ORIGINAL RESEARCH

Incisor Tooth Length Changes Following Three-piece Intrusion Arch - A spiral Computed Tomography Study

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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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INTRODUCTION

In majority of orthodontic cases, routine treatment protocol has been applied. In a few special cases rather than conventional protocol, we need to choose different treatment mechanics. Strang defined overbite as the overlapping of the upper anterior teeth over the lowers in the vertical plane. The ideal overbite in a normal occlusion may range from 2 mm to 4 mm or 5% to 25%. The overbite >40% should be considered as deep overbite and affects the periodontal structures and temporomandibular joints.[1] 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 back bends, three-piece intrusion arch, Ricketts utility arch, Nanda Connecticut intrusion arch, and mini-implant-assisted intrusion.[1,3,4] 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] Burstone three-piece intrusion arch is based on statically determinant force system, which implies that the magnitude of all the forces produced by activation is measurable.[11-20] 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. 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. Metallic markers were used to avoid magnification and projection errors.

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.

All patients had 0.022 Roth prescription pre-adjusted edgewise appliance with triple buccal tube (3M UNITEK) for intrusion and retraction. Evaluation of records was done. The overall length of the tooth on the film was measured along its long axis from apex to the incisal edge. After determining the change in actual tooth length, root resorption was thus calculated using the formula. Pre-intrusion length of tooth–post-intrusion length of tooth = change in length of tooth after intrusion (amount of resorption). Computed tomographic slices of 0.068 mm thickness each were acquired from a GE 64-slice spiral computed tomography (CT) machine. The number of slices per patient varied from 25 to 45 depending on the length of the teeth. The acquired data images are then reconstructed three dimensionally by a software known as Dicom centricity 3G - volume rendering and reconstruction (GE). Since no magnification or projection error has ever been reported, direct computerized measurements were being taken from the incisal edge to the clearly visible root tip of the acquired image through all the acquired slices with an accuracy of up to 99.95%. The mark and measure feature of this software were used for this purpose. All other views of the crown and root were viewed by rotating the reconstructed image three dimensionally. They were checked for the presence of any abnormality.

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. The differences between the two groups were evaluated using student *t*-test. $P \leq 0.05$ were evaluated as statistically significant. Table 1 shows the mean length of the right (R) and left (L) central incisor measured by IOPA before intrusion is 25.1470mm and after intrusion is 23.5740 mm. The mean length of the right (R) and left (L) lateral incisor measured by IOPA before intrusion is 23.2370 mm and after intrusion is 21.5490 mm. Table 2 shows the mean length of the right (R) and left (L) central incisor measured by the spiral CT before intrusion is 24.2200 mm and after intrusion is 23.7000 mm. The mean length of the right (R) and left (L)

Table 1: Evaluation of changes in tooth length by IOPA

Case number	Central incisor		Lateral incisor	
	Pre-intrusion (mm)	Post-intrusion (mm)	Pre-intrusion (mm)	Post-intrusion (mm)
Case 1				
R	24.48	21.05	22.56	20.25
L	24.41	23.81	23.96	20.42
Case 2				
R	25.23	24.92	22.86	21.91
L	24.91	24.91	22.38	25.31
Case 3				
R	25.04	23.16	25.09	23.30
L	29.12	26.26	24.32	23.32
Case 4				
R	23.15	21.87	21.89	19.83
L	23.98	23.46	22.89	21.82
Case 5				
R	24.9	23.24	23.75	22.98
L	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

Table 2: Evaluation of changes in tooth length by Spiral CT

Case number	Central incisor		Lateral incisor	
	Pre-intrusion (mm)	Post-intrusion (mm)	Pre-intrusion (mm)	Post-intrusion (mm)
Case 1				
R	22.7	22.0	21.4	21.0
L	22.2	21.8	21.4	21.2
Case 2				
R	24.0	23.7	21.3	20.9
L	23.4	22.9	23.6	23.1
Case 3				
R	28.3	27.8	25.5	24.9
L	27.1	26.7	23.9	22.6
Case 4				
R	22.7	22.3	21.3	21
L	23.3	22.9	21.2	20.7
Case 5				
R	24.4	23.7	23.1	22.6
L	24.0	23.2	21.1	20.4
Mean (mm)	24.220	23.700	22.3500	21.8400
Standard deviation	1.97923	1.99444	1.36365	1.42142

CT: Computed tomography

Table 3: Level of significance of root resorption paired sample test

	Difference in mean lengths (Pre-post) (mm)	S.D	*P*-value*
IOPA			
Central incisor (Pair 1)	1.57300	1.01167	0.001
Lateral incisor (Pair 2)	1.68800	0.66013	0.00
Spiral CT			
Central incisor (Pair 3)	0.52000	0.15492	0.00
Lateral incisor (Pair 4)	0.61000	0.33149	0.001

*students paired *t*-test was used to calculate the *P*-value *P*<0.05 was considered as the level of significance, CT: Computed tomography, SD: Standard deviation

lateral incisor measured by the spiral CT before intrusion is 22.3500 mm and after intrusion is 21.8400 mm. Table 3 shows the comparison between the pre- and post-intrusion root lengths of the central and lateral incisors measured by IOPA spiral CT. The central incisors measured by IOPA show a mean resorption of 1.5730 mm with a significance of 0.001. The lateral incisors measured by IOPA show a mean resorption of 1.68800 mm with a significance of 0.000. The central incisors measured by the spiral CT show a mean resorption of 0.52000mm with a significance of 0.000. The lateral incisors measured by the spiral CT shows a mean resorption of 0.61000 mm with a significance of 0.001.

Mean and standard deviation between central incisors and lateral incisor tooth lengths measured preintrusion and post intrusion by IOPA are shown in Table 1.

Mean and standard deviation between central incisors and lateral incisor tooth lengths measured pre-intrusion and post-intrusion by spiral CT are shown in Table 2.

Mean, standard deviation, and test of significance between pre- and post-intrusion root length changes for central incisors and lateral incisors central incisor evaluated by IOPA radiograph and spiral CT are shown in Table 3.

DISCUSSION

Dental intrusion constitutes an integral part of orthodontic treatment to improve sagittal and vertical incisor relationship. For many years, it was believed that it was impossible to intrude teeth and that, if intrusion was attempted, undesirable sequelae such as resorption would occur. Literature has shown that incisors are most likely to show external apical root resorption as well as most advanced extent of resorption.[6-11] 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.[12-20] Therefore, root resorption associated with the use of three-piece intrusion arch was studied with IOPA and its accuracy was studied for further confirmation with a more accurate Spiral CT. From Table 1, the IOPA radiographs showed a mean resorption of 1.573 mm for an intrusion of 2.712 mm for the central incisors and a mean resorption of 1.68800 mm for the lateral incisors. In the IOPA technique, central incisors showed a

mean resorption of 1.5730 mm with a significant P = 0.001 and lateral incisors showed a mean resorption of 1.6880 mm with a significance of P = 0.000. The findings correlate with the previous studies by Hooman *et al*. (2007)[14] and Dermaut and De Munck[8] in assessing the amount of root resorption radiographically. Pre- and post-intrusion spiral 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 is 0.520 mm and the mean resorption that has happened for the lateral incisors for a mean intrusion of 2.712 mm was 0.610mm. In the spiral CT technique, central incisors showed a mean resorption of 0.520 mm with a significance of P = 0.000 and lateral incisors showed a mean resorption of 0.610 mm with a significance of P = 0.001. Since the tooth examined by the spiral CT and IOPA was the same, on the final comparison of the net amount of resorption exposed by the two different techniques from Table 3, a mean difference of 1.053 mm for central incisors and 1.009 mm for the lateral incisor were found. These results reveal that IOPA is less sensitive to precision details, particularly over small anatomical areas. These variations in spite of the increased standardization attempts only signify the need for a better diagnostic technique to explore three-dimensional objects.

CONCLUSION

The three-piece intrusion arch is a simple appliance with a less complicating design and biomechanics. Biomechanics strategies utilizing the three-piece intrusion arch effectively aided in closure of spaces, correction of high gingival exposure, intrusion of the upper anteriors, and controlling posterior anchorage. All desired treatment outcomes were achieved without prolonging treatment time. Proper biomechanic strategies can effectively bring about true intrusion of the upper anteriors as well as correct the upper incisor proclination without prolonging treatment time. The use of three-piece intrusion arch to achieve orthodontic correction assures the attainment of predictable treatment results.

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