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Comparison of Intrusive Effects of Miniscrews and Utility Arch and Their Effects on Root Resorption

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Abstract:
Objective: *To investigate the amount of incisor intrusion obtained by two intrusion mechanics including utility arch and miniscrews. Also, to compare the amount of root resorption noticed during active intrusion phase.* ***Materials and Methods:*** *The patients were divided into 2 groups. In Group 1, intrusion was carried out by using miniscrews; in Group 2, intrusion was carried out by using utility arch. In Group 1, brackets were bonded to the 4 maxillary incisors only and the teeth were leveled with nickel-titanium wires. Two miniscrews were placed distal to the maxillary lateral incisors and intrusion was carried out by closed coil springs. In Group 2, upper incisors and molars were involved and after initial leveling and alignment a passive preformed nickel-titanium utility arch was inserted followed by custom-made Rickett's TMA utility arch. Radiographic grid was used for assessment of root resorption during active intrusion.* ***Results:*** *The results of present study proved that intrusion has occurred in both miniscrew as well as utility arch groups but comparatively no significant difference was found in amount of intrusion.* ***Conclusion:*** *Both miniscrew and utility arch are equally effective in carrying out intrusion of upper incisors but greater amount of root resorption was seen in utility group compared to miniscrew group.*
Keywords: *Miniscrew, Utility arch, Intrusion, Root resorption.*

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I. Introduction

An accurate assessment of a patient's facial skeletal pattern in vertical, sagittal and transverse direction is paramount in orthodontic diagnosis and treatment planning.[1] Deepbite refers to a discrepancy in vertical plane. It is a complex orthodontic problem that is a common feature of many malocclusions. Graber has defined "Deep bite" as a condition of excessive overbite, where the vertical measurements between the maxillary and mandibular incisors margin is excessive when the mandible is brought into habitual or centric occlusion. It is said to be one of the most deleterious malocclusions for long term health of the masticatory apparatus and the dental units. Correction of deep overbite with incisor intrusion should be addressed after correcting transverse and sagittal discrepancies.[2]

Non-surgical correction of deep bite involves either extrusion of posterior teeth, intrusion of incisors or both. The treatment of choice depends upon a variety of factors such as inter-labial gap, smile line, incisors display, lip length and vertical dimensions. Conventional methods of incisor intrusion usually involve appliances such as utility arches, Connecticut intrusion arch, three-piece intrusion arches, K-sir arch (Kalra simultaneous intrusion and retraction arch) or reversed curve arches and tip back springs.[3] The purpose of present study is to compare the intrusive effects of miniscrews and utility arch and their effects on root resorption.

II. Materials And Methods

The present study was conducted in the Department of Orthodontics and Dentofacial Orthopaedics in 12 subjects undergoing orthodontic treatment and having deep bite with age group between 12-25 yrs. Subject

selection criteria included patients with overbite more than 3 mm, incisor display more than 2 mm at rest and age group of 12-25yrs. Exclusion criteria were patients with active periodontal disease, root canal treated anterior teeth, patients with mutilated dentition and individuals with history of medical conditions such as asthma, hypothyroidism and diabetes.

The patients were further divided into 2 groups of 6 each. In Group 1, intrusion was carried out by miniscrews; in Group 2, intrusion was carried out by using utility arch. In Group 1, brackets were bonded to the 4 maxillary incisors only, and the teeth were leveled with nickel-titanium wires starting from 0.14 NiTi upto 0.017 × 0.025 SS. Two miniscrews were placed distally to the maxillary lateral incisors under local anesthesia. After a stabilization period of 21 days, patient was recalled and J- hooks were soldered at distal aspect of 0.017'' × 0.025'' SS wire segment and miniscrews were loaded with closed coil spring in such a way that one end of spring is attached to J-hook and another is attached to miniscrew. A total of 80 grams of force was applied, 40 gram on each side of J-hooks and a Dontrix gauge (Leone, Italy) was used for measurement of forces. (Fig-1)

In Group 2 also, upper incisors were involved and bands were cemented to the maxillary first molars. The incisors were leveled with the same wire sequence as Group 1 and it was followed by passive preformed nickel-titanium utility arch which was placed for 1 month. At the end of leveling, a custom-made Rickett's TMA utility arch was made and before its placement 45° tip back, 20° toe-in and 25° buccal root torque was given and the arch was cinched back. (Fig-1) No other treatment was performed until intrusion was completed. Two conventional lateral cephalometric headfilms of the patients, one at the beginning of intrusion (T1) and the other at the end of intrusion (T2), were obtained. Twenty-one landmarks were located and 19 measurements (9 angular, 10 linear) were made on the cephalometric tracings (Fig 2).

Two vertical reference planes were constructed for confirmation of the dental movements. The first reference was the pterygoid vertical (PTV) drawn perpendicular to the sella-nasion (SN) plane and the second was drawn perpendicular to the constructed horizontal plane (7˚ to the SN plane) from the point of intersection of the anterior wall of sella turcica and the anterior clinoid process (VR). The center of resistance (CR) of the maxillary central incisor was determined for each patient rather than the CR of the anterior segment because it can be located easily. The CR of the maxillary central incisor was taken as the point located at one-third of the distance of the root length apical to the alveolar crest.

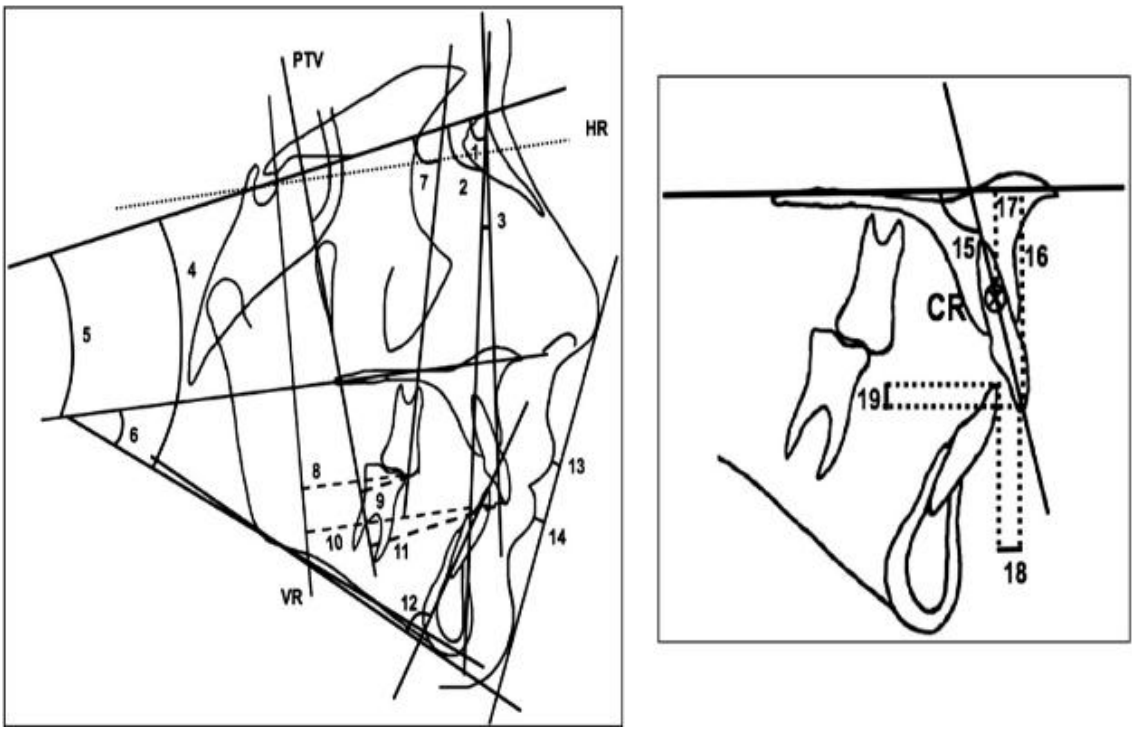

Fig-2 Measurements used in the study: 1, SNA; 2, SNB; 3, ANB; 4, GoGnSN; 5, SN-PP; 6, GoGn-PP; 7, U6-SN; 8, U6-VR; 9, U6-PTV; 10, U1-VR; 11, U1-PTV; 12,IMPA; 13, Ls–E-plane; 14, Li–E-plane; 15, U1-PP; 16, U1-PP; 17, CR-PP; 18, Overjet; 19,Overbite.

III. Observations And Results

Pre and Post mean, S.D and p values of different variables among miniscrew and utility group are shown in Table I. The right central incisor mean root resorption was 0.16 ± 0.25 mm and 0.58 ± 0.73 mm for miniscrew and utility arch group respectively. The left central incisor mean root resorption was 0.75 ± 1.03 mm

and 0.25 ± 0.41 mm for miniscrew and utility arch group respectively. Mean difference between right and left central incisor root resorption in miniscrew group was non- significant (p=0.28). Mean difference between right and left central incisor root resorption in utility arch group was also non- significant (p=0.42). (TABLE II AND III)

Table I: Pre and post mean, S.D and p values of different variables among miniscrew and utility group. Statistically significant value at *p ≤ 0.05, **p ≤ 0.01 and ***p ≤ 0.001

Variable	Miniscrew	Mean	S.D	P	Utility	Mean	S.D	P	P
SNA	Pre	83.83	2.40	0.067	Pre	80.83	3.65	0.415	0.229
	post	82.16	1.60		Post	80.33	2.42		
SNB	Pre	76.33	1.50	0.363	Pre	76.66	3.88	0.363	0.664
	post	76.16	1.47		Post	76.33	3.50		
ANB	Pre	7.50	1.37	0.091	Pre	4.16	2.92	0.611	0.119
	post	6.00	0.63		Post	4.00	2.52		
Go-Gn-Sn	Pre	30.16	4.16	0.765	Pre	24.41	6.39	0.319	0.453
	post	30.50	4.03		Post	26.33	6.68		
Sn-PP	Pre	7.83	1.94	0.709	Pre	8.08	2.37	0.336	0.508
	post	8.16	1.94		Post	9.50	2.73		
Go-Gn-PP	Pre	22.16	4.53	0.444	Pre	18.66	6.08	0.091	0.072
	post	22.83	4.26		Post	17.16	5.19		
U6-SN	Pre	73.00	7.53	0.156	Pre	72.66	6.83	0.018*	0.282
	post	77.83	5.07		Post	75.16	8.35		
U6-VR	Pre	32.16	1.82	0.889	Pre	34.33	6.77	0.307	0.492
	post	32.00	1.47		Post	33.00	5.40		
U6-PTV	Pre	17.33	6.15	0.621	Pre	16.16	4.53	0.175	0.867
	post	18.33	5.95		Post	16.83	5.34		
U1-PTV	Pre	49.00	3.57	0.224	Pre	48.58	5.16	0.230	0.878
	post	50.66	2.50		Post	50.00	6.00		
IMPA	Pre	91.83	6.36	0.102	Pre	90.33	3.38	0.112	0.073
	post	92.50	6.25		Post	90.83	3.31		
U1-VR	Pre	66.00	8.22	0.032*	Pre	66.83	7.08	0.091	0.148
	post	69.83	7.80		Post	68.33	8.14		
Ls-E Plane	Pre	2.41	3.44	0.695	Pre	2.00	1.89	1.00	0.804
	post	2.50	3.20		Post	2.00	1.67		
Li- Eplane	Pre	2.25	1.89	0.167	Pre	1.30	1.92	0.374	0.132
	post	0.33	3.32		Post	1.00	1.90		
U1-PP	Pre	108.83	4.83	0.003**	Pre	112.33	11.25	0.196	0.144
	post	119.00	6.72		Post	116.83	7.90		
U1-PP (L)	Pre	28.83	2.22	0.007**	Pre	29.50	3.27	0.001**	1.000
	post	26.33	2.50		Post	27.00	3.34		
CR-PP	Pre	14.66	1.21	0.002**	Pre	14.50	2.88	0.006**	0.263
	post	11.66	1.50		Post	12.33	2.42		
Overjet	Pre	5.75	3.43	0.004**	Pre	5.00	2.44	0.013*	0.296
	post	7.41	2.93		Post	6.16	2.13		
Overbite	Pre	6.50	2.58	0.020*	Pre	4.33	2.42	0.566	0.156
	post	3.75	1.72		Post	3.66	1.50		

Table II: Mean and standard deviation of right- left central and lateral incisor root resorption among miniscrew and utility group.

	GROUP		Mean	Std. Deviation	P value
R.CI	Miniscrew		0.167	0.25	0.367
	Utility arch		0.583	0.73	0.453
L.CI	Miniscrew		0.750	1.03	0.632
	Utility arch		0.250	0.41	0.793
R.LI	Miniscrew		0.917	0.97	0.549
	Utility arch		1.000	1.14	0.432
L.LI	Miniscrew		0.750	0.68	0.421
	Utility arch		0.917	0.86	0.925

The right lateral incisor mean root resorption was 0.91 ± 0.97 mm and 1.00 ± 1.14 mm for miniscrew and utility arch group respectively. The left lateral incisor mean root resorption was 0.75 ± 0.68 mm and 0.91 ± 0.86 mm for miniscrew and utility arch group respectively. Mean difference between right and left lateral incisor root resorption in miniscrew group was non-significant (p=0.46). Mean difference between right and left lateral incisor root resorption in utility arch group was also non-significant (p=0.80). (TABLE II AND III)

Table III: Mean difference in root resorption between right – left central and lateral incisor among miniscrew and utility group.

Group	Incisors	Mean Root Resorption	Std. Deviation	P value
Miniscrew	R.CI - L.CI	0.5833	1.2007	0.287
	R.LI - L.LI	0.1667	0.5164	0.465
Utility arch	R.CI - L.CI	0.3333	0.9309	0.421
	R.LI - L.LI	0.0833	0.8010	0.809

IV. Discussion

Maxillary incisors display and amount of gingival exposure on smiling plays a key role in determining the type of treatment. Deepbite patients with at least a 4 mm closure of the maxillary incisors with the lower lip and a gummy smile need to be treated with intrusion of the maxillary incisors. So, in patients with an excessive gingival display and normal vertical dimensions, maxillary incisor intrusion is the treatment of choice.[4] Recently, the orthodontic literature has been focused on the evaluation of the smile and the effect of incisor display during smiling.[5]

As conventional arches are connected to the posterior teeth during intrusion, the presence of counteracting moments is frequently inevitable.[6,7] Direct application of intrusive forces from miniscrews offers an efficient alternative to 2 × 4 arches and true intrusion can be achieved. In, recent times it is investigated that mini-implants can act as a effective method for carrying out incisor intrusion with reduced amount of incisor protrusion.[8,9,10] Incisal edge cannot be taken as a reliable reference point for assessment of incisor intrusion because proclination that is seen during intrusion can cause varied values of distance from incisal edge to palatal plane.[11] Since past, various Points have been used by different authors as a reference point for intrusion evaluation. The CR (center of resistance) of an upper incisor is located at one-third of the distance of the root length, apical to the alveolar crest and this point can be used as a reliable landmark for measuring root resorption.[12]

According, to the finite element method as well as in-vivo studies to determine the CR of the incisors, it has been found that the CR of the four incisor teeth lies 8 – 10 mm apical and 5 – 7 mm distal to the lateral incisors.[13] Thus, application of intrusive forces mesial to the lateral incisors would result in their proclination. Therefore, the miniscrews used in the present study were placed between the lateral incisor and canine roots in order to minimize protrusive movement of the incisors. Root resorption is one of the most serious consequences of intrusion. Inflammatory root resorption is a side-effect related to the biological tissue response that enables teeth to be moved during orthodontic treatment.[14] Deshields[15] found no correlation with upper incisor intrusion and root resorption. Conversely, McFadden et al[16] found 1.8 mm root shortening in patients treated with utility arches. Costipoulos and Nanda[17] noted negligible amounts of resorption with intrusion and concluded that intrusion with low forces can be effective in reducing overbite without significant root resorption. In present study, these findings prove that more amount of root resorption was seen in utility arch group as compared to miniscrew group but statistically no significant difference was found in amount of root resorption between two groups. These results are contrary to the study done by Muraleedhara Bhat,[19] who reported greater amount of root resoption in miniscrew group compared to utility arch group.

In present study, there was no significant change in the pre and post intrusion values of mean SNA, SNB and ANB either within the group or between the groups. Go-Gn-Sn values were also largely unaffected. Significant changes were observed in mean U6- SN in utility arch group, upper molars were tipped distally by 3.17º during intrusion by utility arch. This happened due to the fact that slight distal tipping of 1st molars is seen due to tip back bend in utility arch whereas in case of miniscrews, intrusion mechanics were confined to incisors only and no attachment was done on molars. Similar changes were observed in study done by Omur Polat- Ozsoy et al[18] who reported 6.82º of distal molar tipping in utility group and no molar tipping was observed in mini-implant group. Due to distal tipping of molars in utility arch group, a significant change was noticed in Mean U6-VR. A mean change of 3.33 mm was observed in position of upper molars at post-intrusion period in utility group. Whereas a mean change of 0.16 mm was observed in miniscrew group and this change was not significant. Mean incisor proclination found in this study in case of miniscrew group was 10.16,º which was higher than that reported by Omur Polat-Ozsoy.[18] This shows that there was mean 5.66º of greater proclination in miniscrew group compared to utility arch group. Mean incisor intrusion achieved in both miniscrews and implant group was 2.5 mm as suggested by U1-PP linear. In this study, mean increase in overjet in miniscrew group was 1.66 mm and it was 1.16 mm in utility group. Decrease in overbite was seen in both the groups but greater amount of reduction in overbite was seen in mini-implant group. Overbite decrease in miniscrew group was 2.75 mm and overbite decrease in utility group was 0.67 mm.

V. Conclusion

The conclusion derived from the results obtained in this study are:

1. Both miniscrew and utility arch are equally effective in carrying out intrusion.
2. During intrusion, greater amount of incisor proclination was found in miniscrew group compared to utility arch group.
3. Distal molar tipping was seen in upper first molars in case of utility arch group whereas no such significant change in molar position was seen in miniscrew group.
4. Root resorption was seen in both miniscrew and utility arch group but greater resorption was seen in utility arch group compared to miniscrew group.

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