Evaluation of tooth angulation measured on cone beam computed tomography and panoramic radiographs

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by

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## Table of Contents

List of figures ................................................................................................................. 3  
List of tables ....................................................................................................................... 6  
Acknowledgments ............................................................................................................ 7  
Signed Statement ............................................................................................................. 8  
Summary .......................................................................................................................... 9  
Introduction ..................................................................................................................... 10  
Literature review ........................................................................................................... 11  
  Importance of root parallelism ..................................................................................... 11  
  Panoramic radiography ................................................................................................. 14  
  The focal trough (Image layer, layer of sharpness) ....................................................... 17  
  The relation between focal troughs and dental arches .................................................. 18  
  Cone beam computed tomography .............................................................................. 20  
  Panoramic radiography and CBCT interface ................................................................. 21  
Aims ................................................................................................................................ 22  
  Hypothesis .................................................................................................................. 22  
Materials and Methods ............................................................................................... 23  
  Method to establish Aim 1: Establish that CBCT is an effective way to assess tooth angulations ............................................................................................................. 23  
    Statistical methods ................................................................................................. 28  
  Method to establish Aim 2: Define a method to establish brand specific OPG focal trough. ....................................................................................................................... 28  
  Method to establish Aim 3: Generate a method to reveal how dentists mis-interpret the OPG image and to produce OPG and Focal Trough Specific angulations extrapolation ........................................................................ 31  
  Method to establish Aim 4: Compare the angulations extracted from the OPG extrapolation to the Focal Trough Specific extrapolation .......................................................... 39  
    Statistical methods ................................................................................................. 40  
  Method to establish Aim 5: Correct the OPG interpretation by forming an OPG brand-specific formula ................................................................................................. 40  
Results ............................................................................................................................ 41  
  Results for Aim 1: Establish that CBCT is an effective way to assess tooth angulations .................................................................................................................. 41
Statistical analysis .............................................................................................................. 43

Results for Aim 2: Define a method to establish the brand specific OPG focal trough ...... 44

Results for Aim 3: Generate a method to reveal how dentists mis-interpret the OPG and to produce OPG and Focal Trough Specific angulations extrapolations. ................................. 45

Results for Aim 4: Compare the angulations extracted from the OPG extrapolation to the Focal Trough Specific extrapolation................................................................. 49

  Visual comparison............................................................................................................ 49

  Angular measurement comparison ................................................................................. 51

  Statistical analysis ........................................................................................................ 54

Results for Aim 5: Correct the OPG interpretation by forming an OPG brand-specific formula................................................................................................................. 59

Discussion .......................................................................................................................... 61

Discussion for Aim 1: Establish that CBCT is an effective way to assess tooth angulations 61

Discussion for Aim 2: Define a method to establish the brand specific OPG focal trough. 61

Discussion for Aim 3: Generate a method to reveal how dentists mis-interpret the OPG and to produce OPG and Focal Trough Specific angulations extrapolations................. 61

Discussion for Aim 4: Compare the angulations extracted from the OPG extrapolation to the Focal Trough Specific extrapolation................................................................. 64

  Visual comparison............................................................................................................ 64

  Angle measurements comparison ................................................................................. 64

Discussion for Aim 5: Correct the OPG interpretation by forming an OPG brand-specific formula................................................................................................................. 65

  Carestream....................................................................................................................... 65

  Vatech ............................................................................................................................ 66

Conclusion .......................................................................................................................... 68

Conclusion for Aim 1: Establish that CBCT is a good way to assess teeth angulations...... 68

Conclusion for Aim 2: Define a method to establish the brand specific OPG focal trough. 68

Conclusion for Aim 3: Generate a method to reveal how dentists mis-interpret the OPG and to produce OPG and Focal Trough Specific extrapolations. ................................. 68

Conclusion for Aim 4 and Aim 5: Compare the angulations extracted from OPG extrapolation to the Focal Trough Specific extrapolations and Correct the OPG interpretation by forming an OPG brand-specific formula................................................. 68

References ......................................................................................................................... 70
List of figures

Figure 1 long axes relation in a “normal” untreated individual from "Six keys to normal occlusion".[1] ............................................................................................................................... 11

Figure 2 A flat curve of Spee requires parallel roots.[1] ................................................................. 12

Figure 3 The inter-related effect of tip and torque[1]. ........................................................................ 13

Figure 4 Burstone’s explanation of how tooth inclination is indicative of a problem which is dental (left) or skeletal (right) in origin[6]. ....................................................................................... 14

Figure 5 Rotational tomography from Patero[15]. ........................................................................... 15

Figure 6 Orthopantomography as described by Paatero. O1 and O3 represent the axes for the right and left buccal segments while O2 represents the axis for the narrower anterior segment. X is the x-ray beam. R is the x-ray source. K is the film and 1,2,3,4 represent the film movement sequence.[17] .................................................................................................................. 16

Figure 7 Different focal troughs of 3 different machines as illustrated by Lund and Manson-Hing [29].......................................................................................................................... 18

Figure 8 OPG of skull/typodont used in the study by Mckee et al [46]. ............................................. 19

Figure 9 Method validation proposal for Aim 1 ................................................................................ 23

Figure 10 Teeth with titanium cylindrical (2mm height and diameter) markers inserted at the coronal and apical ends. Red lines are drawn between coronal and apical markers on the four sides of each tooth. ........................................................................................................... 24

Figure 11 Aim 1 method validation block formation. ....................................................................... 25

Figure 12 Teeth in wax block. .......................................................................................................... 25

Figure 13 The block inside the grid box. .......................................................................................... 26

Figure 14 The block was photographed from two orthogonal angles. ............................................ 26

Figure 15 Using the Cobb angle measurement tool in RadiAnt DICOM Viewer. ............................. 27

Figure 16 Focal trough grid orientation in the OPG machine. .......................................................... 29

Figure 17 The focal trough detection block on a dental arch grid. .................................................... 30

Figure 18 OPG of the focal trough detection block. Note that some rods are blurred or out of focus while a particular band is in focus. .............................................................................. 30

Figure 19 Marking of the most medial and the most lateral rods in focus on the 2.5mm grid. ....... 31

Figure 20 (A) OPG in the mind of dentists (B) Red plane represent the long axis of the upper left permanent canine.......................................................... 32
Figure 21 The skull after cutting the alveolar processes.

Figure 22 Stainless steel balls inserted at the coronal and apical ends of extracted teeth.

Figure 23 The skull with inserted wax typodont.

Figure 24 Skull OPGs (A)Vatech machine (B) Carestream machine.

Figure 25 Using Dolphin® Imaging 11.5 Premium Marking the stainless steel with red dots and obtaining their X,Y,Z coordinates.

Figure 26 (A) Frontal view of teeth long axes in green. Coronal and apical ends in red.(B) Superior view of teeth within the skull.(C)Vatech focal trough and(D) CareStream focal trough planes wrapped around the teeth coordinates.

Figure 27 Matching spline curve to focal trough plane and projecting root coordinates to the curve.

Figure 28 intersecting the curve with the coordinates orthogonal projections.

Figure 29. The focal troughs (green shading) and central planes (red line) for the Carestream® and Vatech® machines. The grid measure is 2.5mm x 2.5mm.

Figure 30. (A) Carestream OPG extrapolation. (B) Vatech OPG extrapolation.

Figure 31. (A) Carestream Focal Trough Specific extrapolation. (B) Vatech Focal Trough Specific extrapolation.

Figure 32 OPG extrapolations visual comparison for Carestream and Vatech.

Figure 33 Focal Trough Specific extrapolations visual comparison for Carestream and Vatech.

Figure 34 Carestream OPG & Focal Trough Specific extrapolations visual comparison.

Figure 35 Vatech OPG & Focal Trough Specific extrapolations visual comparison.

Figure 36 Agreement between Carestream Focal Trough Specific extrapolation and OPG extrapolation. The horizontal scale is the number of the angles from Table 8. The vertical scale is the angle measurements.

Figure 37 Agreement between Vatech Focal Trough Specific and OPG extrapolations. The horizontal scale is the number of the angles from Table 8. The vertical scale is the angle measurements.

Figure 38 Agreement between Carestream and Vatech OPG extrapolations. The horizontal scale is the number of the angles from Table 8. The vertical scale is the angle measurements.

Figure 39 Correlation agreement Carestream and Vatech Focal Trough Specific extrapolations. The horizontal scale is the number of the angles from Table 8. The vertical scale is the angle measurements.
Figure 40 Focal Trough Specific extrapolation comparison between Carestream and Vatech measured in angles .......................................................................................................................... 55

Figure 41 OPG extrapolation comparison between Carestream and Vatech measured in angles …55

Figure 42 Comparison between Carestream Focal Trough Specific and OPG extrapolations measured in angles ........................................................................................................... 56

Figure 43 Comparison between Vatech Focal Trough Specific and OPG extrapolations measured in angles. .................................................................................................................. 56

Figure 44. Skull OPGs (A) Vatech machine (B) Carestream machine. Note that the Green arrows point at the medial side of the mandibular condylar head and the blue arrows point at the lateral side of the mandibular condylar head. Also note how the same condylar head look different in two different panoramic machine images ........................................................................... 63

Figure 45 Dental arches (D) and mandibular bone arches (M) plotted by gender (A) and by ethnicity (B) from Nummikoski et al.[73] ....................................................................................................................... 67
List of tables

Table 1. Photo measurements in angles from T1, T2 and T3 to the three dimensions X (height), Y (width) and Z (depth). 1, 4 & 6 represent the central incisor, premolar and molar, respectively. In columns, for example, F Tooth-X means the angle between the tooth and X axis as seen from the Frontal view of the wax block inside the grid box. R Tooth-Z means the angle between the tooth and Z axis looking from the Right side view of the wax block inside the grid box. ........................................41

Table 2 Averages from the measurements In Table 1. ........................................................................................................42

Table 3. CBCT measurements in angles from T1, T2 and T3. 1, 4 & 6 represent the central incisor, premolar and molar respectively. In columns, for example, F Tooth-X means the angle between the tooth and X axis looking from the Posterior view in the CBCT machine. R Tooth-Z means the angle between the tooth and Z axis looking from the Right side view in the CBCT machine. .........................42

Table 4. Averages from the measurements in Table 3. ........................................................................................................42

Table 5. Least Squares Means for the photo and CBCT measurements. ..............................................................................43

Table 6. Least Squares Means differences for the photo and CBCT measurements. .........................................................43

Table 7. Coordinates values for coronal and apical markers of teeth. For example; UR7C means Upper Right second molar crown. UR6R Upper Right first molar Root ..................................................47

Table 8. Teeth inclinations and angles nomination as measured on OPG and Focal Trough Specific extrapolations for both Carestream and Vatech machines. .................................................................52

Table 9. Limits of agreement and P values for 4 comparisons of Carestream and Vatech Focal Trough Specific and OPG extrapolations. ........................................................................................................57

Table 10. Group Least Square Means for OPG extrapolations of Carestream and Vatech machines. .............................58

Table 11. Group Least Square Means for Focal Trough Specific extrapolations of Carestream and Vatech machines. .........................................................................................................................58

Table 12. Group Least Square Means for Focal Trough Specific and OPG extrapolations of Carestream machine. ...............................................................................................................................58

Table 13. Group Least Square Means for Focal Trough Specific and OPG extrapolations of Vatech machine. .................................................................................................................................59

Table 14. Angle differences between Focal Trough Specific and OPG extrapolations for Carestream machine. ...............................................................................................................................59

Table 15. Angle differences between Focal Trough Specific and OPG extrapolations for Vatech machine. .................................................................................................................................60
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Signed Statement

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Ed Karim
Panoramic radiographs have been used for decades in the field of dentistry and in orthodontics in particular. Panoramic radiography use in orthodontics includes (but is not limited to): pre-treatment dental assessment, dental age estimation, the detection of dental anomalies, the identification of missing and impacted teeth, the prognosis for unerupted teeth, periodontal tissue assessment and pre-finishing root parallelism. The determination and validity of root position has been debated by many authors and practitioners. Knowledge regarding the production of panoramic radiographs questions whether they are the best way of judging tooth angulation.

**Aims:** The main aim of this study was to assess dental angulation measurements generated by two panoramic x-ray machines. An attempt would be made to correct appraisal differences and, therefore, render the films more useful in providing the necessary diagnostic information to achieve optimal orthodontic treatment results.

**Methods:** A dry human skull with an inserted typodont was imaged using two different panoramic machines in addition to a CBCT machine. Teeth within the typodont had metal markers attached to their coronal and apical ends. The markers and therefore the long axes of the teeth were identified. Teeth were divided into 5 groups (Anterior-Anterior, Anterior-Premolar, Premolar-Premolar, Premolar-Molar and Molar-Molar). The angles between adjacent teeth were measured on an “OPG extrapolation” produced by tracing markers directly on panoramic radiographs. The same measurements were performed on “Focal Trough Specific extrapolations” which were produced by applying the panoramic machine-specific focal trough around the coordinates of the coronal and apical markers. Each machine had its own “OPG extrapolation” and “Focal Trough Specific extrapolation”. The four extrapolations were compared.

**Results:** A wide range of variation in tooth angulation was found between the measurements of each machine. For the Carestream machine, the Premolar-Molar and Molar-Molar regions were represented poorly on panoramic radiographs. While for the Vatech machine, Premolar-Premolar and Anterior-Premolar were the groups represented least accurately on the panoramic radiographs.

**Conclusion:** Panoramic radiographs should be interpreted with caution when assessing tooth angulations. Panoramic x-ray machine manufacturers should be encouraged to provide a range of error values to help practitioners have a better understanding of the limitations of panoramic radiographic interpretation.