

## THREE-DIMENSIONAL EVALUATION OF TWO INTRUSIVE MODALITIES IN TREATMENT OF DEEP BITE CASES ACCOMPANIED WITH GUMMY SMILE (RANDOMIZED CONTROLLED TRIAL)

Mohamed A. Abd El Badea<sup>1</sup>, Ahmed N. Abd Elhameed<sup>2</sup> and Wael M. Refai<sup>3</sup>

### Abstract

**Objective:** To evaluate the efficiency and side effects of intrusion arch versus miniscrew-supported intrusive arch in treatment of deep bite cases accompanied with gummy smile. **Subjects and methods:** The study samples included forty patients selected from the outpatient clinic of the Department of Orthodontics, Faculty of Dentistry, Minya University. Forty adult patients (11 males and 29 females) were non-growing patients with Average age from 18-25 years old with increased gingival show during smiling and excessive overbite diagnosed by clinical examination. All diagnostic and radiographic records were completed and the patients were divided into two groups with 20 subjects in each group. Group A was treated with traditional intrusive arch and group B was treated with intrusive arch supported on two miniscrews placed buccally between the second bicuspid and the first molar bilaterally. **Results:** Intrusion in upper incisors occurred by 0.95 to 1.53 mm in group A and 1.96 to 2.34 mm in group B and the amount of produced inclination during intrusion was greater in group A than group B. The amount of external apical root resorption was mild in both group with less values in group A than group B. **Conclusion:** Both modalities successfully intrude the upper anterior teeth but more inclination changes was observed in group A than group B and insignificant root resorption was observed in both groups.

**Key words:** Incisor intrusion, Intrusive arch, Deep bite treatment, Gummy smile

### Introduction

Excessive overlapping of the lower incisors by the upper ones is termed deep overbite<sup>1</sup>. This condition is associated with many negative effects on the periodontium, temporomandibular joint and the esthetic appearance of the patient<sup>2</sup>. So, treatment of deep bite is very important to maintain the periodontal integrity and enhance the facial appearance of the patient. Between 21% and 26% of the general population and around 75% of orthodontic patients were found to have profound overbite<sup>2</sup>.

Treatment of deep bite can be accomplished by posterior teeth extrusion, anterior teeth intrusion or combination of both<sup>3,4</sup>. Intrusion of the anterior segment was considered the most effective and stable treatment option in adults<sup>5</sup>.

In cases of deep bite accompanied with excessive incisal show (gummy smile), the incisor intrusion produces a suitable treatment option for deep bite and in the same time will reduce the gummy smile of the patients<sup>6</sup>. The anterior segment intrusion can be performed by various mechanisms. The J-hook head gear can

<sup>1</sup> Candidate in department of orthodontics, Faculty of Dentistry, Minia University.

<sup>2</sup> Lecturer in department of orthodontics, Faculty of Dentistry, Minia University.

<sup>3</sup> Professor and head of orthodontic department, Faculty of Dentistry, Minia University.

produce intrusion but need patient cooperation and the intrusion arch is more accepted by the patients but it produces some side effects in the form of posterior teeth extrusion and the anterior teeth proclination<sup>7</sup>.

The utility arch fabricated from stainless steel were found to exert more force than intrusive arch made of TMA wire<sup>8,9</sup>. The absolute anchorage produced by temporary anchorage devices provided more treatment options for different orthodontic situations that require anchorage reinforcement to minimize the undesirable side effects<sup>10</sup>. However, additional costs, patient acceptance, and screw looseness during therapy may limit their utilisation<sup>11</sup>.

This study was conducted to investigate the effect of using the miniscrews to support the intrusion arch during intrusion of the anterior teeth and to compare between the traditional intrusive arch and miniscrews supported intrusive arch.

## **Subject and Methods**

### **Study design**

A double blinded randomized control clinical trial was established to evaluate the efficiency and side effects of intrusion arch versus miniscrew-supported intrusion arch in treatment of deep bite cases accompanied with gummy smile.

### **Ethical regulation:**

This study was approved by the Research Ethics Committee of the Faculty of Dentistry, Minya University. (ID number 484 / 2021)

### **Sample size:**

The software "SAMPSIZE" was used to identify this study's sample size as a superiority randomized clinical trial. taking the risk of patient withdrawal into account, 40 patients (20 in each group) were recruited for this study (the predicted size of the sample was 11)

Forty patients selected from the outpatient clinic of the Department of Orthodontics, Faculty of Dentistry, Minya University. Forty adult patients (11 males and 29 females) were non-growing patients with average age from 18-25 years old with increased gingival show during smiling and excessive overbite diagnosed by clinical examination.

The case history and clinical examination was conducted for each patient and all diagnostic and radiographic records were completed. The study was revised and accepted by the ethics committee of Minya University and an informed consent was taken from all patients after clear explanation of the study procedures and possible side effects.

The patients were divided into two groups:

- **Group A: 20 patients were treated with traditional intrusive arch**
- **Group B: 20 patients were treated with intrusive arch supported on two miniscrews placed buccally between the second bicuspid and the first molar bilaterally.**

All permanent teeth were received brackets (Mini-master Roth with 0.022×0.028 slot) and buccal tubes in first and

second molars and from the beginning of the treatment the upper incisors were ligated together and the main arch wire was cut distal to the canine or the lateral incisor bilaterally (segmental mechanics).

Alignment was done up to 0.019 0.025-inch stainless steel arch wire in both arches.

In group A: an intrusion arch (made of 16×22 TMA wire) was fitted in the accessory tube of the upper first molar and activated by bending mesial to the buccal tube to produce force of 60-80gm calibrated using force gauge.



**Figure 1: maxillary incisors intrusion using intrusive arch at the beginning of treatment**

In group B: an intrusive arch (made of 16×22 TMA wire) was fitted in the holes of two miniscrews placed between upper second premolar and first molar on each side.

Korean titanium mini-screws (MCT Bio) were inserted in interradicular areas perpendicular to the bone surface and midpoint

between the roots of upper second premolar and first molar in both sides. A mini-screw with 8 mm length and 1.6mm head diameter was used for each patient in group B. The intrusive arch was activated by the same manner using the same force gauge to produce 60-80 gm force for intrusion.



**Figure 2: maxillary incisors intrusion using miniscrews supported intrusive arch at the beginning of treatment**

Before activation of the intrusion arch, three dimensional images of CBCT were taken for all patients. Every four weeks, follow-up visits were conducted and at each follow-up appointment, the stability of the mini-screw

was checked. If mini-screw failure was noted, the intrusion was paused and after a week, the mini-screw was reinserted and intrusion was reactivated. After three months of activation, the intrusion was terminated.



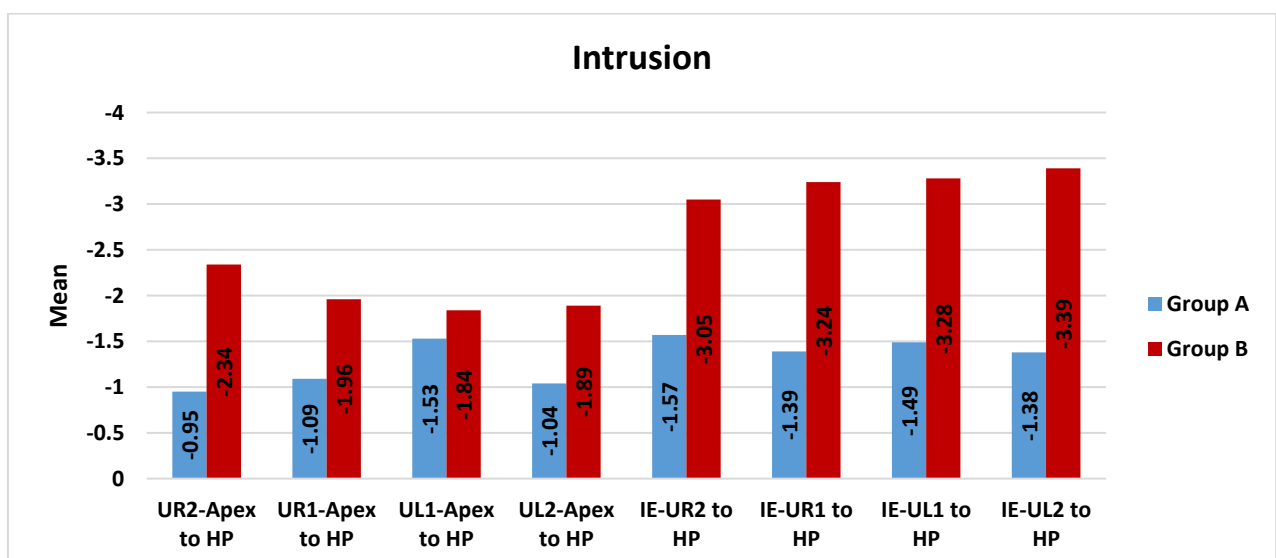
**Figure 3: intrusion of upper incisors using (right) miniscrews supported intrusive arch and (left) intrusive arch**

The patients were sent to the same center of radiology to obtain the last cone beam imaging three months after the intrusion. Regardless of whether total intrusion was

achieved or not. And the amount of intrusion, root resorption and upper incisors inclination differences were measured for each group.

## Results

- Regarding intrusion of upper incisors in both groups, no significant difference between two groups was found.



**Figure 4: Bar chart showing mean difference between pre and post intrusion measurements in both groups.**

- Concerning the length of upper incisors in both groups, nonsignificant difference between two groups was found except L of UL2 in group A was significantly higher than group B.

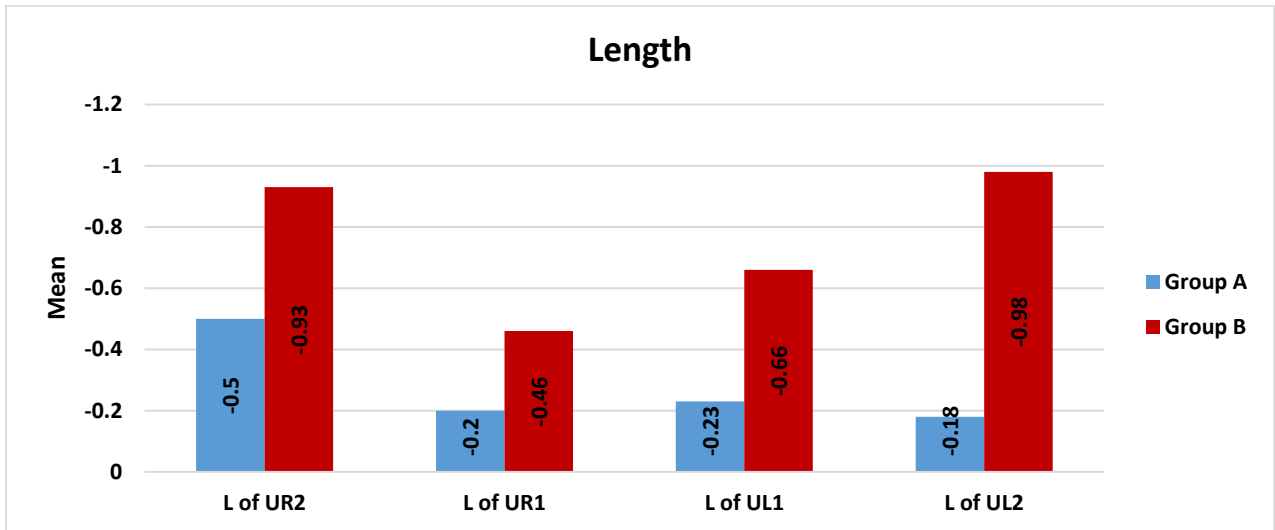


Figure 5: Bar chart showing mean difference between pre and post length measurements in both groups.

- Viewing the inclination of upper incisors in both groups, nonsignificant difference between two groups was found.

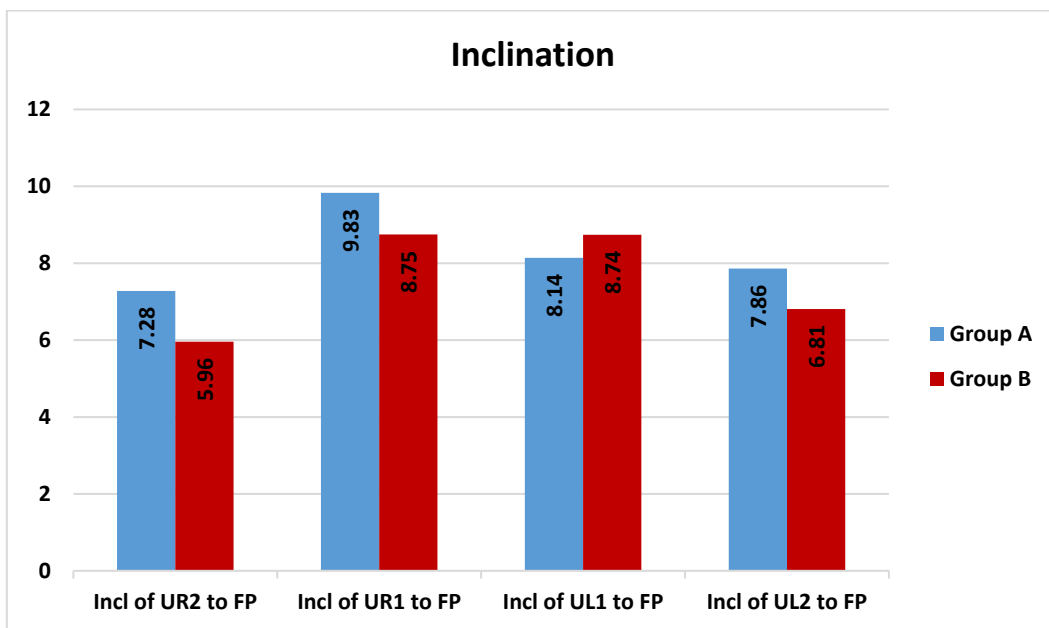


Figure 6: Bar chart showing mean difference between pre and post inclination measurements in both groups.

Measurements of UR1-Apex to HP, UL1-Apex to HP, UR2-Apex to HP, UL2-Apex to HP, IE-UR1 to HP, IE-UL1 to HP, IE-UR2 to HP, and IE-UL2 to HP were all substantially lower in Group A than in Group B indicating that group A (conventional intrusion arch) has a lower intrusion rate than group B (intrusion arch, which is supported by miniscrews). Inclination of UR1 to FP, Inclination of UL1 to FP, Inclination of UR2 to FP, and Inclination of UL2 to FP observations from group A were substantially greater than those from group B indicating that group A (conventional intrusion arch) has an upper incisor inclination that is higher than group B (intrusion arch supported by miniscrews).

### **Discussion**

Deep bite is one of the difficult multifactorial orthodontic malocclusions that need special consideration in diagnosis and treatment planning. In adult patients, the intrusion of the upper anterior teeth is the most suitable treatment when the patient suffers from gummy smile<sup>6</sup>.

In recent studies, several force ranges between 40 and 100 g have been employed<sup>12,13,14</sup>. The intrusion force must be applied at the center of resistance of the upper incisors which is located 5 to 7 mm distal to the lateral incisors to reduce this possible side effects<sup>14, 15</sup>.

Olmes S found that TADs are more effective than Connecticut intrusive arch in treatment of overbite but can produce more root resorption<sup>17</sup>. Sifakakis I et al concluded that The Burstone TMA 0.017 0.025 intrusion

arch produces the lowest force during incisor intrusion and the moment produced at the sagittal plan was very low<sup>9</sup>. Polat-Ozay O et al found less adverse effects produced on the posterior teeth after miniscrew application for incisors intrusion<sup>11</sup>. Kumar P et al found that the miniscrews with dimension of 1.3 mm in diameter and 7 mm in length offered satisfactory anchorage for the intrusion of the maxillary incisors<sup>15</sup>. Alam F et al concluded that both and burstone intrusion arch produced effective intrusion when appropriate force was applied with less root resorption found after intrusion with the miniscrews<sup>18</sup>.

In this study we compared the intrusive effective of the traditional intrusive arch made of 16.22 TMA wire in group A with the same intrusive arch supported on miniscrews in group B. Patients that met the inclusion criteria and suffered from deep bite with anterior gummy smile were collected for the study and divided into two groups. We compared the traditional anchorage from the posterior teeth in group A with the skeletal anchorage in group B. CBCT gives the chance to measure these changes more accurately and in 3 dimensions<sup>19</sup>.

The main arch wire was cut into one anterior and two posterior parts before intrusion<sup>20</sup>. The anterior region was ligated by steel ligature before intrusion and the activation of the intrusion arches was by ligation as close as to the Centre of resistance as described by Lindauer and Isaacson who described the effects of the point of the force application on intrusion and teeth flaring according to the distance from the Centre of

resistance of the anterior teeth<sup>21</sup>. Force gauge was used to measure 60-80 mg intrusion force for the upper anterior teeth and the intrusive arches were ligated near the Centre of resistance of the anterior region<sup>16</sup>.

The average intrusion rate in the former studies was 2.4 to 4mm while in this study the intrusion rate was 0.95 to 1.53mm in group A and 1.96 to 2.34mm in group B and the deep bite were corrected in both groups. We found that the amount of intrusion in group A measured from the root apex to the horizontal plane was 1.09 mm and 1.53 mm in UR1 and UL1 respectively and 0.95 mm and 1.04mm in UL2 and UR2 which means that the amount of intrusion was greater in the central incisors than the laterals. In group B, the amount of intrusion of UR2, UR1, UL1 and UL2 was 2.34mm, 1.96mm, 1.84mm and 1.89mm respectively. The average movement of the root apex to horizontal plane was greater when compared with the previous studies (Ozsoy et al)<sup>11</sup>.

In the sagittal plane, the amount of inclination of the incisors in relation to Frankfort plane was greater in group A (8.2 degree) than group B (7.5 degree). the results were greater than obtained by Ozsoy et al<sup>11</sup> and Degushi et al<sup>7</sup> but less than the results found by Parker et al and Kinzel et al who found higher results of inclination after maxillary incisor intrusion (about 13 degree)<sup>22,23</sup> using traditional ways. The differences in inclination between studies was related to the various mechanics used. The produced proclination may be useful in cases suffering from deep bite

and gummy smile combined with retroclined upper incisors.

Heavy force will not increase the rate of intrusion but will raise the hazards of EARR<sup>24</sup> so in this study light force (60-88 mg) was used to produce the required amount of intrusion with minimum effect on root resorption.

Root resorption following intrusion was observed by McFadden et al et al and Upadhyay et al<sup>24,25</sup> On the other hand, Costipoulos and Nanda concluded that intrusion using light force can be beneficial in correcting deep bite without leading to considerable root resorption<sup>26</sup>. It was found that the total amount of resorption ranged from 0.2mm to 0.5mm in group A and from 0.46mm to 0.93mm in group B. The amount of resorption ranged from just blunting to shortening by less than 1mm in both groups and less amount of EARR was found in group A than Group B. Group A (intrusion arch) experienced less intrusion than group B (miniscrew supported intrusive arch) and inclination values in group (A) was larger than that found in group (B).

### Conclusion

- 1- **The amount of intrusion using miniscrews supported intrusion arch was greater than the amount produced by traditional intrusion arch**
- 2- **The amount of produced inclination during intrusion was greater in group A than group B.**
- 3- **The amount external apical of root resorption was mild in both group**

**with less values in group A than  
group B.**

### **References**

1. Bergersen E. A longitudinal study of anterior vertical overbite from eight to twenty years of age. *Angle Orthod.* 1988; 58(3):237-256.
2. Proffit W, Fields HJ, Moray LJ. Prevalence of malocclusion and orthodontic treatment need in the US. *Int J Adult Orthodon Orthognath Surg.* 1998; 13:97-106.
3. Otto RL, Anholm JM, Engel G a. A comparative analysis of intrusion of incisor teeth achieved in adults and children according to facial type. *Am J Orthod.* 1980; 77:437-446.
4. Helling E. Increased overbite and craniomandibular disorders. a clinical approach. *Am J Orthod Dentofac Orthop.* 1990; 98:516-522. [https://doi.org/10.1016/0889-5406\(90\)70018-8](https://doi.org/10.1016/0889-5406(90)70018-8)
5. Burstone CR. Deep overbite correction by intrusion. *Am J Orthod.* 1977; 72(1):1-22. [https://doi.org/10.1016/0002-9416\(77\)90121-X](https://doi.org/10.1016/0002-9416(77)90121-X)
6. Ng J, Major PW, Heo G, Flores-Mir C. True incisor intrusion attained during orthodontic treatment: A systematic review and meta-analysis. *Am J Orthod Dentofac Orthop.* 2005; 128:212-219.
7. Deguchi T, Murakami T, Kuroda S, Yabuuchi T, Kamioka H, Takano-Yamamoto T. Comparison of the intrusion effects on the maxillary incisors between implant anchorage and J-hook headgear. *Am J Orthod Dentofac Orthop.* 2008; 133:654-660.
8. Lewis P. Correction of deep overbite: a report of three cases. *Am J Orthod Dentofac Orthop.* 1987; 91:342-345.
9. Sifakakis I, Pandis N, Makou M, Eliades T, Christoph B. Forces and moments generated with various incisor intrusion systems on maxillary and mandibular anterior teeth. *Angle Orthod.* 2009; 79:928-933.
10. Ohnishi H, Yagi T, Yasuda Y, Takada K. A mini-implant for orthodontic anchorage in a deep overbite case. *Angle Orthod.* 2005; 75:444-452.
11. Polat-Ozsoy O, Arman-Ozcirpici A, Veziroglu F. Miniscrews for upper incisor intrusion. *Eur J Orthod.* 2009; 31:412-416.
12. Janzen E. A balanced smile is a most important treatment objective. *Am J Orthod.* 1977; 72:359-372. [https://doi.org/10.1016/0002-9416\(77\)90349-9](https://doi.org/10.1016/0002-9416(77)90349-9)
13. Kinzel J, Aberschek P, Mischak I, Droschl H. Study of the extent of torque, protrusion and intrusion of the incisors in the context of Class II, division 2 treatment in adults. *J Orofac Orthop.* 2002 Jul;63(4):283-99. English, German. doi: 10.1007/s00056-002-0109-2. PMID: 12198744.
13. Polat-Özsoy Ö, Arman-Özçirpici A, Veziroğlu F, Çetinşahin A. Comparison of the intrusive effects of miniscrews and utility arches. *American journal of orthodontics and dentofacial orthopedics.* 2011 Apr 1;139(4):526-32.
14. Van Steenberg E, Burstone CJ, Prahl-Andersen B, Aartman IH a. The influence of force magnitude on intrusion of the maxillary segment. *Angle Orthod.* 2005; 75(5):723-



- 729.14. Wong RWK, Alkhal H a., Rabie a. BM. Use of cervical vertebral maturation to determine skeletal age. *Am J Orthod Dentofac Orthop.* 2009; 136(4): 484.e6.
- 15.Kumar P, Datana S, Londhe SM, Kadu A. Rate of intrusion of maxillary incisors in Class II Div 1 malocclusion using skeletal anchorage device and Connecticut intrusion arch. *medical journal armed forces india.* 2017 Jan 1;73(1):65-73.
- 16.Matsui S, Caputo a. a., Chaconas SJ, Kiyomura H. Center of resistance of anterior arch segment. *Am J Orthod Dentofac Orthop.* 2000; 118:171-178.
- 17.Olmez S, Aras I, Comparison of treatment effects of two intrusive mechanics. *Turki ye Klinik leri J Den tal Sci* 2016;22(3):195-201
- 18-Alam F, Chauhan AK, Sharma A, Verma S, Raj Y. Comparative cone-beam computed tomographic evaluation of maxillary incisor intrusion and associated root resorption: Intrusion arch vs mini-implants. *Am J Orthod Dentofacial Orthop.* 2023 Mar;163(3): e84-e92. doi: 10.1016/j.ajodo.2022.12.007. Epub 2023 Jan 11. PMID: 36635144.
- 19- Kau CH, Richmond S, Palomo JM, Hans MG. Current products and practice: three-dimensional cone beam computerized tomography in orthodontics. *Journal of orthodontics.* 2005 Dec 1;32(4):282-93.
- 20.Weiland F, Bantleon H, Droschl H. Evaluation of continuous arch and segmented arch leveling techniques in adult patients--a clinical study. *Am J Orthod Dentofac Orthop.* 1996; 110(6):647-652.
21. Isaacson RJ, Lindauer SJ, Davidovitch M. On tooth movement. *Angle Orthod.* 1993 Winter;63(4):305-9. doi: 10.1043/0003-3219(1993)063<0305: OTM>2.0.CO;2. PMID: 8297056.
- 22.Kinzel J, Aberschek P, Mischak I, Droschl H. Study of the extent of torque, protrusion and intrusion of the incisors in the context of Class II, division 2 treatment in adults. *J Orofac Orthop.* 2002; 63(4):283-299.
- 23.Parker RJ, Harris EF. Directions of orthodontic tooth movements associated with external apical root resorption of the maxillary central incisor. *Am J Orthod Dentofacial Orthop.* 1998 Dec;114(6):677-83. doi: 10.1016/s0889-5406(98)70200-8. PMID: 9844208.
- 24.McFadden WM, Engstrom C, Engstrom H, Anholm JM. A study of the relationship between incisor intrusion and root shortening. *Am J Orthod Dentofacial Orthop.* 1989 Nov;96(5):390-6. doi: 10.1016/0889-5406(89)90323-5. PMID: 2683733.
- 25.Upadhyay M, Nagaraj K, Yadav S, Saxena R. Mini-implants for en masse intrusion of maxillary anterior teeth in a severe Class II division 2 malocclusion. *Journal of orthodontics.* 2008 Jun 1;35(2):79-89.
- 26.Costopoulos G, Nanda R. An evaluation of root resorption incident to orthodontic intrusion. *Am J Orthod Dentofacial Orthop.* 1996 May;109(5):543-8. doi: 10.1016/s0889-5406(96)70140-3. PMID: 8638600.