Bony Adaptation After Expansion With Light-To-Moderate, Continuous Forces
Collin Kraus, DDS, MS

Tooth-Size-Arch-Length Discrepancy
• aka “Crowding”
• Common orthodontic problem
  – Couri et al. 2006

Tooth-Size-Arch-Length Discrepancy
• Traditional solutions for gaining space
  – Reduce tooth mass (extract, slenderize)
  – Increasing arch length
    • A-P: Proclination, Distalization
    • Transverse: *Expansion
      – Skeletal (sutural separation) → RPE
      – Dental (dentoalveolar) → expanded archwires*

Archwire Expansion
• Are negative side effects a result?
  – Tipping? Root resorption? Dehiscences?
• Do bony limits exist?
• Can light-to-moderate, continuous forces applied from buccally-placed arch wires produce expansion of teeth with accompanying lateral apposition of bone?

Project Aims
• To evaluate the movements of maxillary 2nd premolars expanded with light-to-moderate, continuous forces.
• To evaluate the adaptation of bone when the teeth are expanded.

Materials & Methods
• 7 male foxhound/mongrel dogs
• ~55-65 lbs
• Approximately 2 yrs old
• Properties of dog bone, other than primates, best approximate the properties of human bone (Lennon et al. 1998).
**Dependent Variables/Outcome Measures**

- **Tooth Movements**
  - Amount of expansion
  - Force levels
  - Amount of tipping
- **Bony Adaptation**
  - Bone height & thickness
  - Presence/absence of bone facial to PM2
  - Dehiscence?
  - New bone?

**Timeline**

<table>
<thead>
<tr>
<th>Weeks</th>
<th>0</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>7</th>
<th>9</th>
<th>10</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Records</td>
<td>T0</td>
<td>T1</td>
<td>T2</td>
<td>T3</td>
<td>T4</td>
<td>T5</td>
<td>T5</td>
<td>T6</td>
</tr>
<tr>
<td>Wires</td>
<td>16x2</td>
<td>CuNiT1</td>
<td>19x2</td>
<td>CuNiT1</td>
<td>Passive</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bone Markers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

12 weeks total
9 weeks active expansion, 3 weeks consolidation
Last set of records taken at week 8 (even weeks only)

**Results**

Intra-oral measures of tooth movements

**Radiographic movements of PM2**

**Force Applied to PM2**
Tipping of PM2

- Dog A = 15.1°
- Dog B = 23.5°
- Dog C = 9.8°
- Dog D = 14.8°
- Dog E = 10°
- Dog F = 26.5°
- Dog G = 10.6°
- Average = 15.8°

Micro-CT

Experimental
3.7 mm movement
15.1° tipping

Buccal Bone Height

Root Resorption

BBT – Mesial Root
Conclusions

- Expansion (~1mm/4wk, ~3.5mm/8wk) was achieved
- Tipping accounted for much of the expansion
- All seven experimental teeth demonstrated significant dehiscence of bone over both roots

Conclusions

- The facial surface of the tooth root was resorbed during the tipping/expansion
- Buccal bone thickness decreased at the coronal level and increased at the apical level

Conclusions

- Bone apposition occurred on the PDL side of buccal bone near the apex of the root and on the PDL side of palatal bone near the crest
- Bone apposition occurred apically on the palatal side of the root and coronally on the periosteal side of buccal bone

***

- While bone was definitely added, the results found in this study do not support archwire expansion as it is currently performed
- Due to the dehiscences formed, the negative consequences outweigh the positive
- More studies are needed to find a better way!
Thank you!!!