Proper Inclination of Each Whole Tooth Relative to its Respective Alveolar Process

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**Research question:** What is the proper inclination of each tooth relative to the alveolar process?

**Research sample:** 76 “near normal” subjects

- **Photographic screening:**
  - No history of prior orthodontic Tx; Complete dentition (*normal shape and size teeth*); first molar relationship: 1/2 Step Cl II ~ 1/4 step Cl III; OB/OJ 0-5 mm;
  - Dental X-bite <2mm limited to one tooth; Rotation < 15° / (≤ 3 teeth); Spacing < 6 mm / crowding < 4 mm / (≤ 3 teeth); No apparent facial and arch form asymmetry

- **X-ray screening:**
  - Pano: Generally parallel roots / no missing teeth except 8s / no supernumerary teeth
  - CBCT: Good image quality / teeth in full occlusion
  - Ceph: ANB -1° ~ 6.5° / FMA 14° ~ 37° / U1/L1 110° ~145°

Between Apr 2004~Oct 2009, 1840 patients had large view CBCT taken as part of their initial orthodontic record at the University of Southern California. After applying the inclusion and exclusion criteria, 76 patients qualified for the “near normal” group.

We constructed a digital protractor in Dolpin 3D. The digital protractor was used the same way as shown by Dr. Andrews for measuring crown inclination with a real protractor, except that we measured from the whole tooth long axis and Dr. Andrews measured from the facial axis. Our paper published in the July 2012 AJODO validated the digital protractor.

We measured the dental inclination from the long axis of each tooth and we defined the tooth long axis as the line connecting its crown center and the root center.

We reported each tooth normal inclination obtained from the 76 near normal patients in a second paper published in the May 2012 AJODO.

We also measured the alveolar process inclination. The alveolar process long axis is defined as the line connecting the alveolar process crest centers and the apical base centers in the facialingual plane for each tooth. The maxillary and the mandibular alveolar crest centers for all the teeth line up in parallel to the occlusal plane in these near normal subjects; the apical base
level for the mandible is also parallel to the occlusal plane and passing through the cephalometric B point, where we typically use as the landmark for the mandibular apical base. For the maxillary apical base, the level was first set in correspondence to the mandibular B point, and that is the A point. However, that was too high above the apices of most of the teeth. We later chose a plane that passed through the posterior border of the incisal canal (B).

We did not digitize the alveolar process long axis at each tooth location. Instead, we digitized the interproximal alveolar process long axis. That is because root prominences cause variations in the outline of the alveolar process and mess up the localization of the true centers. The interproximal, on the other hand, is usually not disturbed by the tooth anatomy. Therefore, we measured and averaged the mesial and distal interproximal measurements for each tooth.

We used the same digital protractor mentioned earlier to measure the inclination of the alveolar processes. Subtractions were done to get the dental and alveolar process inclination differences.

**Results:**

1). For both arches, first premolars had the largest differences between dental and the alveolar process inclinations, and the differences between the two measurements tapered down in both directions; This suggested teeth in the mid-segment of the arch are more off-centered than teeth in the front and in the back.

2). the differences were much larger for the maxilla than for the mandible at each tooth location. This suggested that upper teeth are more off-centered than the lower teeth;

3). the dental and alveolar process inclination differences were zero at the lower central incisor and the lower first molars, suggesting central location of these two teeth in the alveolar process.

**Conclusions:**

We have developed a digital protractor to measure each tooth dental and alveolar process inclination by using CBCT images

We have established the norm for each tooth dental and alveolar process inclinations by pooling the measurements from 76 near normal patients

Not all teeth are in the center of the alveolar processes. Only the L1 and L6 are centrally located. The central location of these teeth may be of biological necessity due to limited spaces available around their roots.

For the rest of the teeth, they have a tendency to be less facially inclined or more upright than the corresponding alveolar process.