TARGETED ENDODONTIC MICRO SURGERY:
IMPLICATIONS OF THE GREATER PALATINE ARTERY

Capt Bracken G. Smith, USAF, DC
Endodontics Resident, AF Postgraduate Dental School
Uniformed Services University of the Health Sciences
The speaker has no conflict of interest related to this presentation.

The views expressed are those of the authors and do not reflect the official views or policy of the Department of Defense or its Components or the Uniformed Services University of the Health Sciences.
TARGETED ENDODONTIC MICROSDURGERY

Photo courtesy Dr. Julie Anderson
ENDODONTIC MICRO SURGERY

Facial

* (Red Asterisk)

Palatal

Questions
PALATAL VITAL STRUCTURES

- Incisive Foramen
- Greater Palatine Nerve
- Greater Palatine Artery
- Greater Palatine Foramen
**GREATER PALATINE ARTERY**

**COURSE & DIAMETER**

- Course (Sagittal View)
- Greater Palatine Foramen

**Location by Population:**

<table>
<thead>
<tr>
<th>Population</th>
<th>D to 3rd M</th>
<th>3rd M</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>European</td>
<td>2%</td>
<td>75%</td>
<td>77%</td>
</tr>
<tr>
<td>African</td>
<td>37%</td>
<td>69%</td>
<td>106%?</td>
</tr>
<tr>
<td>Asian</td>
<td>7%</td>
<td>42%</td>
<td>49%</td>
</tr>
<tr>
<td>Brazilian</td>
<td>22%</td>
<td>74%</td>
<td>96%</td>
</tr>
<tr>
<td>Indian</td>
<td>7%</td>
<td>70%</td>
<td>77%</td>
</tr>
<tr>
<td>African &amp; Indian</td>
<td>15%</td>
<td>67%</td>
<td>82%</td>
</tr>
</tbody>
</table>
GREATER PALATINE ARTERY
COURSE & DIAMETER

- Diameter (Sagittal View)
  - Outer (GP Foramen): 2.65 ± 1.3 mm
  - Inner (2\textsuperscript{nd} Molar): 1.48 ± 0.34 mm
  - Outer (1\textsuperscript{st} PM): 1.96 ± 0.9 mm

- Projected Diameter
  - Outer (2\textsuperscript{nd} Molar): 2.5 mm
  - Outer (1\textsuperscript{st} Molar): 2.35 mm
GREATER PALATINE ARTERY
COURSE & DIAMETER

• Location (Coronal View)
  • Junction of hard palate & alveolus
  • Lateral, deep, & inferior to GPN

• Projected Diameter
  • Outer (2nd Molar): 2.5 mm
  • Outer (1st Molar): 2.35 mm

• Safety Margin
  • 2 mm from vital structures
GREATER PALATINE ARTERY
PALATAL TRANSITION MORPHOLOGY

• Location (Coronal View)
  • Junction of hard palate & alveolus
  • Lateral, deep, & inferior to GPN

• Variations
  • Spine
  • Bridge
    • Groove covered by fibrous connective tissue
  • Smooth
    • Indistinct vertical to horizontal transition
• Location (Coronal View)
  • Junction of hard palate & alveolus
  • Lateral, deep, & inferior to GPN
• Variations
  • Spine or Greater Palatine Crest
  • Bridge
    • Groove covered by fibrous connective tissue
  • Smooth
    • Indistinct vertical to horizontal transition
GREATER PALATINE ARTERY
PALATAL TRANSITION MORPHOLOGY

• Location (Coronal View)
  • Junction of hard palate & alveolus
  • Lateral, deep, & inferior to GPN

• Variations
  • Spine or Greater Palatine Crest
  • Bridge
    • Groove covered by fibrous connective tissue
  • Smooth
    • Indistinct vertical to horizontal transition
GREATER PALATINE ARTERY
PALATAL TRANSITION MORPHOLOGY

Spine
Bridge
Smooth
TARGETED ENDODONTIC MICRO SURGERY
KNOWLEDGE GAP

• Knowledge Gap
  • Proximity of Maxillary 1st & 2nd Molar Palatal Roots
    • Greater Palatine Foramen
    • Greater Palatine Neurovascular Bundle
  • Feasibility of TEMS via Palatal Approach
Research Objectives

1) To classify the GPA relative to maxillary first and second molar palatal root apices

2) To assess the feasibility of maxillary first and second molar palatal root TEMS based on CBCT analyses.

3) To provide morphometric analyses of CBCT images relating the maxillary first and second molar palatal root apices to the greater palatine foramen & greater palatine artery
Institutional Review Board Approval

Obtain approval from the USAF 59th Medical Wing IRB.

Image Selection

Obtain 100 previously acquired CBCT scans

- 3D Accuitomo at AFPDS Endo & Perio Departments
- January 2017 through October 2018

Inclusion/Exclusion Criteria
TARGETED ENDODONTIC MICRO SURGERY RESEARCH DESIGN

• **Image Selection**
  - Anonymize CBCTs; no identifiers retained with images
  - Store and view from encrypted, non-network hard drive

• **Image Evaluation**
  - Analyze CBCTs with i-Dixel and obtain the following data:
    A. Classification of maxillary molar palatal roots in relation to GPA
    B. Feasibility of TEMS pathways to palatal roots
    C. Distances from maxillary molar palatal roots to GPF & GPA
**Image Evaluation**

1) Classify the GPA relative to maxillary molar palatal root apices

- Vertical position of maxillary molar palatal root apex
- Reference line at root apex parallel to hard palate
- Projected GPA (solid) & diameter (dashed)
TARGETED ENDODONTIC MICRO SURGERY
RESEARCH DESIGN

• Image Evaluation

2) Determine the feasibility of TEMS

- Projected GPA
- 2 mm Safety Margin
- 5 mm Trephine/Reference TEMS Pathway
  -- Tangential to or superior to root apex, not inferior
• **Image Evaluation**

3) Measure distances from maxillary molar palatal roots to GPF & GPA
• **Image Evaluation**

3) Measure distances from maxillary molar palatal roots to GPF & GPA
TARGETED ENDODONTIC MICROSURGERY

RESULTS

Greater Palatine Artery Classifications & TEMS Feasibility

1st Molars
2nd Molars
All Molars
# Targeted Endodontic Microsurgery Results

<table>
<thead>
<tr>
<th>Measurement</th>
<th>1st Molars</th>
<th>2nd Molars</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Root--GPF</td>
<td>126</td>
<td>11.13</td>
<td>2.68</td>
</tr>
<tr>
<td>Root--GPA</td>
<td>126</td>
<td>2.37</td>
<td>1.46</td>
</tr>
<tr>
<td>CEJ--GPA</td>
<td>126</td>
<td>12.86</td>
<td>2.29</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>All Molars</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>250</td>
<td>8.06</td>
<td>4.06</td>
<td>0.25 - 18.46</td>
</tr>
<tr>
<td></td>
<td>250</td>
<td>2.45</td>
<td>1.62</td>
<td>0.18 - 8.13</td>
</tr>
<tr>
<td></td>
<td>250</td>
<td>13.45</td>
<td>2.47</td>
<td>7.08 - 19.88</td>
</tr>
</tbody>
</table>
# TARGETED ENDODONTIC MICROSURGERY

## RESULTS

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Female</th>
<th></th>
<th></th>
<th></th>
<th>Male</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Mean</td>
<td>SD</td>
<td>Range</td>
<td>N</td>
<td>Mean</td>
<td>SD</td>
<td>Range</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Root--GPF</td>
<td>122</td>
<td>7.95</td>
<td>3.84</td>
<td>0.60 - 14.93</td>
<td>128</td>
<td>8.17</td>
<td>4.27</td>
<td>0.25 - 18.46</td>
<td>0.66</td>
<td></td>
</tr>
<tr>
<td>Root--GPA</td>
<td>122</td>
<td>2.51</td>
<td>1.50</td>
<td>0.18 - 7.90</td>
<td>128</td>
<td>2.39</td>
<td>1.72</td>
<td>0.25 - 8.13</td>
<td>0.57</td>
<td></td>
</tr>
<tr>
<td>CEJ--GPA</td>
<td>122</td>
<td>12.54</td>
<td>2.56</td>
<td>7.08 - 19.88</td>
<td>128</td>
<td>14.33</td>
<td>2.04</td>
<td>10.36 - 18.83</td>
<td>&lt; 0.0001</td>
<td></td>
</tr>
</tbody>
</table>

### All Molars

<table>
<thead>
<tr>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>250</td>
<td>8.06</td>
<td>4.06</td>
<td>0.25 - 18.46</td>
</tr>
<tr>
<td>250</td>
<td>2.45</td>
<td>1.62</td>
<td>0.18 - 8.13</td>
</tr>
<tr>
<td>250</td>
<td>13.45</td>
<td>2.47</td>
<td>7.08 - 19.88</td>
</tr>
</tbody>
</table>
TARGETED ENDODONTIC MICRO大切手术

DISCUSSION

- Palatal Transition Morphology
- Greater Palatine Artery Position
  - Direct visualization
  - Indirect visualization
- Safety Margin
- TEMS Feasibility
TARGETED ENDODONTIC MICRO SURGERY

CONCLUSIONS

• Palatal transition morphology aided in projecting the position of the GPA

• Maxillary 2\textsuperscript{nd} molar roots were closer to the GPA than 1\textsuperscript{st} molar roots

• Palatal-approach TEMS feasibility was relative to the palatal root-to-GPA distance.
ACKNOWLEDGEMENTS

**Lt Col Jarom J. Ray**, DDS, Endodontics Residency Program Director, Air Force Postgraduate Dental School and Uniformed Services University of the Health Sciences Postgraduate Dental College.

**Lt Col Allen M. Pratt**, DMD, Endodontics Residency Training Officer, Air Force Postgraduate Dental School and Uniformed Services University of the Health Sciences Postgraduate Dental College.

**Capt Julie A. Anderson**, DMD, Endodontist, Hurlburt Field Dental Clinic.

**Dr. Shawn Countryman** for Oral and Maxillofacial radiology calibration.

**Dr. Jisuk Park** for statistical analyses support.
TARGETED ENDODONTIC MICROSCUERGERY: IMPLICATIONS OF THE GREATER PALATINE ARTERY

THANK YOU!

Questions?
bracken.g.smith.mil@mail.mil