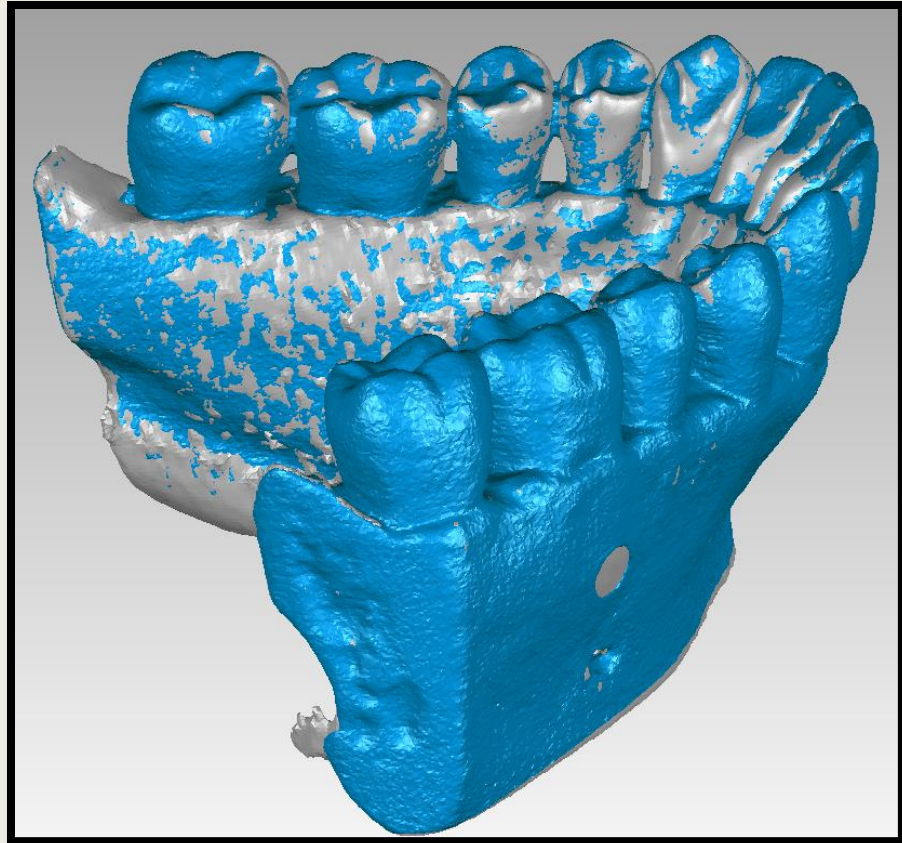
# Simulated Surgical Model



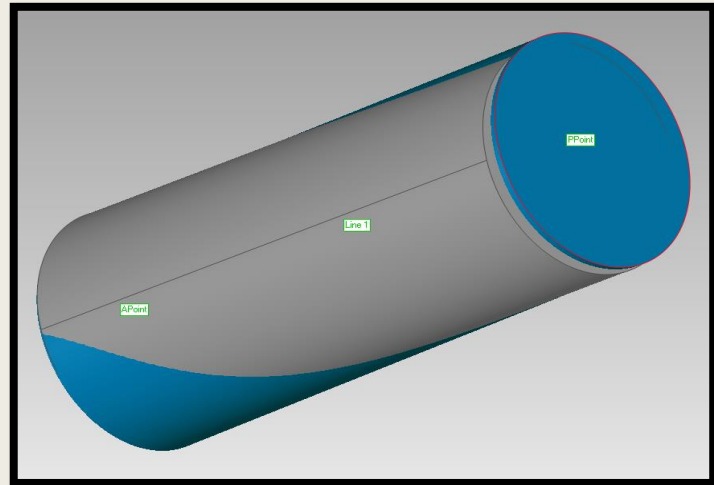
# Post CBCT Scan Images



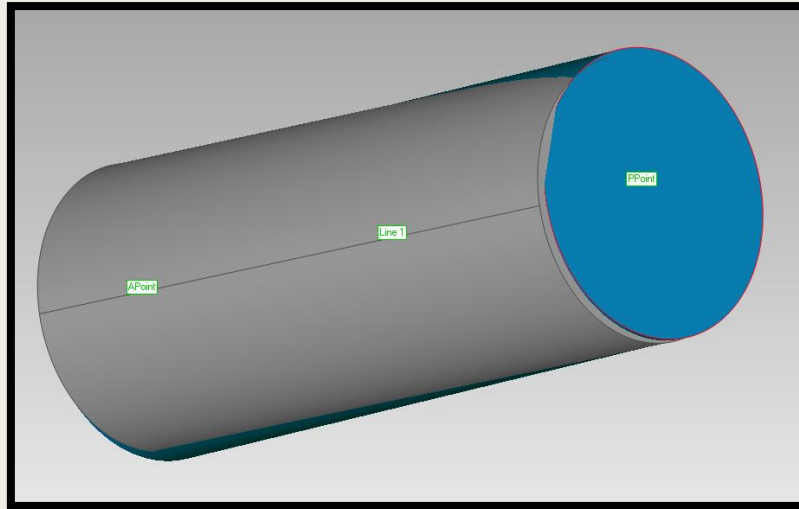
# Pre & Post-op Scans Merged



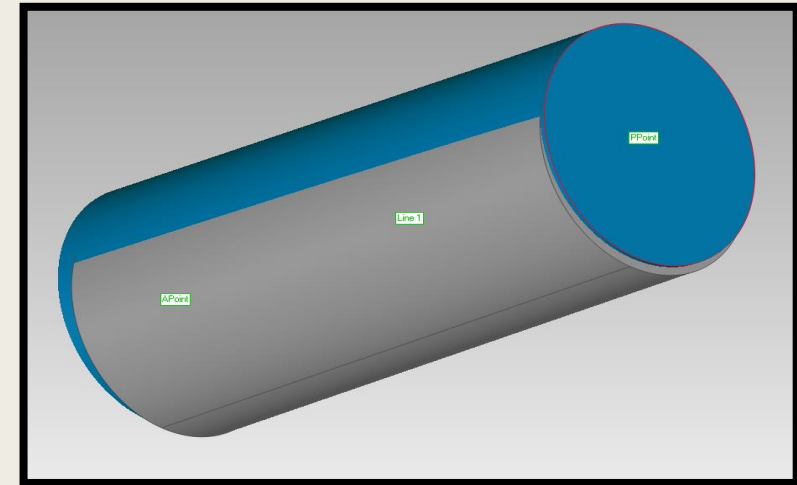
# Port Length Comparison



5mm



7mm



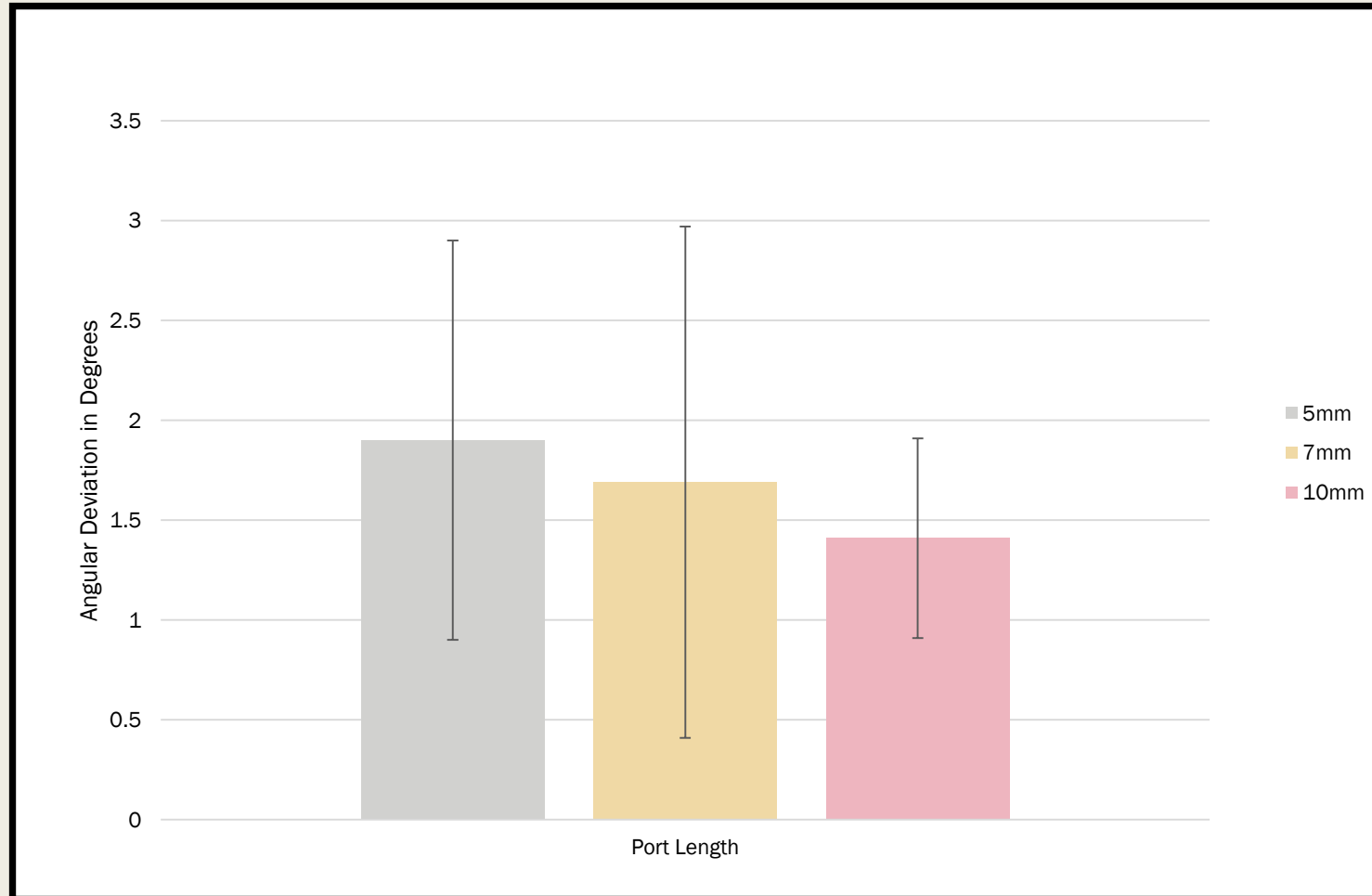
10mm

- \*\*Blue cylinder planned osteotomy
- \*\*Gray cylinder surgical osteotomy

# Data Analysis

- Null Hypothesis: TEMS guides are equally accurate regardless of port length.
- One-way analysis of variance (ANOVA) was conducted to examine the effects of port guide length on the outcomes. Significance was set to  $P < 0.05$ .

# Angular Deviation of Osteotomy



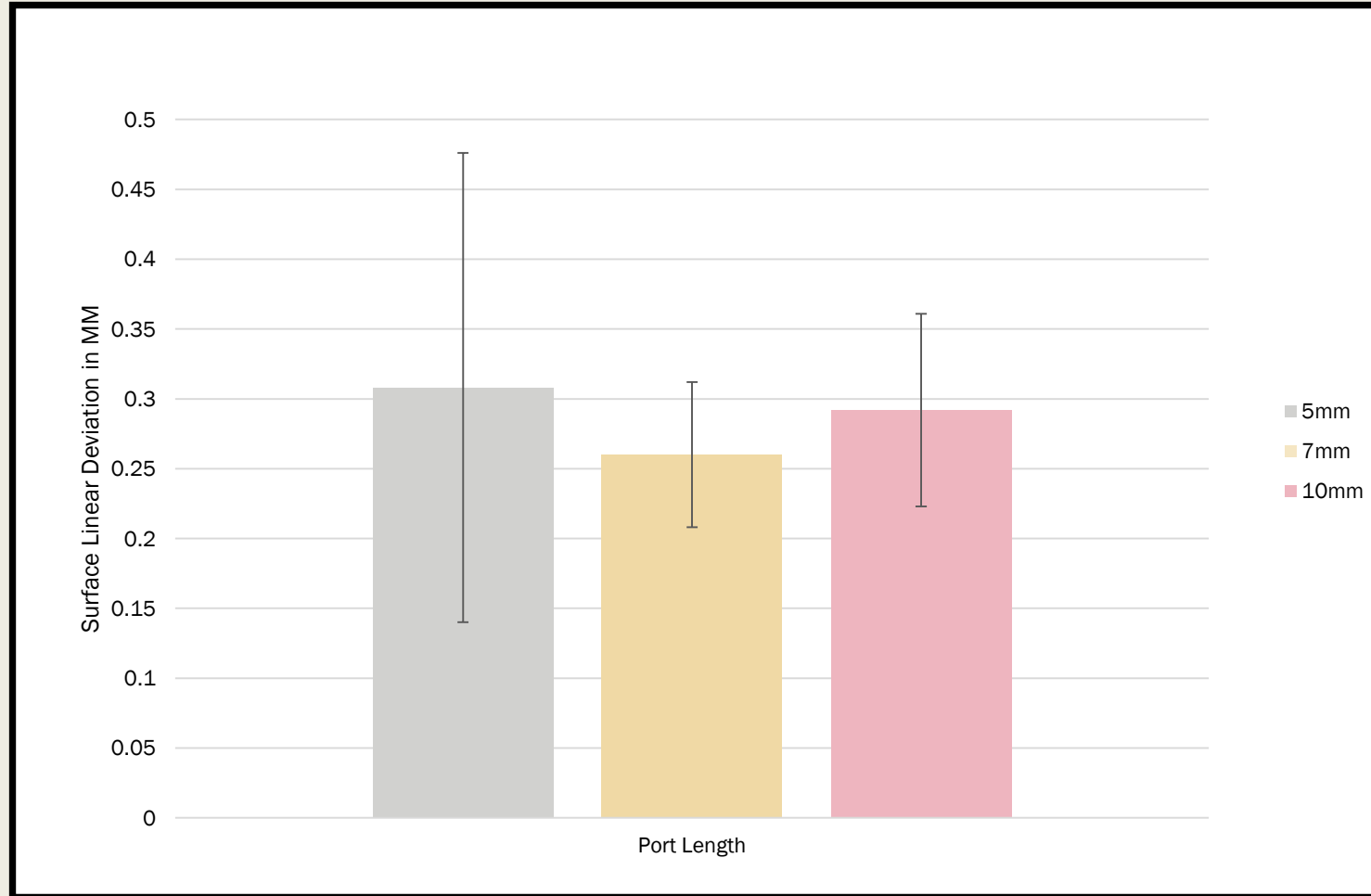
Key:

5mm:  $1.9^{\circ} \pm 1.0^{\circ}$

7mm:  $1.7^{\circ} \pm 1.3^{\circ}$

10mm:  $1.4^{\circ} \pm 0.5^{\circ}$

# Linear Deviation at Osteotomy Entry



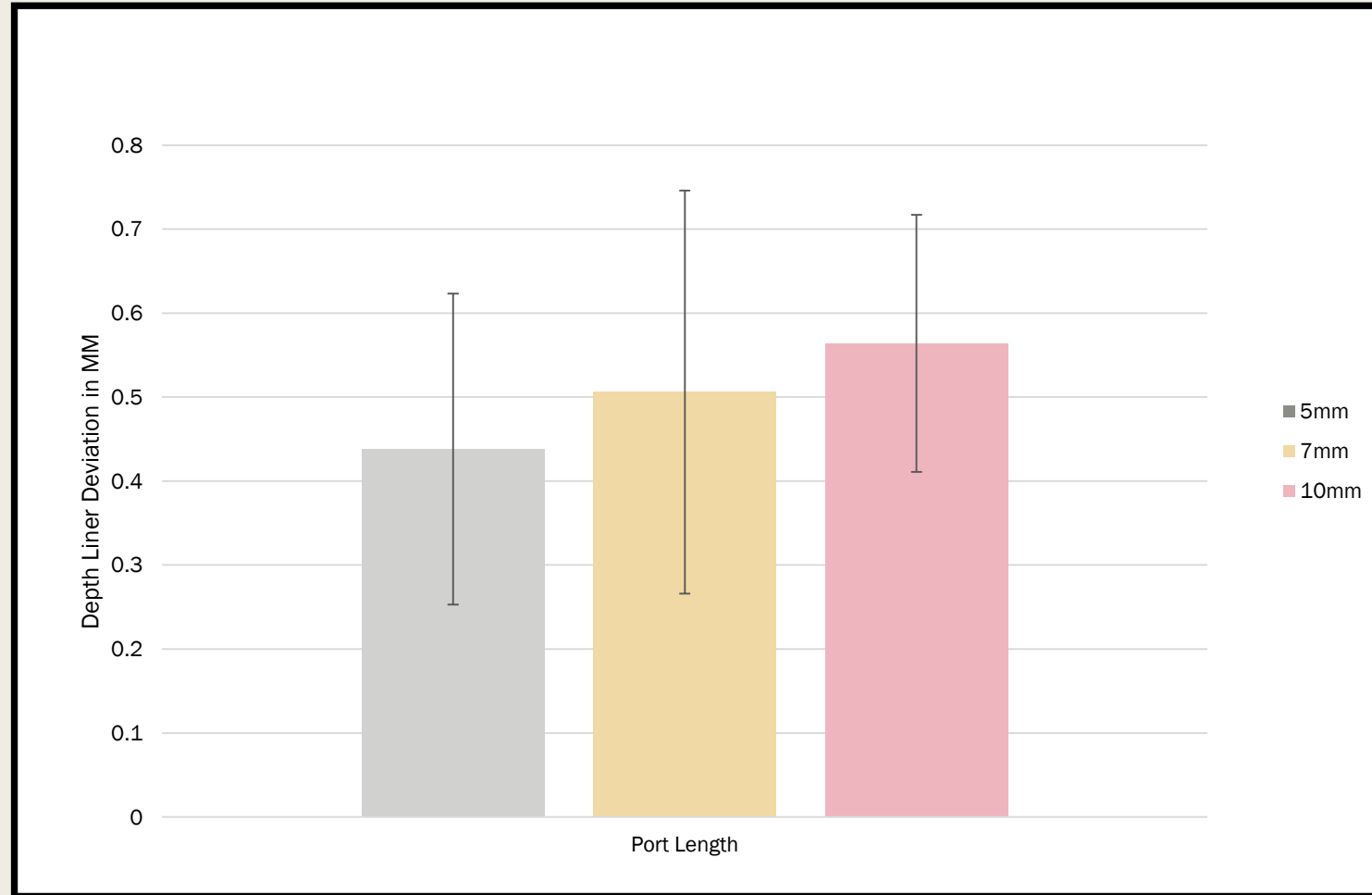
Key:

5mm:  $0.31\text{mm} \pm 0.17\text{mm}$

7mm:  $0.26\text{mm} \pm 0.05\text{mm}$

10mm:  $0.29\text{mm} \pm 0.7\text{mm}$

# Linear Deviation at Osteotomy Depth



Key:

5mm:  $0.44\text{mm} \pm 0.19\text{mm}$

7mm:  $0.51\text{mm} \pm 0.24\text{mm}$

10mm:  $0.56\text{mm} \pm 0.15\text{mm}$

# Conclusion

- Targeted Endodontic Microsurgery

- *There is no significant difference in accuracy or linear deviation when comparing 5mm, 7mm, and 10mm port lengths on simulated 3D printed surgical models.*

- Note:

- *Errors can occur and compound at every stage of the procedure in targeted endodontic microsurgery: scanning, processing, manufacturing, surgery, and mechanical parts of the guide.*
- *A new trephine was used for each simulated surgery (single-use)*

# Future Direction

- Cadaver or animal model



# Thank You

- Much appreciation for the hard work of Mr. Daniel P. Sierra and Mr. James E. Pizzini, Air Force Postgraduate Medical CAD/CAM Lab.
- Thank you Dr. Allen Pratt, Dr. Jelena Seibold, Dr. Jarom Ray, Dr. John Lovell for guidance and mentorship throughout the project.

# References

- Apostolakis D, Kourakis G. CAD / CAM implant surgical guides: maximum errors in implant positioning attributable to the properties of the metal sleeve / osteotomy drill combination. *Int J Implant Dent.* 2018;4(1):34
- Hawkins TK, Wealleans JA, Pratt AM, Ray JJ. Targeted endodontic microsurgery and endodontic microsurgery: a surgical simulation comparison. *Int Endod J.* 2019;715–22.
- Giacomino CM, Ray JJ, Wealleans JA. Targeted Endodontic Microsurgery: A Novel Approach to Anatomically Challenging Scenarios Using 3-dimensional–printed Guides and Trephine Burs—A Report of 3 Cases. *J Endod.* 2018 Apr 1;44(4):671–7.
- Buniag AG, Pratt AM, Ray JJ. Targeted Endodontic Microsurgery: A Retrospective Outcomes Assessment of 24 Cases. *J Endod.* 2021 May;47(5):762-769.

# Questions