Versatile retraction mechanics: Implant assisted en-masse retraction with a boot loop

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Abstract
The purpose of this paper is to explain the versatility offered by the use of arch wires with boot loops in retraction mechanics while taking direct anchorage from mini-screws. Materials and Methods: The materials include the mini screws placed at the appropriate location and retraction arches made of 0.019 X 0.025 SS with boot loops placed distal to the lateral incisors. Mini screw provides a stable anchorage for enmasse retraction of the anterior teeth with the help of a boot loop using sliding and/or loop mechanics. Results: The arch wires with boot loops have a definite advantage over the soldered/ crimpable hooks because of the versatility it offers during the process of retraction. Conclusion: An innovative approach combining the advantages of absolute anchorage using mini implants and a retraction arch with boot loop is presented here.

Keywords: Loop mechanics, mini implants, retraction mechanics

Introduction
Incisor retraction is one of the primary goals in the majority of orthodontic patients who present with Class I bimaxillary dento-alveolar proclination or Class II division 1 malocclusions. Careful management of the anchorage is very critical to achieve clinical success in such cases. Treatment mechanics for anterior retraction are many and varied. It could be broadly classified as friction mechanics (sliding mechanics) or frictionless mechanics (loop mechanics) based on whether the archwire is made to slide though the buccal segment during the retraction or not. Both have its inherent advantages and disadvantages. With the advent of mini screws, there is an apparent shift of focus from the days of reinforcing anchorage by using differential moments to absolute anchorage by using an implant assisted sliding mechanics.[1]

Sliding mechanics mainly involves attachment of a force module from the posterior anchorage unit to the unit which requires retraction. It could be a 6 or 4 unit anterior segment based on whether the canines have been taken back individually or not. An inherent disadvantage with such a procedure is the loss of torque of the incisors as the retraction proceeds. The loss of torque is inevitable due to the following reasons:
• The retraction force is applied away from the center of resistance of the incisor segment
• There exists a play between the wire and the bracket which allows free tipping. Although a full sized arch wire can prevent the loss of torque to a certain extent, it cannot be used for sliding mechanics as the sliding gets hampered due to the excessive friction between the wire and the brackets/molar tube in the buccal segment.[2]

To compensate for the loss of torque the proponents of the third generation PEA (MBT prescription) has increased the torque values of the incisor brackets. In spite of an increase in the torque values, it was advocated to incorporate further torque by giving curves in the rectangular wire, as and when required.[3] It is very tedious to regain the lost torque in edgewise mechano-therapy as it is difficult to obtain sufficient third order moments at the wire bracket interface. Furthermore, the heavier force needed to overcome the frictional resistance could lead to loss of anchorage as the force becomes optimal for the larger anchor unit leading to its mesial movement.

Loop mechanics involves the retraction of anteriors by activation of a loop placed between the anterior and the posterior segments.[4] Various geometrical designs of loops are available with stated and perceived advantages and disadvantages. Frictional forces are not brought into play (except when the clinician is activating the loop) as there is no sliding of the wire through the buccal segment. The loss of torque, which happens during retraction, could be prevented by adding additional gable moments by way of \( \alpha \) bends as the teeth are being retracted. Another advantage of the loop mechanics is the reinforcement of
the posterior anchorage by using the concept of differential moments (higher posterior moment obtained by placement of a β bend reinforces the posterior anchorage).

With the availability of preformed wires with soldered hooks or crimpable hooks, most clinicians prefer the use of frictionless mechanics for the sake of convenience.

The temporary anchorage devices (TADs) have provided the clinician with a safe alternative to prevent anchorage loss during sliding mechanics.[6] The TADs serve as an anchor either directly or indirectly. In the direct method, the force module is attached between the mini-screw and the anterior hook whereas in the indirect method the posteriors are rigidly ligated to the mini-screw thereby stabilizing them while engaging the force module between the posteriors and the anteriors. Most often than not, clinicians tend to prefer the use of sliding mechanics while using implant assisted anchorage.[8]

Materials and Methods

A 22-year-old adult female patient reported with a chief complaint of proclination of anterior teeth and was diagnosed as having Class I bimaxillary dentoalveolar proclination on a Class I skeletal base. It was decided to treat her with extractions of first premolars in upper and lower arches to normalize incisor inclinations, achieve a stable buccal occlusion and a harmonious facial profile. Multi bracket treatment with 0.022 × 0.028” Roth prescription (3M Unitek) was chosen. Following extractions, teeth were initially leveled and aligned using a 0.014 inch NiTi followed by 0.016 inch NiTi wire. The initial alignment wire was replaced with a 0.018 inch Australian arch wire, which was replaced with 0.019 × 0.025 inch stainless steel working arch wires. The arch wire is made with a boot loop placed 2–3 mm distal to the canine bracket. The height of the boot loop is dependent on the specific case being treated and is designed to allow the retraction force to be directed through the center of resistance of the anterior teeth. The boot loop can be placed 2–3 mm distal to the lateral incisor bracket also if the clinician wants to add to anterior torque.

After allowing the working arch wire to express the tip for a minimum period of 1 month, mini implants are inserted between the upper second premolar and molar. Self-drilling mini implants were used, made of titanium and measuring 8 mm in length and 1.5 mm in width (SK Surgical, India). The patient was prepared for placement of mini implant, diagnostic intraoral periapical (IOPA) radiographs were obtained for assessing the bone level, sinus and if adequate separation between the roots of the premolar and molar is available. Topical anesthesia was applied, followed by local anesthesia infiltration. Following anesthesia, the mini implants were inserted at the junction of the attached and movable mucosa, at an angle of 45° centered along the alveolar bone between the premolar and first molar. Post insertion IOPA radiographs were taken to ensure that the min implants were placed as planned.

The force module was attached from the mini screw to the boot loop to effect anterior retraction. Once the retraction is completed, detailing and finishing was done with regular treatment mechanics.

The activation of the loop can be brought about by three methods:

- Loops could be activated in the conventional way (by cinching the wire behind the molar tube) for retraction after stabilizing the posterior segment indirectly with the TAD
- Loop activation could also be done directly with implant as the anchor by engaging a force module between the distal leg of the loop (which is being activated) and the implant
- Loops could also be used as a point of attachment (a substitute to a soldered or crimpable hook) for engaging the force module while doing en-masse retraction with sliding mechanics (this method was followed in the case presented).

Results

The results obtained after retracting anteriors using sliding mechanics and an arch wire with boot loop are promising. Though the boot loop was in place for a considerable period, the patient did not complain of any significant amount of discomfort except in the initial 2 or 3 days after the loop placement. Adequate torque control was observed post treatment as also seen in the torque comparison between pretreatment and post treatment cephalograms.

Discussion

Versatility offered by a boot loop in enabling retraction using mini implant and the various clinical guidelines are explained with as follows:

- Engaging the force module to the mesial leg facilitates sliding mechanics (horizontal arm prevents the slippage of elastomeric/elastic) whereas engaging to the distal leg activates the loop facilitating frictionless mechanics. This is particularly useful in breaking the binding encountered during the retraction with sliding mechanics. Though there is a discontinuity in the archwire due to the formation of the loop, no skewing of the arch was seen in the treated case
- Adequate β bend given at the distal leg provides torque to the incisors by virtue of the wire-bracket geometry where as additional torque can be given by incorporating α bends. Since the wire stays flat behind the β bend (unlike a reverse curve, which is commonly incorporated to gain torque in the third generation pre adjusted edge-wise appliances) the free sliding is never affected
The amount of $\beta$ bend is decided by the extent of bodily control needed during the retraction. Upright incisors require more bodily control during the retraction thereby warranting gable bend placement from the initial days of retraction. However, severely proclined incisors require controlled tipping; hence, the clinician should be watchful about the incisor inclination during the retraction and the gable bends should be placed as and when required.

The horizontal arm of the boot loop can be crimped to bring about a relative intrusion of the four incisors in cases where there is interference for retraction from the extruded lower incisors (till you achieve lower incisor intrusion with the necessary mechanics).

The height of the horizontal arm can be adjusted to have the desired force vector. Horizontal arm below the level of the implant will bring about an intrusive vector during retraction. Care should be taken to prevent the torque loss in such situations as the force is applied below the center of resistance of the incisor segment. A mini-screw and the horizontal arm positioned at the level of the center of resistance of the incisor segment allows pure translation of the incisors where as a horizontal arm above the level of the center of resistance will allow gain in torque of incisors. Increasing the vertical height should be done carefully without impinging on to the soft tissues.

Versatile retraction mechanics combines the advantages of a boot loop and mini implant assisted retraction while using sliding mechanics. The multiple options available while combining a mini implant and an arch wire with boot loop, allows the clinicians to do en-masse retraction once a working arch wire of 0.019 × 0.025 SS is inserted (without any further arch wire change during the phase of retraction) [Figures 1-3]. The amount of beta bend given was based on the extent of proclination of the incisors. The treated case does not show any significant amount of torque loss warranting root corrections during the final stages of the treatment [Figure 4 and Table 1]. It was seen that the versatile

Table 1: The cephalometric parameters pretreatment and post treatment

| Parameter                                | Pre treatment | Post treatment |
|------------------------------------------|---------------|----------------|
| SNA angle (degree)                       | 85            | 84             |
| N Perpendicular to A (mm)                | 1             | -1             |
| SNB angle (degree)                       | 83            | 82.5           |
| N Perpendicular to Pog (mm)              | -1            | -2             |
| ANB (degree)                             | 2             | 1.5            |
| Upper incisor to NA (degree/mm)          | 29/8          | 25/5           |
| Upper incisor to A vertical (mm)         | 9             | 0              |
| Upper incisor to A-Pog (mm)              | 9.5           | 4              |
| Upper incisor to FH plane (degree)       | 121           | 112            |
| Upper incisor to SN plane (degree)       | 116           | 108            |
| Lower incisor to NA (degree)             | 40/9          | 23/3           |
| Lower incisor to SN plane (degree)       | 105           | 93             |
| Lower incisor to mandibular plane (degree)| 35            | 18             |
| Lower incisor to occlusal plane (degree) | 6.5           | 1.5            |
| Interincisal angle                       | 116           | 132            |

SNA: Angle formed between Sella-Nasion plane and Nasion-Point A plane, SNB: Angle formed between Sella-Nasion plane and Nasion-Point B plane, ANB: Angle formed between Nasion-Point A plane and Nasion-Point B plane, NA:Nasion-Point A plane, FH: Frankfort horizontal, SN: Selln nasion plane
retraction mechanics is a viable and efficient alternative to conventional sliding mechanics using crimpable hooks.

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Figure 4: Pre treatment and Post treatment cephalograms and Superimpositions