Does lack of space prevent root completion in impacted maxillary canines?

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<th>Background</th>
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<td>Maxillary canines are the second most commonly impacted teeth after third molars with palatally impacted canines occurring more frequently than labially impacted canines. Maxillary canines are critical for the stabilization of occlusal forces in the mouth and play a significant role in facial aesthetics. Impacted canines sometimes give rise to incomplete root development. Restricted root formation can lead to decreased bone support due to the root's function in the transfer of forces. The root also provides the passageway for its blood supply and the associated neurovascular bundle. Therefore, complete root formation of the canine contributes greatly to long term function and health of the tooth. Canine root formation is guided by the Hertwig's epithelial root sheath (HERS) complex and adjacent dental mesenchyme. Trauma to the HERS complex can unhinge proper root formation. Two dimensional radiographic images do not provide adequate information about canine root development or position of the impacted tooth. Cone beam computed tomography (CBCT) scans provide a 3-D view of the tooth and adjacent structures such as the nasal fossa would provide detailed information regarding root surface, root anomalies and possible overlap between canine’s crown and incisor’s roots.</td>
<td>Image 1: This image series represents that various planes of view by which impacted canines and its surrounding teeth in the maxilla exist in relationship to one another.</td>
<td>1 Impacted canine teeth were significantly shorter than their non-impacted counterparts (p=0.01) (Figure 1).</td>
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<td>2 There was less space available at the root apex among maxillary impacted canines, whose roots were not fully developed, and this difference was statistically significant (p=0.021) (Figure 2).</td>
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<td>3 A moderately strong negative correlation was found between closed root apices on impacted canines and decreased space availability between root apex and floor of maxillary sinus/nasal fossa (r = -0.42).</td>
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**Objective**

The objective of this study was to utilize CBCT technology in order to evaluate the degree of root development of unilaterally impacted canines based on the relationship between root development and the amount of space available between root apex and maxillary sinus/nasal fossa floor.

**Methods**

A total of 54 de-identified CBCT scans with unilaterally impacted maxillary canines were retrospectively assessed from 35 female and 19 male participants. Inclusion criteria constituted patients over the age of 15 referred for orthodontic treatment with unilaterally impacted maxillary canines. The non-impacted canines on the contralateral side served as a control in this study. Exclusion criteria included patients who did not present only unilateral impacted maxillary canines, or patients who met inclusion criteria but did not meet the age requirement. Both the impacted and contralateral non-impacted sides were evaluated for key variables on Anatomage INVIVO - version 5 software, including but not limited to: degree of root development on unilateral and contralateral canine, proximity to closest anatomical barrier at root apex (maxillary sinus or nasal fossa), length of impacted canine, length of non-impacted contralateral canine, type of impaction, root curvature, distance from closest surrounding teeth, and patient gender.

**Conclusion & Future Directions**

Maxillary impacted canine root length and apex formation may be influenced by the lack of space between the tooth apex and either the floor of the maxillary sinus or nasal fossa floor.

**Clinical**: Future studies would establish whether earlier intervention would be beneficial for full root formation. The introduction of space at tooth apex when it is brought into occlusion may give the root the room it needs to fully form. This must be done during the root’s critical developmental period.

**Biochemical**: Future investigations may also focus on the microenvironment of the HERS complex when the root apices abuts sinus or fossa floor. There is a scientific need to establish which signaling pathways are involved.

**Acknowledgements**

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