LONGITUDINAL STABILITY OF MINISCREW IMPLANTS WITH LOCAL APPLICATION OF ZOLEDRONATE

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MSI’s in Orthodontics

- Controlling anchorage... one of the most difficult things to achieve in Orthodontics
- The use of mini-screw implants (MSI’s) requires minimal patient cooperation making the job easier and more efficient for the practitioner
- The main problem is MSI failure (15-20%)

Systematic reviews

- 2293 MSIs; Range 0-100%; Most < 20% if mobile and displaced MSIs were included (Reynders et al. 2009)
- 2374 MSIs; Range 0-100%; Mean: 15.3% (Schatzle et al. 2009)
- 1519 MSIs; Range: 0-41%; Mean: 16.4% (Crismani et al. 2010)

MSI’s move...

Purpose

- Evaluate the potential of locally delivered zoledronate for enhancing the stability of MSIs
- Assess the success rate
- Compare differences in MSI stability experimental vs control
- Use μCT for comparison of bone-implant interface experimental VS control

Materials and Methods

- Split--jaw design
- 3 skeletally mature male mongrel dogs
- 55 – 65 lbs.
- Between one and two years of age
Materials and Methods

- 60 MSIs total (20 per dog)
  - 30 experimental (Zoledronate)
  - 30 controls
- Neodont™ (Curitiba Brasil)
  - Self-tapping
  - Titanium alloy
  - 1.6 mm x 5 mm
  - Collar height 1 mm

Percentage of total MSI location

- Maxilla: 48%
- Mandible Buccal: 35%
- Mandible Lingual: 17%

<table>
<thead>
<tr>
<th></th>
<th>MAXILLA</th>
<th>MANDIBLE Buccal</th>
<th>MANDIBLE Lingual</th>
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</thead>
<tbody>
<tr>
<td>Day R1</td>
<td>8</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>Day R2</td>
<td>5</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>Day R3</td>
<td>8</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>total</td>
<td>21</td>
<td>29</td>
<td>10</td>
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Research Design

- Randomization: Zoledronate VS Control
- Implant Stability Quotient (ISQ)
- Ostell Mentor
- µCT scans

Surgical Protocol

- Prophylaxis using ultrasonic scaling
- Intubation
- Irrigation of surrounding gingival tissues with 0.2% chlorhexidine

Surgical Setup
**Surgical Protocol**

- Radiographs

- Local anesthetic 2% Lidocaine, 1:100,000 epinephrine

- Measurement of surgical site

- Tissue marker 3M Unitek

- 1.5 mm tissue punch 3M Unitek

- Pilot hole drilled with 1.1 mm surgical drill (Neodent) and copious irrigation

- Blinded randomized local application of substance to the pilot hole with insulin syringe

- Immediate implant placement post substance insertion

**Post-op Rx**

- Buccal Upper

- Buccal Lower

- Buccal & Lingual Lower
**ISQ “Osstell Mentor” (Göteborg Sweden)**

**μCT**
- Specimen preparation
- 28 total
  - MAXILLA: 6 control, 6 experimental
  - MANDIBLE: 8 control, 8 experimental

**μCT 3D Reconstruction**
- VOI defined for each bone implant specimen
- Cortical and Trabecular bone were identified
- The middle mixed bone was not evaluated

**μCT 3D Reconstruction**
- 3D layers of bone
  - Bone Volume/Total Volume (BV/TV)
- 3-D volume fraction measurements evaluated
  - 6-24 µm
  - 24-42 µm
  - 42-60 µm
RESULTS

Stable and Mobile MSIs

4 MSIs showed clinical signs of mobility but did not fail

Tissue Reaction

Maxilla
Mandible Buccal
Mandible Lingual

Changes of MSI stability from baseline

Medians (50%)

6-24 µm

24-42 µm

42-60 µm

* P<0.05
Conclusions

- A single, small, locally-applied dose of zoledronate was sufficient to avoid significant loss of stability in experimental MSIs over time.

Conclusions

- In the trabecular region, there was more bone around experimental than control MSIs.

Conclusions

- In the cortical region, there was less bone around experimental than control MSIs.

Clinical Implications

- Most of the MSI is placed in trabecular bone
- Zoledronate causes bone turnover around trabecular bone
- Greater stability

Discussion

Zoledronate MSIs

- ↑ Stability of Zol MSI...
  - Attributed to changes and bone remodeling occurring in the trabecular bone (TB)
  - Almost 2:1 ratio of MSI in TB
- Trabecular Bone:
  - Fast and constant turnover
  - Formation detected since week one (Berglundh et al. 2003)
  - Suggested to be responsible for Secondary Stability (Berglundh et al. 2003)

Safety - 3 Concerns

1. Effects in growing children
2. Risk of bisphosphonate-associated osteonecrosis of the jaws (BONJ)
3. Half-life of “ten years or more”

**CLINICAL APPLICATIONS OF BPs**

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<tr>
<th>Orthopedic</th>
<th>Dental</th>
<th>Orthodontics</th>
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<tr>
<td>- Increased mechanical fixation of orthopedic implants (Peter, 2005; Peter, 2006; Aspenberg, 2009; Shinkai, 2007; Uus, 2008)</td>
<td>- Treat periodontitis (Shinoda, 2008)</td>
<td>- Reduce root resorption during OTM (Jabore, 2009; Ignor, 2014)</td>
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<td>- Accelerated healing of fractures (Aspenberg, 2009)</td>
<td>- Bone loss after mucoper. flap surgery (Koo, 2007; Chen et al., 2005)</td>
<td>- Decrease post-orthodontic relapse (Iglesias-Linares, 2010)</td>
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<td>- Improved stability of joint replacements (Koo, 2007; Aspenberg, 2009; Fiedor, 2009)</td>
<td>- Reduce bone/root resorption, ankylosis, and pulpal min of reimplanted teeth (Aspenberg, 2009; Li, 2006)</td>
<td>- Decrease skeletal relapse after RPE (Iglesias-Linares, 2010)</td>
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<td>- Decrease relapse after mandibular distraction (Iglesias-Linares, 2010)</td>
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<td>- Decrease anlage loss (Iglesias-Linares, 2010; Ignor, 2014; Uus, 2008)</td>
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