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Maxillary Miniscrew Anchorage Stability Aided By Orthodontic Retraction Of Anterior Tooth - A Case Report

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Abstract

The present case report describes the treatment of a 28-year-old female patient who reported with a chief complaint of forwardly placed upper front teeth with marked lip protrusion. Facial photographic and extraoral examination exhibited a convex profile with potentially competent lips, retruded chin, and deep mentolabial sulcus with an acute nasolabial angle. Cephalometric and model analysis showed Angle's Class II division 1 subdivision malocclusion on a class II skeletal pattern attributable to prognathic maxilla and retrognathic mandible in relation to anterior cranial base showing average growth pattern with proclined upper and lower incisors with spacing in relation to upper and lower anteriors with midline shifted towards left by 2mm in maxilla and 4mm in mandible. The treatment choice of retraction of the maxillary and mandibular anterior teeth assisted by all four first premolar extraction with miniscrews implant for maximum anchorage was preferred to achieve absolute anchorage and improve facial profile. Dynamic assessment of absolute range of movement was carried out on digital orthopantomograms by taking pterygomaxillary fissure (PTF) common point to the miniscrew implant site showed 0.2mm deviation after a period of 1month with excellent anchorage stability. Hence further studies with standard protocol and measurement tools are recommended to establish miniscrew implant as a stable anchorage device

Keywords: Miniscrew, Orthodontic force, Pterygomaxillary fissure, Reciprocal force, Stability

Introduction

Success of orthodontic treatment outcome depends largely on maximum anchorage control that resist untoward tooth movement or that allows effective tooth movement into the desired area for achieving both structural and facial esthetics [1]. Preservation of reciprocal reaction to anchor unit is always a difficult task owing to the growth pattern and tissue associated factors [2, 3]. Anchorage control in severe skeletal Class II malocclusion patient who presents with convex facial profile, marked lip protrusion, proclination of maxillary incisors requiring extraction followed by retraction of anterior teeth by using maximum anchorage is always a challenging task in orthodontic treatment. In order to obtain maximum or absolute anchorage and prevent anchorage loss several methods like Nance palatal arch, lingual holding arch, transpalatal arch bars, inter-maxillary elastics, multiple teeth anchorage systems and extraoral traction devices by head gear, lip bumper were used with inherent drawbacks that includes complex designs, high cost, discomfort, poor

esthetics, frequent maintenance and appliance deterioration [4-6].

With the introduction of dental implants, and miniplates for achieving skeletal anchorage, numerous studies have reported higher success rates. Nonetheless, factors like larger size, type of material, frequency of maintenance, high cost, complex surgical procedures and postoperative complications led to its downfall [7, 8]. Currently, titanium miniscrews less than 2.0mm in diameter are frequently used as stable temporary anchorage device (TAD) in the maxillary region often placed between the tooth roots because of its smaller diameter with ligatures and elastomers supporting component, ability to assist en-masse retraction of anterior teeth, ease of placement and removal, immediate loading with a rapid retraction phase as well as cost effectiveness [1, 9, 10]. Few case reports have also shown miniscrew anchorage system effectively aided retraction of anterior tooth with accelerated rate of tooth movement without significant loss of anchorage or stability than conventional anchorage reinforcements in skeletal class II patients [4, 11-13]. The present case report demonstrates the efficacy of miniscrew implants as an anchorage aid in the case of severe angle's class II division 1 subdivision malocclusion on a class II skeletal pattern attributable to prognathic maxilla and retrognathic mandible with marked protrusive lips.

Case Report:

A 28-year old female patient reported to the department of orthodontics and dentofacial orthopedics with a chief complaint of forwardly placed upper front teeth with marked lip protrusion. Patient gives a history of thumb sucking and was treated for the same using removable appliance for a period of 6months. Intraorally she had class II canine and molar relation on the left side with 4mm anterior overjet. Her oral hygiene status, gingival and periodontal health was good, and her temporomandibular joints were asymptomatic.

On Facial photograph and extraoral examination, the patient exhibited a convex profile appearance, posterior facial divergence, 3mm interlabial gap, potentially competent lips with retruded chin, deep mentolabial sulcus with an acute nasolabial angle. Functional examination revealed hyperactive mentalis and perioral muscular activity with no evident lip hypotonicy. Intraoral and dental casts showed U shaped symmetrical maxillary and mandibular arch with class I molar and canine relation on the right side and class II canine and molar relation on the left side with 4mm anterior overjet, minimal maxillary and mandibular arch crowding, proclination and spacing in relation to upper and lower anteriors. With respect to the facial midline, the upper and lower dental midlines were deviated to the left by 2 mm and 4 mm, respectively. The panoramic radiograph showed the presence of all 32 teeth with fully completed root formation including the third molars.

On Cephalometric analysis, the ANB angle was 10^0, and the Wits appraisal was 13mm indicative of class II skeletal deformity pattern. The SNA angle of 87^0 reflected a relative forward position or prognathic maxilla, and the SNB angle of 77^0 indicated mandibular deficiency. The U1-NA distance of 6mm at an angle of 30^0 and L1-N-B distance of 16mm at an angle of 48^0 revealed that she had significant proclination of maxillary and mandibular incisors. Other significant findings includes average growth pattern with FMA 23^0, protrusive upper and lower lip, decreased upper and lower gonian angle and acute nasolabial angle (81^0). On Model analysis, an arch length discrepancy of 5mm in upper arch and 3mm in lower arch was observed in Careys arch perimeter analysis, Ponts analysis indicated (SI=36mm, CMV=56.2mm, MMV=47mm) need for expansion and Peck index revealed reproximation is not possible in relation to lower anteriors.

Diagnosis and Treatment objectives:

Final diagnosis of Angle's Class II division 1 subdivision malocclusion on a class II skeletal pattern attributable to prognathic maxilla and retrognathic mandible in relation to anterior cranial base showing average growth pattern with proclined upper and lower incisors with spacing in relation to upper and lower anteriors with midline shifted towards left by 2mm in maxilla and 4mm in mandible with increased overjet and protrusive upper, lower lips with acute nasolabial angle was given. Treatment objectives included the following: (1) align and level the teeth in both arches and establish functional occlusion, (2) achieve Class I canine and molar relationship with an ideal overjet and overbite relationship, (3) obtain a

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balanced facial profile with correction of midline shift, and (4) improve smile esthetics.

Preliminary Treatment Phase:

In this preliminary clinical phase oral prophylaxis was performed followed by initial orthodontic mechanotherapy. The treatment options included extraction of mandibular and maxillary third molars to aid in uprighting with combination of orthognathic surgery for better esthetic. However patient did not prefer this treatment option due to post-operative failure risk and treatment expenses concerns. The second alternative included maxillary first premolars extraction for overjet correction followed by retraction and leaving the posterior occlusion with a Class II molar relationship. Nevertheless, class II skeletal pattern with significant proclination of maxillary and mandibular incisors (Increased overjet) often requires more force and excessive anchorage effort when retracting canines and incisors of both the arches. The third treatment option of retraction of the maxillary and mandibular anterior teeth assisted by all four first premolar extraction with miniscrews implant for maximum anchorage was preferred to achieve absolute anchorage and improve facial profile as the patient was more concerned about her esthetic profile and proclined incisors on both upper and lower arch.

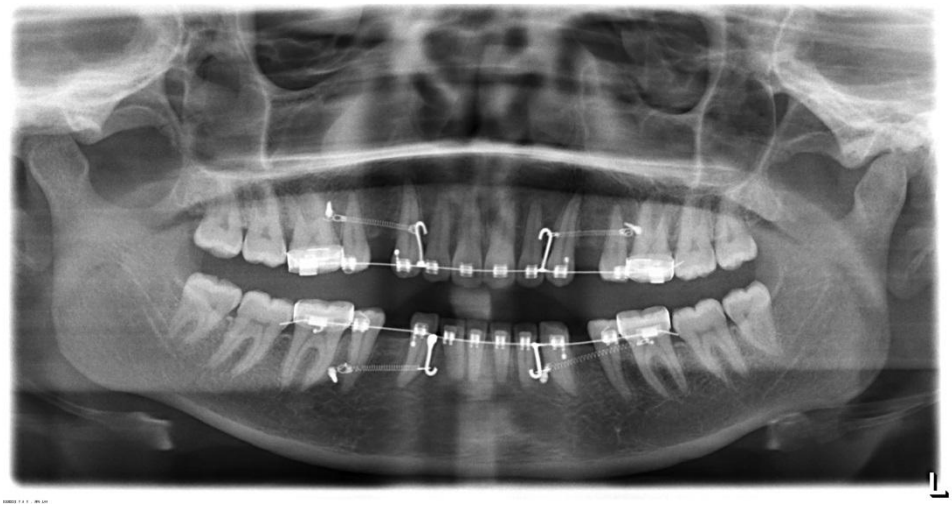
Treatment Progress:

After the extraction of maxillary and mandibular first premolars, pre-adjusted Bi-dimensional edgewise appliances 0.019"× 0.025" slot in the centrals and laterals, and 0.022"× 0.028"slot canine, bicuspids and molars fixed appliances were placed in both the arches. Following initial leveling and alignment, four orthodontic mini-screws of 1.5 mm diameter and 8mm length (SK surgicals®) were inserted (1 miniscrew per quadrant) under local anesthesia with maximum torque of 10N. With a vertical incision and a plot drill of 0.9mm diameter, single operator under profuse irrigation all screws were placed into the buccal cortical bone between second premolars and the first molars on upper and lower arch at both right and left side as direct anchorage.

Retraction and Anchorage phase:

Immediately after placement of mini-screws without waiting period, a continuous, rectangular 0.019" ×0.025" stainless steel arch-wire with anterior hooks and closed coil nitinol springs (NiTi) were used to close the extraction spaces with sliding mechanics. Ni–Ti retraction force was applied from the maxillary and mandibular mini-implants to canine which receives the reactive forces of tooth movement and the six anterior teeth were retracted simultaneously. To prevent flaring of the anterior teeth, the archwires were ligated passively until space was closed by posterior teeth movement. Force magnitude was kept at 100g (constant) over the evaluation period of 4 weeks. Patients were re-evaluated after 4 weeks intervals until retraction was considered complete. Strict instructions were given to the patient regarding oral hygiene.

(Fig: a)



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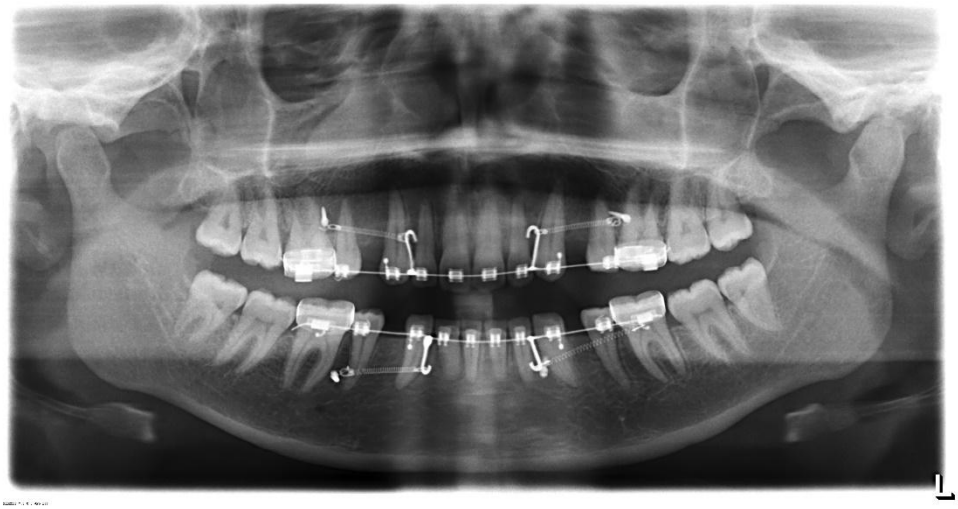
Evaluation Phase:

Dynamic assessment of absolute range of tooth movement was carried out on digital orthopantomograms (OPG) taken before retraction or placement of the implant; and after closure of the extraction spaces with the use of Planmeca ProMax 2D scanner (Planmeca Oy, Helsinki, Finland). In this case study, Pterygomaxillary fissure (PMF), a triangular shaped lateral opening of pterygopalatine fossa bounded anteriorly by the posterior wall of the maxillary sinus, medially by the palatine bone and posteriorly by the pterygoid plates was taken as a common point for measurement of miniscrew stability. In terms of the cephalometric measurements studies have shown, a significant correlation was found between upper central incisor, posterior facial height and Pterygomaxillary fissure (PMF) length and also between PMF width, lower lip and occlusal plane [14-16].

(Fig: b)



Stability assessment and Treatment outcomes:

For anchorage stability assessment, line joining the PMF and miniscrew placement site was measured using digital pre-operative OPG and the readings were taken as P1. Centroid points were determined for the crowns of the maxillary first molars at the midpoint between the greatest mesial and distal convexity of the crowns as seen on the cephalometric radiographs. The long axis of the maxillary molar was obtained by drawing a line through the centroid perpendicular to the line connecting the most convex points on the crown. Similarly measurements were carried out after 1 month following miniscrew placement and the readings were taken as P2 and the final movement was calculated by subtracting P2 from P1 (P2-P1). It was observed a transitional effect on the miniscrew implant resulted in movement of 0.2mm from the initial position observed under digital OPG at PMF common point. After initial arch correction and en masse anterior tooth movement, the treatment was completed with ideal arch-wires and elastics for final arch correction and occlusal equilibration. Lingual bonded retainers on the maxillary and mandibular six anterior teeth was recommended following removal of all appliances and miniscrew implants. The total treatment time of 20- 24 months was anticipated.

Discussion:

Temporary anchorage devices (TADs) have been recommended in complex orthodontic cases that requires uprighting or distalization of molars, anterior or posterior tooth intrusion, or molar protraction and also in cases of skeletal class II malocclusion, open bite with occlusal plane correction without any patient compliance or anchorage loss [17, 18]. The success rate of these TADs depends on type of device used, area of placement, type of tooth involved, quality of bone, amount of force required, and patient-related factors [3].

Miniscrew implant devices reported 50% to 95% success rate with larger variation predominantly

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influenced by miniscrew and treatment procedure factors [3, 19]. It is proposed that bone healing and osseointegration waiting period before loading is not required, since the primary stability by mechanical retention of the miniscrews is sufficient to sustain a regular orthodontic loading. However early failure is mainly attributed to poor or weak integration between miniscrew-implant and bone surface which changes throughout the primary and secondary phases of stability [1-4, 19, 20]. Until now only few studies investigated the effect of miniscrew TADs stability through orthodontic anchorage control used for anterior teeth retraction.

For evaluation of miniscrew implant stability various common points that includes pterygoid point, nasal floor, midline, pterygomaxillary fissure (PTF), coronoid process in maxilla to the retraction site/point are preferred owing to its cephalometric landmark importance. Sadry et al reported that increase in anterior face height and PTM length measurement in female is characterized by an increase in the maxilla skeletal unit [16]. On the other hand, Rothstein and Yoon-Tarlie found a statistically positive relationship between the anterior facial heights and the maxilla posterior heights in adolescence [21]. While Costa et al found no correlation between the anterior face height and maxillary posterior vertical alveoli and PTM [22].

Previous studies have shown retraction of the 6 maxillary anterior teeth using conventional 2-step retraction of the canine and incisors often resulted in rotations and mesiodistal tipping of the canine [1, 2, 23, 24]. In this case study, no such instances were recorded. However 0.2mm anchorage loss (movement) can be translatory and attributed to deformation, error caused in imaging or absence of reciprocal forces applied on the molars in similar studies. Yee et al concluded that 45% of the total space was lost upon application of a reciprocal heavy force of 300g and 38% lost due to a reciprocal light force of 50g [25] while Hoe et al reported 2mm anchorage loss in patients treated with miniscrew implants compared to anchorage loss of 1.9mm using traditional 2 step method [26]. Studies have also illustrated that the stability of miniscrew anchorage by cephalometric analysis is occasionally undervalued due to lack of experience, inaccurate identification of landmark points, while clinically under orthodontic evaluation, these structures remain stable in the supporting alveolar bone [24-26].

Conclusion:

Temporary anchorage devices are complete anchorage device with higher stability that can be used effectively for anterior teeth retraction. Miniscrew implants placed in the interdental cortical bone between the maxillary first molar and second premolar proved to be efficient for intraoral anchorage reinforcements for en-masse retraction and intrusion of the maxillary anterior teeth. Despite several case reports only few studies investigated the effect of miniscrew TADs stability through orthodontic anchorage control used for anterior teeth retraction. Hence further studies with standard protocol and measurement tools are recommended to establish miniscrew implant as a stable anchorage device.

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