

Comparison of Two Different Intrusion Techniques (An in Vitro Study)

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الخلاصة

الأهداف: ان الهدف من اجراء هذه الدراسة هو مقارنة تأثير تقنيتين مختلفتين على موضع القواطع العلوية خلال الحركة الانغراسية. **المواد وطرائق العمل:** عينة الدراسة تتكون من مجموعتين، تضم المجموعة الاولى القوس الانغراسي متعدد الاستعمالات، بينما تضم المجموعة الثانية القوس الانغراسي المستمر. تم استخدام القوس العلوي لمثلil الانسان التشاهي من نوع 1 CI II div. تم تحفيز الاقواس في كلا المجموعتين لتسلط قوة مقدارها ٦٠ غرام، تم اخذ صور رقمية لمثلil الانسان التشاهي قبل وبعد عملية انغراس الاسنان و من ثم تم تحليلها بواسطة برنامج Autodesk AutoCAD. تم قياس ومقارنة ستة متغيرات لكل مجموعة وتم تحديد مستوى المعنوية عند ٠.٠٥. **النتائج:** نتائج هذه الدراسة اظهرت وجود فرق معنوي في الموقع العمودي لنقطة منتصف الجذر المقدرة، وفي تغيير الميل المحوري، وفي الموقع الامامي الخلفي للحافة القاطعة، وفي المشاركة النسبية للعضم والبروز للتغير في الميل المحوري للقواطع العلوية، كما اظهرت ايضا وجود فرق غير معنوي للتغير في الموقع العمودي للحافة القاطعة. **الاستنتاجات:** باستخدام قوس الانغراس المستمر تم الحصول على انغراس حقيقي للقواطع العلوية مع اقل بروز ممكن.

ABSTRACT

Aims: This study was aimed to compare the effects of two different techniques on the position of maxillary incisors during the intrusive movement. **Materials and Methods:** The sample consisted of two groups, the utility intrusion arch and continuous intrusion arch groups. Upper typodont arch of class II division I was used and the arches were activated to deliver 60 gram of force. Pre and postoperative digital images were taken and analyzed using Autodesk AutoCAD software™. For each group six parameters were measured and compared. A significance value of 0.05 was predetermined. **Results:** Significant difference was found in vertical change of estimated midpoint of root position, axial inclination, anteroposterior position of incisal edge, relative contribution of torque and protrusion to the change in inclination and insignificant difference in vertical change of incisal edge position. **Conclusions:** Maxillary incisors intrusion with a minimal protrusion could be achieved with the continuous intrusion arch technique.

Keywords: Maxillary incisor, Intrusion, Utility intrusion arch, Continuous intrusion arch

Al-Jumaili KhA, Al-Soufy SS. Comparison of Two Different Intrusion Techniques (An in Vitro Study). *Al-Rafidain Dent J.* 2013; 13(3): 442-449.

Received: 18/6/2012

Sent to Referees: 20/6/2012

Accepted for Publication: 17/7/2012

INTRODUCTION

Deep overbite is one of the most common malocclusion seen in children as well as adults that can occur along with other associated malocclusions.⁽¹⁾ There are various classifications for deep overbite according to the associated etiological factors, deep bite can be divided into two groups, developmental and acquired deep overbite.^(2, 3)

Treatment techniques include labial tipping of anterior teeth, extrusion of posterior teeth, intrusion of anterior teeth, distal tipping of posterior teeth and surgical approaches.^(4,5,28) The decision must be based on the patient's age, etiology of the anomaly, skeletal and dental morphology,

surrounding muscular and periodontal tissues, existence of the deep bite in the rest position, length of lips, occlusal plane, ideal incisor position and the lower facial height.^(6- 8) The intrusion of anterior teeth may be very useful in correcting a deep overbite. In patients with excessive maxillary incisor display, intrusion of the maxillary anterior teeth will not only improve esthetics but also help in the correction of the deep overbite.⁽²¹⁾ Other advantages of intrusive mechanics include good control of the vertical dimension.⁽⁹⁾ Several mechanics have been described for incisor intrusion J-Hook headgears, functional appliances, anterior bite-planes, Begg mechanics, Edgewise mechanics, three piece

base-arch, Connecticut intrusion arch, Utility intrusion arch, and Continuous intrusion arch can be used.^(4,9-12)

The purpose of this study is to examine and compare dental positional changes obtained by utility intrusion arch (UIA) and continuous intrusion arch (CoIA).

MATERIALS AND METHODS

The sample of this prospective study was composed of 2 groups, utility intrusion arch and continuous intrusion arch groups.

A. Preparation of Typodont models

Two typodont model of C1 II div.1 type were used, metal teeth were set up in a reverse curve of spee and deepbite of 4 mm. Preadjusted Roth stainless steel brackets of 0.022"x0.030" slot dimensions (Lancer Orthodontics, San Diego, USA) were bonded to the upper incisor and canine by Epoxy steel adhesive (Zhangzhou Yst Bond Material Co., Ltd., Fujian, China) with the aids of bracket positioning gauge to ensure greater vertical accuracy.⁽¹⁷⁾ Preadjusted Roth stainless steel bands of the upper first molars with 0.022" x 0.030" slot dimensions were cemented by zinc phosphate cement in 3 steps.⁽¹⁸⁾ Three acrylic bite planes was constructed from chemical cure acrylic resin, anterior bite plane was used to reposition the maxillary incisor to its original position after each trial, posterior bite plane was used to prevent mobilization of anchorage teeth during experimental intrusion and acrylic labial plate was used to restore wax contour around the roots of the four maxillary incisor and help in restoring anteroposterior position of incisors. Three reference bars were used, central incisor, horizontal reference bars and vertical reference bar. Central incisor reference bar (CRB) is representing the estimated longitudinal axis of the right maxillary central incisor. The distance between the upper end of this reference bar and the estimated mid-point of the root (EMR) and root apex was measured and equal to 26.50, 34.50 millimeter consecutively and it remained constant. This bar was used to locate the position of (EMR) and root apex as shown in Figure (1). The horizontal reference bar (HRB) is

Once the positions of the incisal edge, (EMR) and root apex were determined in

representing the zero position to which the upper incisor must be repositioned after each experimental trial. The vertical reference bar (VRB) is a metallic ruler attached to the wood table as shown in Figure (1). It aids in repositioning of maxillary incisors in sagittal plane after each experiment and helps in standardization of pre and postoperative image analyzed by Autodesk AutoCAD© software.

B. Preparation of laboratorial Environments

Specially designed wood table of (13x30 cm) in dimension to which a metal base of typodont articulator was attached. A standard distance of (10 cm) was maintained between the digital camera and the ruler Figure (2).

C. Standardization of the tools

Anterior bite plane and acrylic labial plate were used to reposition the teeth to their original position (Zero position). A standard distance of 7.15 ± 0.1 , 4.35 ± 0.1 mm is measured respectively between the labial surface of the right maxillary central incisor, the upper end of reference bar and the anterior margin of the ruler.

Pre and Post-intrusion image analysis

Pre and post-intrusion images for all experimental trials is analyzed by Autodesk AutoCAD© software. All images were standardized (scaled) in such a way that the distance of 10 mm on the image was equal to a distance of 10 mm on the ruler. The linear measurements on the image were equal to the real measurements in the same plane of the ruler. Digital images analyses were made by drawing three lines:

- 1.The horizontal line was drawn over the horizontal reference bar (HRB).
- 2.The vertical line was drawn from the point of intersection between horizontal and vertical bars and extends down vertically.
- 3.The long axis line was drawn over the central incisor reference bar (CRB) with a constant length (34.50mm), the end of this line was considered the apex of the root and the estimated midpoint of the root (EMR) was localized on this line (26.50mm) from the superior end of the (CRB).

the before intrusion images (BIIs), the position of those points were expressed in

(X, Y) coordinates, and these coordinates were transferred to the after intrusion images (AIIs) and used to locate incisal edge and root apex positions of the maxillary

central incisor prior to intrusion. Two landmarks were located on the BIIs and AIIs and six parameters were measured as shown in Figure (3).

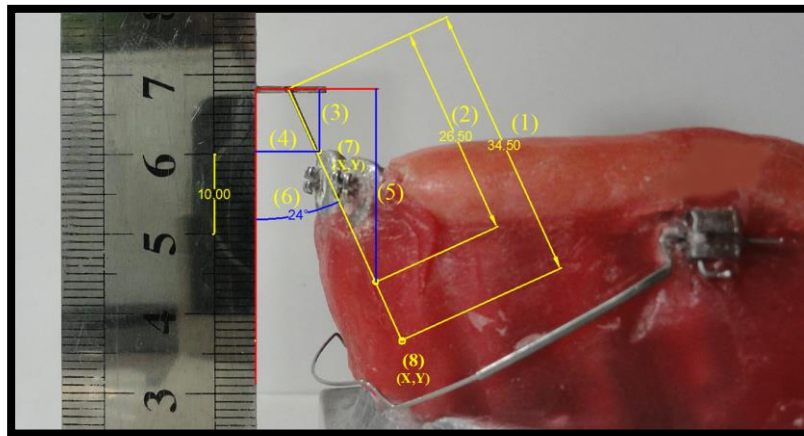


Figure (3): Digital photograph analysis by Autodesk AutoCAD[®] software: 1) Long axis line indicates tooth position before intrusion 2) Distance between EMR and superior end of CRB. 3) Distance between incisal edge and horizontal line (vertical change of incisal edge position). 4) Distance between incisal edge and vertical line (sagittal change of incisal edge position) 5) Distance between EMR and horizontal line (vertical change of EMR) 6) Axial inclination 7) Coordinates of incisal edge position (change in the incisal edge position during intrusion used for calculation of protrusion contribution to the change in the inclination)¹⁹ 8) Coordinates of root apex position (change in the root apex position during intrusion used for calculation of torque contribution to the change in the inclination)¹⁹.

(UIAs) Figure (4) (Adjustable Utility Archwires, OrthoOrganizers, Carlsba, USA) were activated by placing 45° tip back to the molar section, and the arch was cinched back.^(13,20) The (UIA) was adjusted

to deliver 60 gram of intrusive force measured at level of incisor brackets slots. (CoIAs) Figure (5) were fabricated according to Burstone description.^(14,15)

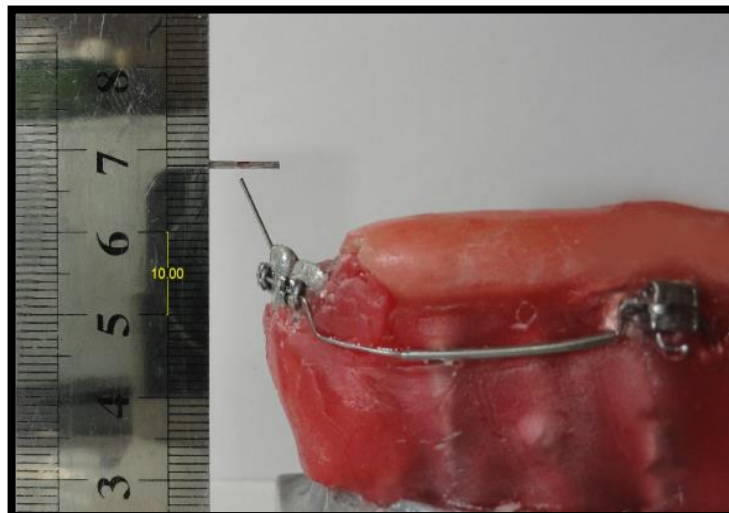


Figure (4): Utility intrusion arch

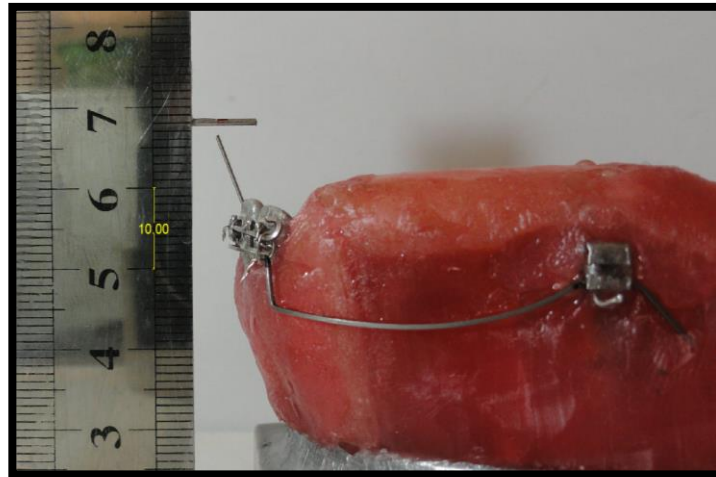


Figure (5): Continuous intrusion arch

A specially designed template was used for the construction of the arches.⁽²⁷⁾ The appliance consisted of a .017" x .025" TMA base arch from the auxiliary tube of first molar to first molar. Activation was done by placing a bend in the wire mesial to the molar⁽¹⁶⁾. The active intrusion arch was tied to a rigid anterior segmental wire (0.019"x0.025 stainless steel") at one point distal to the distal wing of the lateral incisor bracket on each side and cinched back at the molar.⁽⁹⁾ The base arch was adjusted to deliver 60 gram of intrusive force measured at the level just above the incisor brackets slots.

Statistical Analysis

Statistical analyses were performed using the SPSS V13 (SPSS Inc., Chicago, Ill. USA) statistical program. To check reliability of the method, Intra-examiner and inter-examiner calibration were carried out and there were no significant differences between intra-examiner and inter-examiner calibration at the level of

$p < 0.05$. The data were tested for their normal distribution by using the Shapiro-Wilks test. According to the results of this test, an independent t test was used for the evaluation of changes between the two groups. A significance value of 0.05 was predetermined.

RESULTS

Table (1) shows the descriptive statistic of the parameters measured for (UIA) group and for (CoIA) group. The vertical change in the incisal edge position of the upper incisor was 1.39 ± 0.38 mm for (UIA) group and 1.43 ± 0.25 mm for (CoIA) group and the difference between the two groups was insignificant at ($P < 0.05$). The vertical change in the position of (EMR) was 0.96 ± 0.30 mm for (UIA) group and 1.25 ± 0.22 mm for (CoIA) group and the difference between the two groups was significant at ($P < 0.05$).

Table (1): Descriptive statistic of the parameters measured in the study

Group	Variable	Mean	±SD	Minimum	Maximum
Continuous intrusion arch	Vertical change of EMR position (mm)	1.25	0.22	0.86	1.65
	Axial inclination change °	1.20	1.03	0.00	3.0
	Vertical change of incisal edge position (mm)	1.43	0.25	1.00	1.73
	Anteroposterior change of incisal edge position (mm)	0.31	0.20	0.11	0.76
	Relative contribution of torque to change in the axial inclination (%)	45.74	3.20	38.99	49.80
	Relative contribution of protrusion to change in the axial inclination (%)	54.25	3.20	50.20	61.01
Utility intrusion arch	Vertical change of EMR position (mm)	0.96	0.30	0.60	1.57
	Axial inclination change °	3.30	1.33	2.00	6.00
	Vertical change of incisal edge position (mm)	1.39	0.38	0.80	1.83
	Anteroposterior change of incisal edge position (mm)	0.92	0.67	0.10	2.13
	Relative contribution of torque to change in the axial inclination (%)	37.50	4.33	32.56	43.32
	Relative contribution of protrusion to change in the axial inclination (%)	62.59	4.24	56.68	67.44

(mm)= millimeter, (°)= degree, (%)= percent

Protrusion is expressed in anteroposterior change of incisal edge position of upper incisors, It was 0.92±0.67 mm for (UIA) group and 0.31±0.20 mm for (CoIA) group and the difference between the two groups was significant at ($P<0.05$). The relative contribution of torque to the change of inclination of upper incisor was 37.50±4.33 % for (UIA)

group and 45.74±3.20 % for (CoIA) group and the difference between the two groups was significant at ($P<0.05$). The relative contribution of protrusion to the change of inclination of upper incisor was 62.59±4.24 % for (UIA) group and 54.25±3.20 % for (CoIA) group and the difference between the two groups was significant at ($P<0.05$).

Table (2): Comparison of the differences between groups

Variable	Group	Mean	±SD	T - value	P - value
Vertical change of EMR position (mm)	utility intrusion arch	0.96	0.30	2.414	0.027†
	Continuous intrusion arch	1.25	0.22		
Axial inclination change °	utility intrusion arch	3.30	1.33	3.930	0.001†
	Continuous intrusion arch	1.20	1.03		
Vertical change of incisal edge position (mm)	utility intrusion arch	1.39	0.38	0.310	0.760
	Continuous intrusion arch	1.43	0.25		
Anteroposterior change of incisal edge position (mm)	utility intrusion arch	0.92	0.67	2.725	0.020†
	Continuous intrusion arch	0.31	0.20		
Relative contribution of torque to change in the axial inclination (%)	utility intrusion arch	37.50	4.33	4.836	0.001†
	Continuous intrusion arch	45.74	3.20		
Relative contribution of protrusion to change in the axial inclination (%)	utility intrusion arch	62.59	4.24	4.959	0.001†
	Continuous intrusion arch	54.25	3.20		

† P<0.05, (mm)= millimeter, (°)= degree

DISCUSSION

Deep bite is one of the most common malocclusion seen in dental clinic and it is the most difficult to be treated successfully with a minimal tendency for relapse. The history of orthodontics reveals the wide variety of methods developed to correct deep overbite. In this study we compared the dental positional changes created by two different intrusion arches. The maxillary incisors were intruded, protruded and tipped labially with both arch wires. These findings are in accordance with many authors⁽²²⁻²⁴⁾ The maxillary incisors were relatively intruded (vertical change in the incisal edge position) by 1.43±0.25 mm

with (CoIA) and 1.39±0.38 mm with (UIA). Various studies have reported intrusion rates from 1 to 3mm with different intrusion mechanics.^(22, 25, 26)

The true intrusion rates ranged from 0.60 to 1.65 mm. In this study, when additional measurements were made from the (EMR) of the central incisor to estimate the true intrusion, the mean amounts of true intrusion (movement of the EMR) were 1.25 mm for the (CoIA) group and 0.96 mm for the (UIA) group, and the differences between the groups were significant. The amounts of incisor intrusion in this study were close to the values obtained by Polat-Özsoy⁽²⁰⁾ and Weiland

et al.⁽²⁶⁾ The maxillary incisor were tipped labially and protruded by 3.30°, 0.92 mm consecutively in the (UIA) group, and by 1.20°, 0.31 mm in the (CoIA) group, and the difference between the 2 groups was significant. This significant difference between the 2 group is attributed to the difference in the location of the line of vertical force created for incisor intrusion. The utility arch is inserted directly into the edgewise slots of the incisor brackets and, therefore the line of force of the utility arch will be facial to the center of resistance of the upper incisor, with a tendency present for crown facial/root lingual rotation. In contrast, a continuous force to be applied closer to the center of resistance of upper intrusion arch is tied to the incisor segmental arch wire directly distal to the distal wing of lateral incisor bracket that allows the line of incisor, thus decreasing the moment generated that tends to flare the incisors. .

The relative contribution of protrusion to the change of axial inclination of upper incisor for (UIA) group was higher than that of (CoIA) group and this may be attributed to the nature of their attachment at the upper incisor, A utility arch, by inserting directly into the incisor brackets, will usually create a third-order couple at the incisors and a two-couple indeterminate force system, and this couple is created as the inclination of the wire is changed when it is brought to the brackets. While continuous intrusion arch is tied to the incisor segmental arch wire as a point contact creating one couple determinate forces system.

The clinical relevance of this experiment, as well as most in vitro investigations, cannot be drawn without skepticism. The typodont simulation system has a limited ability to take in account some factors that have additional influence in practice, such as intraoral aging and saliva.

CONCLUSIONS

The results of this study showed that intrusion of the maxillary incisors with (CoIA) was superior to that obtained by (UIA) in that true intrusion with minimal protrusion could be achieved. Also (UIA) was successful in reducing over bite by

intruding upper incisor to certain limit but more by altering the axial inclination of the maxillary incisor. Further in vitro study regarding the extrusion of molar as a result of the use of these intrusion mechanics is suggested.

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