ORIGINAL RESEARCH

The Efficacy of the Three-Piece Intrusion Arch - A Clinical Study

Pradeep Kumar[1], Sasikumar Rasappan[2], K. V. Sujan Kumar[3]

ABSTRACT

Background: A deep overbite can be corrected by extrusion of upper/lower posterior teeth, intrusion of upper/lower incisors, and combination. Since uprighting of incisors often lengthens the crown vertically and increases the amount of overbite, the use of three-piece intrusion can be taken to get satisfactory results. The aim and objectives of the study were to check the incisor tooth length using three-piece intrusion arch technique.

Materials and Methods: This prospective study included five patients who were undergoing routine orthodontic treatment with the pre-adjusted edgewise appliance in the Department of Orthodontics, College of Dental Surgery, Saveetha University, Chennai.

Results: The central incisors measured by the spiral computed tomography (CT) show a mean resorption of 0.52000 mm with a significance of 0.000. The lateral incisors measured by the spiral CT show a mean resorption of 0.61000 mm with a significance of 0.001.

Conclusion: The force systems delivered by the appliance are very much predictable and easy to control by the practitioner, thus making it the appliance of choice for effective simultaneous intrusion and retraction of the maxillary incisor teeth.

Keywords: Deep overbite, Incisor tooth length, Orthodontic cases, Spiral computed tomography

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[1,2,3]Professor

[1]Department of Orthodontics and Dentofacial Orthopedics, Sri Ramakrishna Dental College, Coimbatore, Tamilnadu

[2]Department of Orthodontics and Dentofacial Orthopedics, RVS Dental College and Hospital, Coimbatore, Tamil Nadu, India

[3]Department of Orthodontics and Dentofacial Orthopedics, MNR Denta College and Hospital, Fasalwadi, Sangareddy, Telangana

Corresponding Author: Dr. Pradeep Kumar, Department of Orthodontics and Dentofacial Orthopedics, Sri Ramakrishna Dental College, Coimbatore, Tamil Nadu, India. e-mail: dentpradeep@europeannest.com

INTRODUCTION

The relationship of the maxillary incisors to the upper lip line is a critical factor that ensures a pleasing appearance. In clinical practice, the patients presenting with proclined incisors which are also erupted beyond the functional occlusal plane are common.[1] Simple retraction or distal tipping of proclined incisors leads to further deepening of the bite and hence may not produce the ideal result in this study. Research has shown an appliance that can simultaneously intrude and retract incisors, i.e., the three-piece intrusion arch was analyzed and its efficacy introducing simultaneous intrusion and retraction in ten patients, who presented with maxillary incisors that were proclined as well as supra-erupted below the functional occlusal plane.[2,3] In majority of orthodontic cases, routine treatment protocol has been applied. A deep overbite can be corrected by extrusion of upper/lower posterior teeth, intrusion of upper/lower incisors, and combination.[1,2] The orthodontic appliances used to carry out intrusion are J hooks pull headgear, tip backbends, Burstone three-piece intrusion arch, Ricketts utility arch, Nanda Connecticut intrusion arch, and mini-implant-assisted intrusion.[3-5] Intrusive tooth movements are most effectively done with low force magnitudes.[5] The advantages of lower force magnitudes are reduced molar tip back moment and root resorption.[6-10] Since uprighting of incisors often lengthens the crown vertically and increases the amount of overbite, the use of three-piece intrusion can be taken to get satisfactory results. The aim and objectives of the study were to check the efficacy of the three-piece intrusion arch.

METHODOLOGY

This prospective study included five patients who were undergoing routine orthodontic treatment with the pre-adjusted edgewise appliance in the Department of Orthodontics, College of Dental Surgery, Saveetha University, Chennai. Mean age group of the sample was 14–21 years with four females and one male. Before the study was conducted, the Institutional Ethical Clearance was sought and the document was attached. The patient

was explained in detail about his role in the study, and an informed consent was obtained in the patients' own language.

Inclusion Criteria

- Normal healthy periodontium, alveolar bone levels, and root contours should be present.
- No previous orthodontic treatment
- No history of trauma to maxillary incisors.
- Completion of apexification of incisors.
- It should be an extraction case with leveling, alignment, and individual canine retraction completed.
- Sufficient space, overbite of 3 mm–5 mm and overjet of 3 mm–6 mm, for intrusion and retraction should be present.
- Patients should have normal facial height in accordance to their midfacial height, age, and sex according to McNamara and cannot accept molar extrusion as a means of overbite correction were included in the study.
- The amount of maxillary incisal show at rest should be >2 mm.
- Interlabial gap at rest should be >3 mm.

For Intrusion and Retraction

All patients had 0.022 Roth prescription pre-adjusted edgewise appliance with triple buccal tube (3M UNITEK). The right and left anchor units consisted of the first molars, unified by a custom-made soldered transpalatal arch made with 0.036-inch Elgiloy Wire (ORMCO) for anchorage. After initial treatment with sequencing archwires for alignment, canine retraction was completed. The anterior segment was unified with a rigid 0.019 × 0.025 inch stainless steel (ORMCO-orthoform Type III), and posterior segments consisting of the molars, premolars, and canines were unified with 0.018 × 0.025 inch stainless steel (ormco- orthoform Type III). Segmental bilateral tip-back springs of 0.017 × 0.025 inch Titanium molybdenum alloy wire (ORMCO) was used for intrusion. They were inserted into the auxiliary tube of the molars. A gable bend was given with the required intrusive force of 30 g per side. The tip back springs were then cinched distal to the molars to prevent any undue anterior proclination. E-chains (clear short linked) were used to deliver the retractive force of 120 g. The force delivered by the tip-back springs and the E-chain was measured with a Dontrix gauge. Mandibular arch was initially held in place by 0.019 × 0.025 SS archwire for 3 months to ensure that the reduction in overjet and overbite is not contributed by the lower molars extruding or the lower incisors flaring and also to maintain molar position. Clinically, an overjet of 2 mm, overbite of 2 mm, and gingival show of 0–1 mm from the free gingival margin were considered as normal. This was achieved in 3–4 months in the study. The procedure was considered complete on clinical assessment of overjet and overbite, and the intrusion and retraction achieved were later confirmed cephalometrically.

RESULTS

Statistical analyses were performed, and the results were shown as mean ± standard deviation. After the parametric assumptions were tested to determine if the variables were suitable for parametric tests, the differences between pre-treatment variable and post-treatment variable measurements were evaluated with the paired *t*-test. Appliance design in the study consisted of the anterior segment unified with a rigid 0.019 × 0.025 inch stainless steel and posterior segments consisting of the molars, premolars, and canines unified with 0.018 × 0.025 inch stainless steel. The anterior and posterior segments have to be rigid to prevent side effects due to wire deformation.[5] The segmental bilateral tip-back springs were made of 0.017 × 0.025 inch titanium molybdenum alloy. The tip-back springs delivered an intrusive force of 30 g per side through the mechanical loops that were incorporated in the TMA wire. E-chains delivered a distal force of 120 g as specified by Shroff *et al*.[4] The efficacy of the appliance was confirmed cephalometrically. Table 1 shows a mean intrusion of 2.712 mm with the range of intrusion achieved varying from 1.81 mm to 3.79 mm, mean retraction of 2.7980 mm with the range of retraction of the incisal edges varying from 1.82 mm to 2.75 mm, mean retraction of 0.508 of apex varying from 0.23 to 0.69 mm, and mean axial inclination change of 3.2° varying from 3° to 4° which are all suggestive of a combination of intrusion and retraction of the anterior teeth. These findings comply well with the findings of Shroff *et al*.[4] There was no significant movement of the molars which were assessed with their interdigitation with its mandibular counterpart clinically as the proper anchorage situation was met with a TPA and very minimal forces only were used[4,5] [Table 2].

Table 1: Cephalometric evaluation of the efficacy of the 3-piece intrusion arch

	Minimum (mm/degrees)	Maximum (mm/degrees)	Mean (mm)	Standard deviation
V1	1.81	2.90	2.2620	0.43906
V2	2.23	3.79	2.7980	0.77998
V3	1.82	2.75	2.0840	0.37713
V4	0.23	0.69	0.5080	0.17370
V5	3.000	4.000	3.20000	0.44721

Table 2: Evaluation of changes in tooth length by IOPA

Case number movement of the molars	Central incisor		Lateral incisor	
	Pre-intrusion in mm	Post-intrusion in mm	Pre-intrusion in mm	Post-intrusion in mm
Case 1				
Right	24.48	21.05	22.56	20.25
Left	24.41	23.81	23.96	20.42
Case 2				
Right	25.23	24.92	22.86	21.91
Left	24.91	24.91	22.38	25.31
Case 3				
Right	25.04	23.16	25.09	23.30
Left	29.12	26.26	24.32	23.32
Case 4				
Right	23.15	21.87	21.89	19.83
Left	23.98	23.46	22.89	21.82
Case 5				
Right	24.9	23.24	23.75	22.98
Left	24.5	22.94	24.00	23.11
Mean (mm)	25.1470	23.5740	23.2370	21.5490
Standard deviation	1.59765	1.44795	0.99790	1.30303

DISCUSSION

Root resorption during intrusion is surface resorption or transient inflammatory resorption. Replacement resorption is rarely ever seen after orthodontic treatment.[7] Literature has shown that incisors are most likely to show external apical root resorption (EARR) as well as most advanced extent of resorption.[10,11] This has been attributed to the shape of the roots, to biochemical pathways that they might possess, and to the fact that these teeth are moved the farthest. Therefore, root resorption associated with the use of three-piece intrusion arch was studied. The greater the need for intrusion, the greater the concern, since it is well-known that the degree of root resorption increases with intrusion, especially in single-rooted teeth. EARR is a frequent, undesirable side effect in orthodontic treatment, and it has a multifactorial etiology.[11-15] Since one cause of root resorption is orthodontic movement, a correlation may exist between the type of movement and the degree of subsequent root resorption.[16-20] A previous study assessed EARR caused by the mechanical intrusion of the maxillary incisors using intrusion arches by means of periapical radiographs, revealing a mean resorption of 0.6 mm within a 4.3-month period.[7] It is worth highlighting that the degree of force applied and treatment time are seen as factors capable of increasing the likelihood of resorption. A larger amount of EARR was found in teeth subjected to heavy orthodontic force compared with mild forces.[8,9] The findings correlate with the previous studies by Hooman *et al*.[14] and Dermaut and De Munck[8] in assessing the amount of root resorption radiographically. Pre- and post-intrusion spiral computed tomography (CT) data were acquired from the patient and Table 2 shows that the mean root resorption measured for the central incisor for a mean intrusion of 2.712 mm as 0.520mm and the mean resorption that has happened for the lateral incisors for a mean intrusion of 2.712 mm was 0.610 mm. In the spiral CT technique, central incisors showed a mean resorption of 0.520 mm with a significant $P = 0.000$ and lateral incisors showed a mean resorption of 0.610 mm with a significant $P = 0.001$. These results reveal that IOPA is less sensitive to precision details particularly over small anatomical areas, and further, long-term clinical studies are necessary to confirm the results observed in this research. Other analyses, such as volumetric evaluation of the impact of root resorption and possible subsequent repair of the maxillary incisors, would broaden the knowledge about EARR severity three-dimensionally.

CONCLUSION

The three-piece intrusion arch is a simple appliance with a less complicating design and biomechanics. The force systems delivered by the appliance are very much predictable and easy to control by the practitioner, thus making it the appliance of choice for effective simultaneous intrusion and retraction of the maxillary incisor teeth.

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