

INTISARI

Enam kunci oklusi normal serta tidak adanya rotasi merupakan syarat untuk mencapai konsep oklusi ideal. Rotasi pada gigi molar pertama maksila menyebabkan kebutuhan ruang yang lebih besar pada lengkung gigi sehingga berpotensi terhadap kegagalan oklusi antar rahang. *Toe-in bend* merupakan salah satu metode yang dapat digunakan untuk terapi kasus rotasi molar. Dampak fisiologis dan biomekanika *Toe in bend* terhadap gigi, ligamen periodontal dan tulang alveolar belum diketahui secara pasti. Penelitian ini bertujuan menganalisis dampak fisiologis dan biomekanika *Toe-in bend* menggunakan metode *Finite Elemen Analysis*.

Model tiga dimensi maksila hasil pemindaian CBCT beserta perangkat ortodonti teknik Edgewise dengan *toe-in bend* kawat stainless steel 0.016” sudut 90° s.d 175° dikonstruksi menjadi model *finite element*. Simulasi menggunakan software ANSYS dilakukan untuk mengetahui distribusi *stress* (Von Mises *Stress*) gigi, ligamen periodontal, tulang alveolar dan perpindahan *initial* gigi molar pertama maksila pada sumbu X, Y, Z. Analisis deskriptif dan uji statistik dilakukan dengan ($p < 0,05$).

Hasil penelitian menunjukkan pola distribusi *Stress* dan Perpindahan *initial* dengan intensitas berbeda antar kelompok sudut. Uji statistik menunjukkan perbedaan bermakna distribusi *stress* dan perpindahan *initial* ($p < 0,05$). Penggunaan *toe-in bend* pada rentang sudut 145° s.d. 175° dapat menjadi referensi bagi klinisi.

Kata kunci: Rotasi molar maksila, *toe-in bend*, *finite element*, distribusi *Stress*, perpindahan *initial*

ABSTRACT

The six keys to normal occlusion and the absence of rotation are prerequisites for achieving the concept of ideal occlusion. Rotation of the maxillary first molar increases the space requirement in the dental arch, potentially leading to inter-arch occlusal failure. Toe-in bend is one of the methods that can be used to treat molar rotation cases. The physiological and biomechanical impacts of the Toe-in bend on teeth, periodontal ligaments, and alveolar bone are not yet fully understood. This study aims to analyze the physiological and biomechanical impacts of the toe-in bend using the Finite Element Analysis method.

A three-dimensional model of the maxilla from CBCT scans, along with orthodontic edgewise technique appliances with toe-in bend stainless steel wire 0.016” at angles from 90° to 175°, was constructed into a finite element model. Simulations using ANSYS software were conducted to determine the stress distribution (Von Mises Stress) on the teeth, periodontal ligaments, cortical bone, and the initial displacement of the maxillary first molar along the X, Y, and Z axes. Descriptive analysis and statistical tests were performed with ($p < 0.05$).

The descriptive results showed patterns of stress distribution and initial displacement with varying intensities among the angle groups. Statistical tests showed significant differences in values between groups ($p < 0.05$). The use of toe-in bend at angles ranging from 145° to 175° can be considered by clinicians.

Keywords: Maxillary molar rotation, toe-in bend, finite element, stress distribution, initial displacement