Case Report

En-masse intrusion and retraction with preadjusted edgewise appliance using two different sites of mini-implant placement

ABSTRACT

This article compares the treatment outcome between two patients when en-masse intrusion and retraction of the maxillary anterior teeth were performed with mini-implants placed at different sites. Both the patients had a skeletal Class II malocclusion with Angle's Class I molar relation, Class I canine relation, proclination of upper and lower anterior teeth. In the first case, intrusion and retraction was done with conventional friction mechanics for space closure and an intrusive force from a mini-implant placed in the midline. In the second case, intrusion and retraction were done with the application of force from the anterior attachments to mini-implants placed between the second premolars and first permanent molar bilaterally. There was intrusion of the maxillary anterior teeth with both mechanics. However, the evaluation of treatment outcome at the end of space closure showed mesial movement of the maxillary first permanent molar in the first case. In the second case, distal movement and intrusion of the maxillary first permanent molar and decrease in the lower anterior facial height was noted. The mechanics in the first case can be applied for intrusion and retraction of maxillary anterior teeth when anchorage requirement is not critical. The mechanics described in the second case can be used for intrusion and retraction of maxillary anterior teeth in cases with a very high anchorage need and will be beneficial in patients with vertical growth pattern.

Keywords: Intrusion, mini-implant, preadjusted edgewise appliance, retraction

INTRODUCTION

En-masse retraction of maxillary anterior teeth is routinely done with conventional friction mechanics. However, intrusion along with retraction of six anterior teeth is difficult to achieve with conventional friction mechanics. One possible solution to this situation is the use of mini-implants. A thorough knowledge of the biomechanics involved in tooth movement using mini-implants will help us to generate the force system required for en-masse intrusion and retraction of maxillary anterior teeth with mini-implants. Mini-implants can be placed at several sites in the maxillary arch depending on the need of the individual.[1-6] Among all these sites described above, two sites were found to be clinically feasible for en-masse intrusion and retraction of the maxillary anterior teeth.

The first site involves the placement of a single mini-implant at the midline between the two maxillary central incisors[1] and the second one consists of mini-implants placed in the posterior region between the maxillary second premolar and first permanent molars.[2] The two systems employ different

A. Sumathi Felicita, Shabeena Abdul Kader

Department of Orthodontics, Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, Tamil Nadu, India

Address for correspondence: Dr. A. Sumathi Felicita, Department of Orthodontics, Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences, Saveetha University, 162, Poonamallee High Road, Chennai, Tamil Nadu, India.
E-mail: sumifeli@hotmail.com

Received: 04-Nov-2020 **Accepted:** 10-Mar-2021
Published: 07-May-2021

Access this article online	
Website: www.orthodrehab.org	Quick Response Code
DOI: 10.4103/ijor.ijor_44_20	

How to cite this article: Felicita AS, Kader SA. En-masse intrusion and retraction with preadjusted edgewise appliance using two different sites of mini-implant placement. Int J Orthod Rehabil 2021;12:37-43.

biomechanical principles but produce intrusion and retraction of the maxillary anterior teeth.

Biomechanics of the two appliance system

Biomechanics involved with anterior mini-implant

In the first method, 0.022" slot MBT brackets were bonded in the upper and lower arches. The arches were leveled and aligned. 0.018"x 0.025" stainless steel wire was placed. A single mini-implant was placed in the midline between the maxillary central incisors and an elastic thread placed from that mini-implant to the base arch wire to generate the intrusive force [Figure 1]. Retraction of the maxillary anterior teeth was performed with conventional friction mechanics [Figure 1]. In the anterior region, this mechanics generated an intrusive force and a counter-clockwise moment as the point of force application is labial to the center of resistance (Cres) of the maxillary anterior teeth. This counter-clockwise moment may cause labial flaring of the maxillary anterior teeth. However, this labial flaring is negated by the retractive force placed on the base arch wire. Intrusion and retraction of upper anterior teeth takes place with the intrusive force applied from the mini-implant and retractive force applied from the molar buccal tube [Figure 2].

Figure 1: Showing anterior mini-implant mechanics

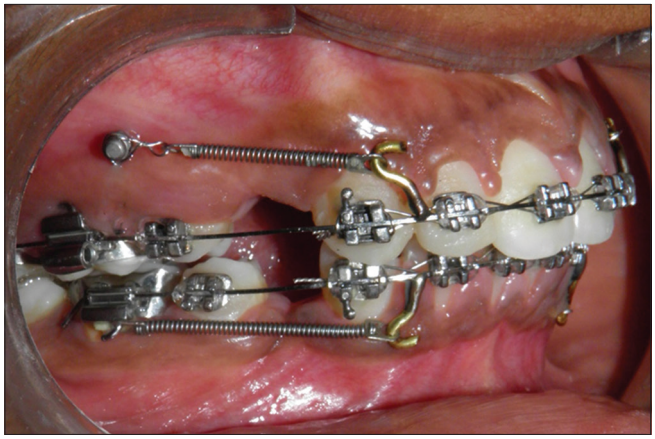

Figure 3: Showing posterior mini-implant mechanics

Biomechanics involved with posterior mini-implant

In the second method, the maxillary and mandibular arches were bonded with 0.022 slot bracket with MBT prescription. The maxillary arch was leveled and aligned to 0.016"x 0.022" stainless steel wire. Mini-implants were placed bilaterally between the maxillary second premolar and first permanent molar at the mucogingival junction [Figure 3]. Retractive force was placed from the attachment soldered between the maxillary lateral incisor and canine onto the posterior mini-implants bilaterally. This results in a diagonal vector of force being applied on the maxillary anterior teeth. This diagonal force vector when resolved will generate an intrusive and retractive component of force [Figure 4]. Since the point of force application is incisal to the Cres of the maxillary anterior teeth, it causes a clockwise moment on the maxillary dentition [Figure 4]. This moment can be prevented with a reverse curve placed on the base arch wire. Table 1 shows the differences between the two mechanics.

Both the methods described above were applied on two individual cases with similar selection criteria to assess the outcome. The aim of this article is to evaluate the outcome achieved using these two methods at the end of space closure.

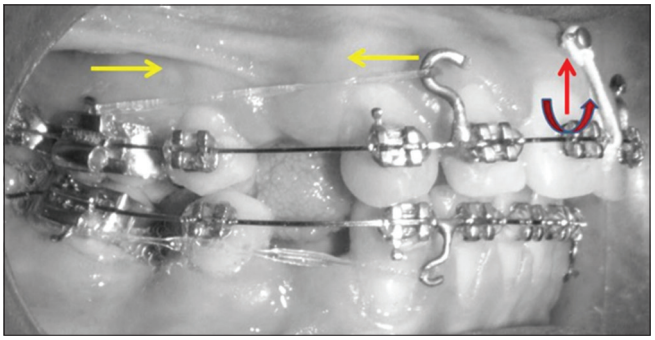

Figure 2: Showing the biomechanics involved in anterior mini-implant mechanics

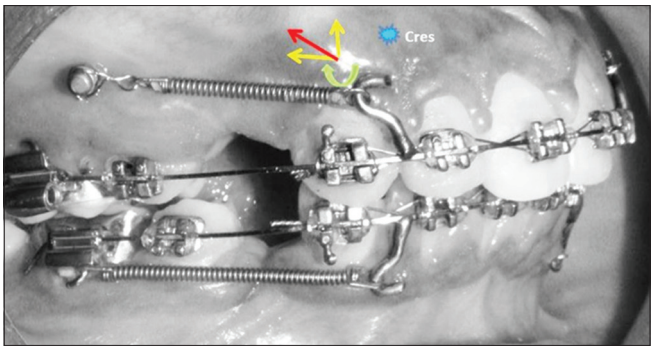

Figure 4: Showing biomechanics of posterior mini-implant mechanics

Table 1: Differences between the two methods used to bring about intrusion and retraction of the maxillary anterior teeth

Factors	Case I (anterior mini-implant mechanics)	Case II (posterior mini-implant mechanics)
Base arch wire	Base arch wire is 0.019 × 0.025 SS	Base arch is 0.016 × 0.022 SS with reverse curve
Number of implant	Single midline implant	Bilateral implant
Site of implant placement	Labial mucosa	Buccal mucosa
Direction of force vector	A horizontal force is applied bilaterally from the soldered attachment between the lateral incisor and canine to the molar hook of the first molar tube. Another force is applied in the midline from the base arch wire to the mini-implant	A single diagonal force is applied from bilaterally the mini-implant to the soldered attachment between the lateral incisor and canine
Intrusion	Intrusion brought about by the intrusive force placed in the midline	Intrusion brought about by the intrusive component of the applied force
Retraction	Retraction brought about by the horizontal force applied	Retraction brought about by the retractive component of applied force
Moment	Counter-clockwise moment generated	Clockwise moment generated
Bite deepening	Negated by the thicker cross section of 19 × 25SS wire and the direct force placed from the mini-implant	Negated by the vertical component of the retraction force
Anchorage	Conventional anchorage preservation with transpalatal arch and second molar banding	Absolute anchorage

MATERIALS AND METHODS

Two patients with similar characteristics were treated with mini-implants placed at two different intraoral sites to produce the same treatment effects were selected.

Case I

A 20-year-old female patient has been reported to the department with a chief complaint of forwardly placed upper front teeth. Clinical examination revealed a mesocephalic shape of head, mesoprosopic facial form, convex profile, acute nasolabial angle, vertical growth pattern, incompetent lips, and increased exposure of the maxillary incisors below the lip line. Intraoral examination revealed an Angle's Class I molar relation, Class I canine relation, bidental proclination with overbite of 5 mm, and overjet of 4 mm.

Lateral cephalometric measurements revealed a skeletal Class II malocclusion with a prognathic ante-inclined maxilla and orthognathic mandible, tendency toward vertical pattern of growth, severe proclination of upper anterior teeth, and moderate proclination of lower anterior teeth. The patient had acute nasolabial angle and protrusive lips [Table 2].

Treatment plan involved camouflaging the skeletal Class II pattern. As the patient had proclination of the upper and lower anterior teeth, extraction of 14, 24, 34, and 44 was contemplated. Levelling and aligning were done. Retraction of the anterior teeth was performed with conventional friction mechanics. A retractive force of 200 g was placed with a closed coil spring on 0.018" × 0.025" stainless steel wire from the soldered attachment to the molar buccal tube in the upper and lower arch. In the maxillary arch, 60 g of intrusive force was placed with an elastic thread placed from the arch wire to the mini-implant placed in the midline [Figure 5a-e].

Figure 5: Intraoral photographs of case 1 taken at the start of intrusion with a single mini-implant was placed in the midline between the maxillary central incisors and an elastic thread placed from the mini-implant placed in the midline to the base arch wire to generate the intrusive force and retractive force applied with conventional friction mechanics

The mini-implant was placed just beneath the attachment of the labial frenum. The patient was reviewed periodically every month until space closure was achieved [Figure 6a-e]. Changes in cephalometric parameters were evaluated at the end of space closure.

Case II

A 23-year-old male patient had a complaint of forwardly placed upper front teeth. Clinical examination revealed a mesomorphic shape of head, mesoprosopic facial form, convex profile, posterior divergence, acute nasolabial angle, incompetent lips, incisal show of 5 mm below the

Table 2: Cephalometric measurements of both patients preintrusion (T1) and postintrusion (T2)

Parameter	Case I			Case II		
	T1	T2	Change	T1	T2	Change
Skeletal						
Sagittal						
SNA (°)	88	88	0	84	82	2
SNB (°)	80	80	0	80	80	0
ANB (°)	8	8	0	4	2	2
Superior prosthion to PM vertical (mm)	53	49.	4	51	46	5
Inferior prosthion to PM vertical (mm)	46	43	3	52	47	5
Vertical						
GoGn to SN (°)	33	35	−2	34	32	2
LFH (mm)	62	62	0	71	66	5
PFH (mm)	68	66	2	70	70	0
Ar-Go-Me (°)	125	123	2	126	126	0
N-S-Ar (°)	124	123	1	125	124	1
Dental						
Sagittal						
IMPA (°)	98	90	8	100	95	5
Interincisal angle (°)	122	131	−9	116	131	−15
U6 to PM vertical (mm)	15	16	−1	19	17	2
U6 to pterygoid vertical (mm)	19	20	−1	22	20	2
U1 to NA (linear) (mm)	6	2	4	18	8	10
U1 to NA (angular) (°)	34	28	6	38	25	13
Overjet (mm)	4	2	2	6	2	4
Vertical						
Upper OP to PP (°)	13	12	1	6	5	1
Lower OP to mandibular plane (°)	24	23	1	23	22	2
Cr to PP (mm)	9	7	2	14	11	3
Overbite (mm)	5	2	3	5	2	3
Upper OP to PP (°)	13	17	−4	6	6	0
Incisor show below lip line (mm)	8	5	3	5	3	2
U6 to palatal plane (mm)	21	21	0	24	21	3
L6 to mandibular plane (mm)	31	32	−1	31	31	0
Soft tissue						
Upper lip to E plane (mm)	4	1	3	3	1	2
Lower lip to E plane (mm)	7	4	3	5	3	3
Nasiolabial angle (°)	95	112	17	105	110	−5
Mentolabial sulcus (mm)	6	4	2	4	4	0
Transverse						
Inter-canine width (mm)						
Maxillary	35	36	−1	33	32	1
Mandibular	25	26	−1	25	25	0
Inter-premolar width (mm)						
Maxillary	38.5	38	0.5	38	36	2
Mandibular	33	32	1	32	32	0
Inter-molar width (mm)						
Maxillary	44	44	0	46	46	0
Mandibular	37	37.5	−0.5	36	36	0

LFH: Lower facial height, PFH: Posterior face height, PP: Photophosphorylation, OP: Oxidative phosphorylation

lip line, and tendency toward vertical growth pattern. Intraoral examination revealed an Angle's Class I molar relation, Class I canine relation, proclination of upper and lower anterior teeth with overbite of 5 mm and overjet of 6 mm.

Cephalometric measurements showed a borderline skeletal Class II malocclusion with mildly prognathic ante-inclined maxilla, orthognathic mandible with average growth pattern, severe proclination of upper anterior teeth, and moderate proclination of lower anterior teeth [Table 1].

Figure 6: Intraoral photographs case 1 taken at the end of intrusion and retraction with anterior intrusion mechanics

Figure 7: Intraoral photographs case 2 taken at the beginning of intrusion and intrusion with posterior mini-implant mechanics

Treatment plan involved the extraction of 14, 24, 35, and 44. Leveling and aligning were achieved. In the lower arch, spaces were closed with conventional friction mechanics. In the maxillary arch, mini-implants were placed bilaterally between the maxillary second premolar and first permanent molar. Closed coil springs that deliver 200 g of force were placed between an attachment soldered between the maxillary incisor and canine bilaterally for space closure [Figure 7a-e]. The patient was reviewed periodically every month until space closure was achieved [Figure 8a-e].

Cephalometric assessment was done to evaluate the change at the end of space closure.

RESULTS

Case I

In case I, assessment of cephalometric change showed no change in SNA, SNB, and ANB angle. There was remodeling of the maxillary and mandibular alveolar bone reflected by the backward movement of the superior prosthion and inferior prosthion by 4 mm and 3 mm, respectively. The mandibular plane increased by 2°. There was no change in lower anterior facial height. The posterior facial height decreased by 2 mm. There was decrease in articular angle and gonial angle by 2° and 1° respectively. The upper anterior teeth intruded by 2 mm. The overbite and overjet reduced by 3 mm and 2 mm, respectively, due to intrusion and retraction of maxillary anterior teeth. The lower axial inclination reduced by 8° and interincisal angle increased by 9°. There was mild anchor loss with a mesial movement of the maxillary molar by 1 mm with no change in its vertical position. There was a counter-clockwise rotation of the maxillary and mandibular occlusal plane by 1°. Both the upper and lower lip retracted by 3 mm. The nasolabial increased by 17°. The inter-canine width increased by 1 mm, inter-premolar width was decreased by 0.5 mm, and inter-molar width showed no change in the maxillary arch.

Case II

Comparison of cephalometric measurements in the second case showed remodeling of the maxilla with a reduction in SNA angle by 2° with no change in SNB angle. ANB angle decreased by 2°. There was remodeling of the maxillary alveolar bone with backward movement of the superior prosthion by 5 mm. Mandibular plane decreased by 2°. The lower anterior facial height decreased by 5 mm. The upper anterior teeth intruded by 3 mm. The overbite and overjet reduced by 3 mm and 4 mm, respectively. The lower axial inclination reduced by 5° and interincisal angle increased by 15°. The maxillary molar distalized by 2 mm and intruded by 3 mm. There was no change in posterior facial height. There was no change in gonial angle with a decrease in articular angle by 1°. There was a counter-clockwise rotation of the maxillary occlusal plane by 1° and mandibular occlusal plane by 2°. There was an upper lip moved back by 2 mm and nasolabial angle increased by 5°. The inter-canine width decreased by 1 mm and inter-premolar width decreased by 2 mm with no change in inter-molar width in the maxillary arch. In the

Figure 8: Intra-oral photographs case 2 taken at the end of space closure with posterior mini-implant mechanics

mandibular arch there was no change in inter-canine width, inter-premolar width and inter-molar width.

DISCUSSION

This case report compares the results obtained between two different treatment mechanics in cases requiring intrusion and retraction of the maxillary anterior teeth. This was achieved with the placement of mini-implant at two different sites in the maxillary arch. As far as the anterior region is concerned, root proximity may be avoided by placing the mini-implant close to the nasal septum, but this requires elevation of mucogingival flap for mini-implant placement. To avoid a surgical procedure, the midline mini-implant in this case was placed slightly gingival to the frenum attachment. This may also reduce postoperative pain and discomfort. Some may argue that interference can be encountered due to the proximity of the root and the risk of root contact as intrusion of the anterior teeth occurs. However, this was not observed in this case. The decreased distance between the mini-implant and the arch wire will reduce the load deflection rate necessitating frequent activations. This should not be a problem if the patient reports for regular and periodic review.

In the existing literature,[1] the anterior intrusive force from the mini-implant is applied by means of ligature wire placed from the head of the mini-implant onto the base arch wire. However, in this case, the force is placed by means of an elastic thread in the anterior region. Such a force can be measured with a Dontrix gauge to maintain the force within physiologic limits.

Looking at the overall outcome in the first case with anterior mini-implant, there was no change in the skeletal pattern. There was remodeling of the alveolar bone probably because of the retraction of the maxillary anterior teeth. The lower anterior facial height was increased possibly due to the extrusion of the mandibular molars. Intrusion of the maxillary anterior teeth was observed with reduction in overbite. The overjet decreased due to retraction of the anterior teeth, and there was an improvement in interincisal angle. Anchor loss was noted with mesial movement of the maxillary molar. An improvement in facial profile of the patient was observed due to the movement of the upper and lower lips. In the transverse plane, there was constriction of the maxillary arch in the anterior region with no change in the posterior region.

Interpretation of outcome in the second case with posterior mini-implant showed a marginal improvement in the skeletal pattern as shown by the ANB angle. There was remodeling of the maxillary base and the alveolar bone. There was reduction in lower anterior facial height probably due intrusion of the maxillary molars. There was intrusion and retraction of the maxillary anterior teeth. There was a reduction in overjet and overbite. Anchorage was gained due to distal movement of the maxillary permanent first molar teeth. There was retraction of the upper and lower lips with improvement in the facial profile. There was marginal expansion of the maxillary arch in the anterior region with no change in inter-molar width in the maxillary arch.

Comparing the outcome between the two mechanics, a difference in treatment outcome was noted in relation to the sagittal and vertical position of the posterior teeth in the maxillary arch. An intrusion in of the maxillary permanent molars with decrease in lower anterior facial height was noted with posterior mini-implant mechanics. No change in the position of the maxillary permanent molars or possibly a marginal extrusion with increase in lower anterior facial height was noted. Anchorage was gained with posterior mini-implant while the opposite was seen with anterior mini-implant. There were minor differences in the transverse measurements too. The other treatment outcome was similar in both the cases and both methods can be employed depending of the treatment need of the existing malocclusion. Anterior mini-implant is advised in situations where the anchorage demand is not critical and posterior mechanics can be employed in patients who require greater vertical control.

Intrusion arches can be used bring about intrusion of anterior teeth, but the anchorage demand on the molars would be high, and there is a possibility of extrusion of the posterior teeth. The mechanics in both the cases brought about

intrusion of the anterior teeth without any unwanted side effects on the maxillary posterior teeth.

Comparing the treatment results achieved with other anterior mini-implant sites[1,6] and method of intrusion,[7-10] it was found that the mini-implant can be used for intrusion on continuous arch wire and produce beneficial results as compared to other sites.[1,6]

However, case reports have only limited value in the evaluation of treatment results and more reliable results may be obtained with randomized clinical trials.

CONCLUSION

Thus, comparing the two systems both methods appear to effective. However, posterior mini-implant appears to be slightly more favorable compared to anterior mini-implant especially in high angle cases.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Ohnishi H, Yagi T, Yasuda Y, Takada K. A miniimplant for orthodontic anchorage in a deep overbite case. Angle Orthod 2005;75:444-52.
2. Garfinkle JS, Cunningham LL Jr., Beeman CS, Kluemper GT, Hicks EP, Kim MO. Evaluation of orthodontic miniplant anchorage in premolar extraction therapy in adolescents. Am J Orthod Dentofacial Orthop 2008;133:642-53.
3. Park HS, Kyung HM, Sung JH. A simple method of molar uprighting with micro-implant anchorage. J Clin Orthod 2002;36:592-6.
4. Park HS, Lee SK, Kwon OW. Group distal movement of teeth using microscrew implant anchorage. Angle Orthod 2005;75:602-9.
5. Park HS, Jang BK, Kyung HM. Maxillary molar intrusion with micro-implant anchorage (MIA). Aust Orthod J 2005;21:129-35.
6. Polat-Ozsoy O, Arman-Ozcirpici A, Veziroglu F. Miniscrews for upper incisor intrusion. Eur J Orthod 2009;31:412-6.
7. Kumar P, Datana S, Londhe SM, Kadu A. Rate of intrusion of maxillary incisors in Class II Div 1 malocclusion using skeletal anchorage device and Connecticut intrusion arch. Med J Armed Forces India 2017;73:65-73.
8. Jayaratne YS, Uribe F, Janakiraman N. Maxillary incisors changes during space closure with conventional and skeletal anchorage methods: A systematic review. J Istanb Univ Fac Dent 2017;51:S90-101.
9. Hans MG, Kishiyama C, Parker SH, Wolf GR, Noachtar R. Cephalometric evaluation of two treatment strategies for deep overbite correction. Angle Orthod 1994;64:265-74.
10. Senışık NE, Türkkahraman H. Treatment effects of intrusion arches and mini-implant systems in deepbite patients. Am J Orthod Dentofacial Orthop 2012;141:723-33.