ORIGINAL RESEARCH

Comparison of the Conventional Method using Intraoral Periapical with the Contemporary Imaging Technology (Spiral Computed Tomography) for the Amount of Apical Root Resorption

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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. 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 aims and objectives of the study were to compare the conventional method using intraoral periapical (IOPA) with the contemporary imaging technology (spiral computed tomography [CT]) for the amount of apical root resorption.

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. The procedure was considered complete on clinical assessment of overjet and overbite, and the intrusion and retraction achieved were later confirmed cephalometrically.

Results: 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 0.52000 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. IOPAs are still important in diagnostics and can never be ignored for newer technologies. However, for much precision details and minute anatomical areas and surface configurations, spiral CT and three-dimensional imaging are the ultimate tools.

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

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INTRODUCTION

Accurate patient's record and reliable information are keys to our understanding of orthodontics. The development of integrated three-dimensional (3D) tools for diagnosis and treatment planning is one of the most exciting developments in orthodontics as the specialty moves into the 21st century. The innovations and advantages of 3D cone-beam computed dental tomography are continually growing for its potential use in dental research. Imaging techniques are important for planning research in dentistry. 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 is common. A deep overbite can be corrected by extrusion of upper/lower posterior teeth, intrusion of upper/lower incisors, and combination.[1,2] The term deep bite is implicated when the vertical overlap of upper incisor over the lower incisors is >50%.[1] It is expressed as the percentage of the lower incisor overlapped by the upper.[2] Deep overbite is a common finding in many malocclusions.[3] Treatment approaches include the use of functional appliances for the labial tipping of anterior

teeth, extrusion of posterior teeth, surgical approaches, and true intrusion of anterior teeth. The orthodontic appliances used to carry out intrusion are J hooks pull headgear, tip-back bends, Burstone three-piece intrusion arch, Ricketts utility arch, Nanda Connecticut intrusion arch, and mini-implants assisted intrusion.[3-5] Intrusive tooth movements are most effectively done with low force magnitudes.[5] The advantage of lower force magnitudes is 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 aims and objectives of the study were to compare the conventional method using intraoral periapical (IOPA) with the contemporary imaging technology (spiral CT) for the amount of apical root resorption.

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, institutional ethical clearance was sought and the document attached. The patient was explained in detail about his role in the study and an informed consent was obtained in the patient's own language. 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 1st 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 and posterior segments consisting of the molars, premolars, and canines were unified with 0.018 × 0.025 inch stainless steel. Segmental bilateral tip-back springs of 0.017 × 0.025 inch titanium-molybdenum alloy (TMA) wire (ORMCO) were 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 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.

Inclusion Criteria

The following criteria were included in this study:

- 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.

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 TMA. 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. Table 1 shows that the mean length of the right (R) and left (L) central incisor measured by IOPA before

intrusion is 25.1470 mm 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 that 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) 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 0.52000 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.

In Table 1, mean and standard deviation between central incisors and lateral incisor tooth lengths measured pre-intrusion and post-intrusion by IOPA.

In Table 2, mean and standard deviation between central incisors and lateral incisor tooth lengths measured pre-intrusion and post-intrusion by spiral CT.

Table 1: Evaluation of changes in tooth length by IOPA

Case number	Central incisor		Lateral incisor	
	Pre-intrusion in mm	Post-intrusion in mm	Pre-intrusion in mm	Post-intrusion in 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 in mm	25.1470	23.5740	23.2370	21.5490
Standard deviation	1.59765	1.44795	0.99790	1.30303

IOPA: Intraoral periapical

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

Case number	Central incisor		Lateral incisor	
	Pre-intrusion in mm	Post-intrusion in mm	Pre-intrusion in mm	Post-intrusion in 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 in 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) in mm	SD	*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 *P* value. *P*<0.05 was considered as the level of statistical significance

In Table 3, mean, standard deviation, and test of significance between pre- and post-intrusion root length change for central incisors and lateral incisors central incisor evaluated by IOPA radiograph and spiral CT.

DISCUSSION

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. External apical root resorption 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 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 is 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 CT data were acquired from the patient and Table 2 showed that the mean root resorption measured for the central incisor for a mean intrusion of 2.712 mm was 0.520 mm 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 $P = 0.001$. Since the tooth examined by the spiral CT and IOPA was the same, on final comparison of the net amount of resorption exposed by the two different techniques from 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. However, more critical evaluation of these force systems in larger sample size, over a longer period of time, would be required to validate these observations. Variation of resorption with sex was not included in the study. Cephalograms still finds an important place for diagnosis and assessing treatment changes that cannot be perceived by CT.

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. IOPAs are still important in diagnostics and can never be ignored for newer technologies. However, for much precision details and minute anatomical areas and surface configurations, spiral CT and 3D imaging are the ultimate tools.

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