Original Article

A Comparative Study Of Different Intrusion Methods And Their Effect On Maxillary Incisors

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Abstract

Introduction: To analyze and contrast the rates of root resorption and intrusion of maxillary incisors produced by Rickett's utility arch, Kalra's Simultaneous Intrusion & Retraction arch, and arch with Reverse Curve of Spee, respectively.
Methods: The research was carried out on a total of 30 patients who ranged in age from 14 to 25 years old and had a deep bite that required at least a 2–4 mm intrusion of their maxillary incisors. On the basis of the intrusion method that was employed, these patients were randomly assigned to one of three groups: Rickets utility arch (Group I), K-SIR arch (Group II), or RCS arch (Group III) (Group III). The quantity of root resorption and the amount of incursion that took place throughout the process were both measured for each subject. In order to analyze the skeletal and dental alterations that occurred both before to and after incisor intrusion, seven angular and six linear cephalometric measurements were taken.
Results: The real incisor intrusion that could be obtained with a utility arch was 1.6 millimeters on average, whereas with K-SIR it was 1.25 millimeters, and with RCS it was 0.70 millimeters. The difference between the three rates was not statistically significant (p = 0.451); the rate of intrusion of the utility arch was 0.44 mm/month, the K-SIR was 0.33 mm/month, and the RCS was 0.35 mm/month. When compared to the K-SIR value of 1.08 mm and the RCS value of 0.96 mm, the mean root resorption of the utility arch was much greater at 1.56 mm.
Conclusion: When compared to the K-SIR arch, the intrusion rate and root resorption are much higher for the utility arch. On the other hand, the root resorption is significantly lower for the K-SIR arch, despite the fact that the rate of intrusion is practically same.

Keywords: Biomechanics, Cepahlometrics, Deep bite, Root resorption

INTRODUCTION

When the jaw is brought into habitual or centric occlusion, a condition known as deep bite occurs. This condition is characterized by excessive vertical overlap of the mandibular incisors by the maxillary incisors. In most cases, incisor wear, palatal impingement, gingival recession, and impaired esthetics are the results of having a deep bite. This problem can be treated by flaring the anterior teeth or uprighting the posterior teeth, intrusion of the incisors, extrusion of the posterior teeth, or a combination of the two. Flaring the anterior teeth can also be used in conjunction with extrusion of the posterior teeth. When performed on individuals who are no longer developing, extrusion of the posterior teeth for the purpose of deep bite correction is not only more difficult, but also less stable than when it is performed on patients who still have substantial growth potential. 1 In addition, disorders

such as extended incisors that are accompanied by a gummy grin might respond better to treatment that involved invading the incisors. 2

There is a wide variety of techniques for performing an intrusion, including the Ricketts utility arch, K-SIR, RCS, J-headgear, implant, Connecticut intrusion arch, Burstone arch, three piece arch, vertical loops, and many others. An attempt is made in the current study to compare the rate of intrusion, root resorption, and effect on maxillary central incisors achieved by three different methods: the Ricketts utility arch, the K-SIR arch, and the RCS arch, all of which are commonly used in our day to day clinical practice. Since it is difficult to choose which method is superior, an attempt is made through the present study to compare these factors.

MATERIALS AND METHOD

The participants in the research ranged in age from 14 to 25 years, and there were a total of 30 of them. Each participant provided their signature on a permission form, and the Human Research Ethical Committee gave its go-ahead before the study began. The inclusion criteria required that the subjects have an intrusion of 2.0–4.0 mm of their maxillary incisors, have no history of trauma to their maxillary central incisors, have complete incisor root formation, have never been treated with orthodontics, have no growth remaining, and show an average growth pattern. Initial leveling and aligning had been finished for all of the topics.

All of the participants were assigned to one of three groups using a random number generator: Group I: Rickett's utility arch (0.017 0.025 TMA with cinch back and rectangular wire in the premolar and molar region), Group II: K-SIR arch (0.017 0.025 TMA with cinch back and rectangular wire in the premolar and molar region), and Group III: RCS arch (0.016 0.022 NiTi

After properly aligning the dental arches and just before beginning any intrusion mechanics, pre-treatment lateral cephalograms in the Natural Head Position3 (NHP) were obtained and analyzed. Post-treatment cephalograms in NHP were obtained just after the intrusion of maxillary incisors because, had the cephalograms been obtained after complete orthodontic treatment, a variety of other factors, particularly during detailing, would have had an effect on the maxillary incisors. This is why the post-treatment cephalograms were obtained just after the intrusion of maxillary incisors. It is common practice to provide additional tension to the incisors; however, doing so would have masked the actual impact that the incursion mechanics had. In order to analyze the skeletal and dental alterations that occurred both prior to and after incisor intrusion, seven angular and six linear cephalometric measurements were taken.

EVALUATION OF THE LEVEL OF ENCROACHMENT

For each individual patient, the length that extended from the incisal border of the upper incisor to the palatal plane of the maxilla was used to determine the amount of intrusion present.4 The profound overbite was corrected, and the results showed that the average length of the incursion was 4.32 0.7 months. The following formula was used to determine the rate of incisors breaking through the gums each month. 5

THE EVALUATION OF ROOT ABSORPTIVE SURFACE AREA

A accurate, long-cone radiography approach was utilized with the assistance of an XCP film holder in order to determine the degree of root resorption that had occurred. When the film was placed parallel to the tooth and the rays were placed perpendicular to the film, there was no evidence of either distortion or enlargement. 6

One radiograph was taken before the intrusion (but after alignment), and another was taken after the intrusion. Both radiographs were compared. Because of this, the resorption that was seen was restricted to the resorption that had place during the active incursion phase. In order to reduce the amount of radiation that the patient was subjected to during the intraoral radiography process, only the central and lateral incisors of the same quadrant were registered on the film.

The radiographs were evaluated using a view box, in which the cement–enamel junctions at the mesial or distal aspects of the tooth in the pre and post treatment IOPA were noted and projected perpendicularly on the tooth axis.7 We measured the total tooth length, the crown length (which was defined as the distance from the cementoenamel junction to the incisal edge), and the root length (which was defined as the distance from the cementoenamel junction to the apex of the root). 8 Although it was considered that the exact distance between the incisal margin and tooth apex and the created cementoenamel junction could not be assessed with adequate accuracy, it was not regarded feasible to accurately quantify the absolute quantities of root resorption.

THE DEPENDABILITY OF THE PROCEDURE

Within the context of the control group, the dependability of the intraoral radiographic measurement method was investigated. If there was no significant root resorption that took place (since there was no treatment and the examination time was brief), then there should be no change seen, and the measures should remain the same. In spite of this, the relation y1/y was computed for each of the control teeth using the method described before. The standard deviation was 0.08, and the mean was 0.99. The results of the t test revealed no statistically significant differences.

A statistical analysis was performed on the values that were observed making use of the statistical analysis software version 15.0 of SPSS (Statistical Package for the Social Sciences). The values were displayed using both numbers (percentages) and the Mean with Standard Deviation.

RESULTS

After treatment, statistically no significant difference among three groups under study was observed for any of the angular parameters except for ANB which was found to be significantly lower in Group I as compared to Groups II and III (Table 1).

Table 1: Comparison change in angular and linear parameters among different groups.

S.N.	Parameter	Group I (n = 10)		Group II (n = 10)		Group III (n = 10)		Significance of difference (ANOVA)	
		Mean	SD	Mean	SD	Mean	SD	F	P
Angular (in degrees)									
1	SNA	0.31	1.23	0.01	1.61	0.11	0.63	0.14	0.82
2	SNB	0.62	0.77	0.11	1.12	0.03	0.65	1.14	0.38
3	ANB	−0.12	1.11	−0.11	0.73	0.02	0.01	0.04	0.96
4	PP-SN	−0.31	2.23	0.42	2.64	0.42	0.85	0.42	0.61
5	Occl-SN	−0.42	3.34	0.31	4.41	3.01	6.45	1.32	0.23
6	Mp-SN	−0.51	2.23	0.42	1.43	−0.62	0.83	1.12	0.32
7	SN-U1	8.22	7.34	5.72	7.15	0.21	2.22	4.32	**0.04**
Linear (in mm)									
1.	S–N	0.01	0.01	0.01	0.01	0.01	0.01	–	–
2.	Overjet	1.82	0.91	1.62	0.72	0.81	1.03	3.51	**0.05**
3.	Overbite	1.73	0.72	1.32	0.72	1.52	0.81	0.74	0.53
4.	PP-U1	1.61	0.51	1.24	0.96	0.71	0.64	3.80	**0.05**
5.	PP-U6	0.01	0.93	0.21	1.01	−0.81	0.78	3.29	0.04
6.	UL-U1	−1.52	1.95	−0.21	1.46	−0.42	1.06	2.01	0.18

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Except for overjet, which was found to be significantly lower in Group II in comparison to Groups I and III (p = 0.008), and UL-U1, which was found to be significantly lower in Groups I and II in comparison to Group III (p = 0.011), there was no statistically significant difference between the three groups under study for any of the linear parameters that were studied (Table 1).

Except for the change in U1-SN, which was found to be substantially smaller in Group II in comparison to Groups I and III (p = 0.024), no significant differences in the mean changes in angular variables were identified across the four groups. On the other hand, a statistically significant divide was found between the groups with regard to the change in linear parameters for overjet and U1-PP. When compared to Groups I and II, the overjet correction and change in U1-PP observed in Group III were shown to be statistically substantially lower (p 0.05). In regard to other criteria, the differences between the groups did not seem to be statistically significant (Table 1).

Regarding the rate of incursion, there was not found to be a significant difference between the groups. Despite this, there were statistically significant differences between the groups when it came to the rate of root resorption (p = 0.006) (Table 2).

Table 2: Comparison of rate of intrusion and root resorption among different groups.

SN	Parameter	Group I (n = 10)		Group II (n = 10)		Group III (n = 10)		Significance of difference (ANOVA)	
		Mean	SD	Mean	SD	Mean	SD	F	P
1	Rate of intrusion (mm/month)	0.43	0.17	0.32	0.15	0.34	0.20	0.81	0.41
2	Root resorption (mm)	1.55	0.35	1.1	0.42	0.97	0.43	6.30	0.06

According to Table 3, the largest difference in terms of rate of intrusion was observed between Groups I and II, while the smallest difference was seen between Groups II and III. On the other hand, the largest difference in terms of root resorption was seen between Groups I and III, while the smallest difference was seen between Groups II and III. However, the only aspect of root resorption in which there were statistically significant variations between the groups was when comparing Groups I and II, as well as when comparing Groups I and III. When compared to Groups II and III, it was shown that Group I had a considerably greater overall mean root resorption. The following is a list of the order in which root resorption occurred in the various groups: Group I > Group II ≃ Group III

Table 3: Inter Group Comparison of Rate of intrusion and root resorption (Tukey HSD test).

SN	Comparison	Rate of intrusion			Root resorption		
		Mean diff.	SE	"P"	Mean diff.	SE	"P"
1.	Group I vs II	0.11	0.08	0.47	0.41	0.19	0.02
2.	Group I vs III	0.08	0.07	0.53	0.63	0.17	0.06
3.	Group II vs III	−0.07	0.06	0.99	0.12	0.19	0.77

Statistically significant difference observed only for root resorption for Groups I and II and for Group I and III.

DISCUSSION

According to the results of our research, the difference in intrusion achieved by utility arch and K-SIR was not statistically significant, however the difference in intrusion achieved by these two methods and RCS was statistically highly significant. The difference between the three rates was not statistically significant (p = 0.451): the rate of intrusion of the utility arch was 0.44 mm/month, the K-SIR was 0.33 mm/month, and the RCS was 0.35 mm/month. The rate of intrusion by utility arch that was achieved in our study is comparable to the results that Neslihan Ebru Senisik9 and Esen Aydogdua10 obtained when comparing the incisors intrusion using mini-implants and the utility arch, which were 0.31 mm/month and 0.25 mm/month respectively. Both of these researchers found that the utility arch achieved a faster rate of intrusion than the mini-implants did. According to the findings of Frank J. Weiland (1996)8, using a segmented arch approach for intrusion with low forces is preferable than using a continuous arch technique.

When compared to Groups I and II, the overjet correction and change in U1-PP observed in Group III were shown to be statistically substantially lower (p 0.05). It is reasonable to assume that no overjet correction has been made in group III (RCS), and that the leveling of the COS occurs more as a result of premolar extrusion than incisor intrusion 11. This is in contrast to the situation in groups I and II, where retraction was simultaneously taking place as a result of a tight cinch back.

It was discovered that Group I (utility arch) had a substantially greater mean root resorption of 1.56 mm when compared to Groups II (K-SIR) which had a value of 1.08 mm and Group III (RCS) which had a value of 0.96 mm. It says that the migration of the root towards the apex will result in an increase in the amount of root resorption. 12,13 It has also been noted that the further an apex has to travel through the bone before reaching its destination, the longer it will be in close contact to an inflammatory process, which may include osteoclastic activity. 12,14 The findings of this study provide credence to this theory because group I had the highest level of root resorption as well as the highest level of root incursion. Research carried out by Meha Verma (2010)12 and Goerigk B, Diedrich P, and Wehrbein H can also lend credence to this theory (1992). 15

However, Dermaut and Munck6 could not find any association between the amount of root resorption that occurred and the quantity of incursion that occurred or how long it lasted. They mentioned that in addition to the apical movement of the root, the nasal floor is also a limiting factor for incursion, and that this may have caused

root resorption. This was mentioned in the context of the previous sentence. In a similar vein, McFadden et al7 said that strong resorptive potential root shortening in a small number of individuals may also be regarded as incursion that has been achieved.

Studies conducted by De Shields, 16 Nelson and Artun17 and Harris18 have shown a correlation between change in axial inclination of incisors and root resorption. This correlation is also evident in our study, as group I (utility arch) showed the maximum change in SN-U1 of 8.6 degrees and also the maximum of mean root resorption of 1.56 millimeters. It is possible that the reason for this is due to the fact that the root will experience a larger amount of resorption after traveling a greater distance via the bone friction. 1 According to McFadden et al7, who conducted research on a variety of factors such as age, sex, facial type, treatment time, extraction versus nonextraction therapy, width of the symphysis, and the angle of the incisors to skeletal reference planes; for their relationship to intrusion and root shortening; using utility arches in the bioprogressive technique; they discovered that root shortening was 1.84 mm for maxillary inci

In the current study, uprighting of incisors was seen, and it occurred in conjunction with a reduction in angle SN-U1. This occurred most frequently with the utility arch, then with the K-SIR, and lastly with the RCS. When comparing the impacts of Burstone and Connecticut intrusion arches, Verma12 discovered that the incisors became erect throughout the process of intrusion. In the case of our research, we believe that the tight cinch back that was done helped to avoid the flaring of the incisors. 1 In spite of the fact that this was in contrast to earlier studies2, 8, 19 in which considerable intrusion was obtained with various intrusion methods such as Connecticut utility implant, a flaring of the upper incisors was always noted with utility arch and Connecticut intrusion arch.

Only patients with Class II Division1 malocclusion and criteria that were very thoroughly characterized were included in our study. The success that can be achieved with other groups of malocclusions, such as those that are defined by growth patterns, cannot be arbitrarily extrapolated from the outcomes that we have obtained. Further research is required to shed light on the connection between force, rate of incursion, and root resorption. This is because our sample size was quite small, and it is possible that the findings might have been different if we had used a larger sample size. The outcomes of this study appear to highlight the need of taking treatment time into consideration when assessing the likelihood that root shortening may occur. When therapy is allowed to continue for an extended period of time, significant root resorption occurs as a result of ongoing high degradative activity associated with osteoclasia. 7 When intrusion of the maxillary incisors is performed, controlling the amount of time spent in treatment is therefore quite important in the majority of instances.

CONCLUSION

We found that there was a statistically significant difference in the mean true incisor intrusion achieved with utility arch 1.6 mm, K-SIR 1.25 mm, and RCS 0.70 mm correspondingly ($p = 0.035$). This difference was noticed in the mean true incisor intrusion reached with utility arch 1.6 mm. There was no statistically significant difference in the rate of incursion between the three groups ($p = 0.451$), When compared to the K-SIR arch's 1.08 mm and the RCS arch's 0.96 mm, the mean root resorption of the Utility arch was much greater at 1.56 mm.

We come to the conclusion that the distance traveled by the root towards the apex has a direct bearing on the rate of root resorption. When compared to the K-SIR arch, the intrusion rate of the utility arch is almost same, but the root resorption is significantly lower. On the other hand, the intrusion rate of the utility arch is significantly higher.

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