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Biomechanical Analysis of Orthodontic Correction of Buccally Malposed Canine: A Finite Element Analysis

**A Thesis Submitted to the Council of the College of
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Abstract

Canines are important and unique teeth for both esthetic and function. It is the most tooth that erupt in malposed position. The buccaly malposed canine is one of the most common condition in orthodontic practice.

The aim of this study is to evaluate the response of canine and maxillary teeth to different magnitudes and directions of orthodontic force in different position of canine using finite element analysis. And to calculate the most common angulation and height of buccaly malposed canine in Iraqi population.

The first part of the study was a cross sectional study on Panoramic radiographs. For patient with buccaly malposed canine determining age, gender, side, and sagittal malocclusion. And measure angulation and height of buccaly malposed canine. T-test and F-test were used to determine significant difference between variables, and calculate most common angulation and height of canine.

The second part of the study is a finite element method study. DICOM data processed by image processing software (Mimics Medical 2018), for generation of 3D volume that managed by computer aided design software (SolidWorks software), for reconstruction 3D model and to align all parts in final assembly. We reconstruct four models according to most common position of canine. These models exported to finite element analysis software (Abaqus CAE software) and apply two load scenarios on each model. Load scenario I include tipping force extend between canine and first molar, Load scenario II include extrusion force extend between canine and main arch wire. Then we run finite element processing.

The result of the survey shows that most common angulation (70° and 75°), height (4mm, and 5mm), with no significant difference between sides, genders and sagittal malocclusion as revealed by T-test and F-test. Correlation study show highly significant reverse relation between heights and angulation.

The finite element analysis result of load scenario I show high displacement in canine and first molar. The canine have uncontrolled palatal and lingual tipping with distal-in rotation. The first molar have bodily mesial and buccal movement with intrusion. Small displacement found in forward direction of central incisor, lateral incisor, first premolar and second premolar.

Scenario II show extrusion of canine in magnitude ($\Delta Z = -2$ to $-4 \mu\text{m}$) more than distal and buccal movement (ΔX & $\Delta Y = 1$ to $2 \mu\text{m}$), and severe intrusion of lateral incisor and moderate intrusion of central incisor. First and second premolar and first molar were not affected.

The Extrusion of buccally malposed canine cause extensive intrusion of lateral incisor even with use maximum anchorage, but the first and second premolar and first molar were not affected. Distal tipping of buccally malposed canine lead to intrusion of first molar and proclination of incisors (increase overjet) even with use heavy gauge archwires