ABSTRACT

Aim:

To evaluate the center of resistance of maxillary anterior segment in second bicuspid extraction cases when retracted using lingual appliance with sliding mechanics using palatal mini-screw implants (MSI) , different position and length of power arm using finite element method(FEM).

Materials and Methods:

A three dimensional finite element model was constructed using CBCT and intra oral laser scan data of the patient. The lingual appliance was modeled along with the lingual arch wire and second bicuspids were extracted from the model.

The study was divided into four groups according to the condition of different retraction mechanics, each differing in position of the power arm and mini-screw implants (MSI). In the group A and C power arm were placed between the lateral incisor and canine on both sides and in group B and D power arm were placed between central incisor and lateral incisor on both sides. Two different length of the power arm (10mm and 13mm) were used in both the positions. In the group A and B, MSIs were placed at four heights, 4mm, 6mm, 8mm and 10mm in the interdental palatal slope mesial to the first molar measuring from the cervical region. In group C and D, MSIs were

placed in the mid palatal region at two different levels 12mm and 24mm behind the distal most portion of the incisive papilla.

A retraction force of 200 gm per side from the hook, towards the direction of the mini-implant position was applied and tooth displacement was studied in Y-axis (anterior-posterior) direction and the Z-axis to the (coronal-apical or vertical) direction by probing points marked at the crown and root of the reference teeth.

Descriptive statistics and two dimensional line graphs were used to represent the type of tooth movement in each reference tooth in all the groups.

Results:

The results of our study in Y-axis showed decreased torque loss in group C when 13mm power arm placed between lateral incisor and canine with MSI placed at 12mm behind the incisive papilla on the mid-palatal area. Group B showed bodily retraction of anterior segment with 13mm power arm placed between central and lateral incisor with MSI placed 8-10mm in the posterior palatal slope mesial to the first molar but the central incisor showed severe torque loss. Group A and D showed loss of torque of anterior segment in all the retraction conditions of which group D showed comparatively less torque loss when MSI placed 12 mm behind the incisive papilla with 13mm length of power arm. When mid-palatal MSI is compared with MSI placed in the posterior palatal slope with power arm placed between the lateral incisor

and canine, more desired tooth movement is seen in sagittal and vertical plane with the mid-palatal MSIs. When the results of group B and group D were compared, group D showed a more controlled crown tipping during retraction with power arm placed between central and lateral incisor.

Conclusion:

Based on the findings of this study we concluded the following,

1. Incisor retraction was effective with minimal torque loss in the group in which the MSI was placed 12mm from the incisive papilla in the maxillary midline.
2. Between the two lengths of power arm that were evaluated, the length of the power arm that was 13mm seem to have a bodily tooth movement.
3. Similarly, the group in which the power arm located between the canine and lateral incisor exhibited greater bodily retraction.

Based on FEM analysis it is logical to conclude that when lingual appliances, a sliding mechanics with the power arm length of 13 mm located between the maxillary lateral incisor and canine and origin of force at MSI placed 12mm from the incisive papilla on the mid-palatal suture region could be the best combination for maximum bodily retraction with minimal torque loss.

However the clinicians should be aware of the inherent limitation of the FEM study and use his clinical acumen when extrapolating these findings in clinical situations.

Key words:

CENTRE OF RESISTANCE, MINI-SCREW IMPLANTS, MID-PALATAL IMPLANTS,