

# Pengaruh berbagai mekanika penegakan gigi terhadap distribusi stress dan perpindahan inisial gigi molar kedua rahang bawah : simulasi tiga dimensi finite element analysis = Stress distribution and initial displacement of mandibular second molar by different uprighting mechanics : a three-dimensional finite element analysis

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## Abstrak

### <b>ABSTRAK</b><br>

Latar Belakang: Kasus kehilangan gigi molar pertama yang disertai dengan mesial tipping dari gigi molar kedua sering ditemui, sehingga penegakan gigi merupakan salah satu mekanika yang sering dilakukan oleh klinisi. Namun, sebagian besar literatur yang tersedia mengenai penegakan gigi merupakan laporan kasus yang memaparkan mengenai

hasil perawatan dengan mekanika tertentu, sesuai dengan pengalaman masing-masing klinisi. Efisiensi dalam perawatan ortodonti, khususnya penegakan gigi, dapat dicapai apabila pergerakan gigi dapat diprediksi. Tujuan: Menganalisis gambaran distribusi stress pada ligamen periodontal gigi molar kedua, pada model 3D mandibula, serta menganalisis perpindahan inisial gigi molar kedua (dalam arah bukolingual, vertikal, dan mesiodistal) ketika diaplikasikan gaya penegakan gigi dengan menggunakan initial archwire, helical uprighting spring, T-loop, serta dengan retromolar miniscrew. Metode:

Konstruksi model tiga dimensi mandibula dilakukan dalam satu kuadran, dengan konfigurasi kehilangan gigi molar pertama dan gigi molar kedua tipping 30°. Empat buah model kerja dibuat sesuai dengan metode penegakan gigi yang akan diuji yaitu dengan initial archwire, helical uprighting spring, T-loop, serta dengan retromolar miniscrew.

Hasil: Terdapat perbedaan bermakna intensitas stress dan perpindahan inisial pada keempat kelompok mekanika yang diuji. Distribusi stress dan perpindahan inisial gigi molar kedua pada penggunaan initial archwire sangat kecil dibandingkan dengan ketiga mekanika lain yang diuji. Pada penggunaan T-loop, helical uprighting spring, dan retromolar miniscrew, area tension terbentuk paling besar di area servikal akar mesial, sedangkan area compression terbentuk pada area servikal akar distal. Pada analisis perpindahan inisial gigi molar kedua, penggunaan helical uprighting spring menunjukkan ekstrusi yang paling besar, diikuti oleh T-loop, dan retromolar miniscrew. Selain itu,

terlihat adanya pergerakan akar pada penggunaan retromolar miniscrew, yang tidak ditemukan pada penggunaan mekanika lainnya. Kesimpulan: Intensitas stress ekuivalen paling besar dihasilkan dari penggunaan helical uprighting spring, T-loop, dan retromolar miniscrew secara berurutan. Analisis perpindahan inisial gigi menunjukkan penggunaan retromolar miniscrew menyebabkan mesial root movement, dibandingkan dengan distal tipping mahkota gigi pada mekanika lain.

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### <b>ABSTRACT</b><br>

Introduction: One of the most frequently encountered clinical situation in adult patients would be the tipping of mandibular second molar which normally occurred due to early loss of the first molar. Previous studies reported different uprighting mechanics were mainly case report and only a few that aimed to describe the

efficacy of the various

available mechanics. A profound understanding of the efficacy and predictability of the various mechanics would improve tooth movement and prevent unwanted side effects that may arise. The aim of this study was to analyse and compare the stress distribution as well as initial displacement of mandibular second molar using various uprighting

mechanics. Methods: A three-dimensional model was constructed and analysed using Finite Element Analysis (FEA) with tipped mandibular second molar set at 30°. Four mandibular models were assembled according to different uprighting mechanics, as follows: initial continuous archwire, helical uprighting spring, T-loop and retromolar

miniscrew. Results: Stress distribution and initial displacement resulted from the use of initial archwire were insignificant compared to other mechanics tested. The highest tensile stress were observed on the cervical area of mesial root and the highest compressive stress were observed on the cervical area of distal root on the application of

T-loop, helical uprighting spring, and retromolar miniscrew mechanics. Analysis of initial tooth displacement showed that helical uprighting spring caused the largest degree of extrusion, followed by T-loop, and retromolar miniscrew. Root movement was observed on the usage of retromolar miniscrew.

Conclusion: Greatest equivalent stress were

observed on the usage of helical uprighting spring, T-loop, and retromolar miniscrew in consecutive order.

Analysis of initial displacement of the second molar showed that the application of retromolar miniscrew caused mesial root movement, while other mechanics showed distal tipping of the crown.