IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 22, Issue 7 Ser.9 (July. 2023), PP 48-62
www.iosrjournals.org

Comparison of the efficacy of intrusion aches & mini-implant for maxillary incisor intrusion - A systematic review

Arshi Talat[1*], Anshul Singla[1], Amrita Puri[1], Shruti Sharma[1], Apoorva Gupta[1], Pooja Mehan[2]

1- Department of Orthodontics and Dentofacial Orthopedics, ITS Dental College, Hospital and Research Centre, Greater Noida, Delhi-NCR, India
2- Specialist Orthodontist MDS Mediclinic Hospital Abu Dhabi
**Corresponding author: Dr. Arshi Talat*
B.D.S, MPH
Department of Orthodontics and Dentofacial Orthopedics,
ITS Dental College, Hospital and Research Centre,
Greater Noida, Delhi-NCR, India

Abstract
Aim and Objectives: *To find out if there is any difference in the efficacy of intrusion arches andmini-implant for maxillary incisor intrusion.*
Materials and Method: *A systematic review was carried out by hand searching and 20 years of database records based on inclusion and exclusion criteria. In this study, seven RCTs have been taken according to inclusion criteria. Each of the studies compared mini-implants with intrusion arches. All the included studies assessed the efficacy of incisor intrusion in terms of the amount of intrusion, rate of intrusion, root resorption, and stability.*
Result: *In this study, seven studies have been taken according to inclusion criteria, and out of these studies three studies have suggested that both mini implant and intrusion arches are equally effective, two studies have suggested mini implant was preferred technique compared to utility arch, while one study suggested that utility arch tend to procline teeth, one of the studies suggested that intrusion arches associated with root resorption compared to mini implant group and one study suggested that SAD (Skeletal Anchorage device) has a higher intrusive effect. CONCLUSION: The study concluded that mini-implant is preferred over utility arches.*
Keywords: *Maxillary incisor intrusion, Intrusion arch, Mini implant*

Date of Submission: 11-07-2023 Date of Acceptance: 21-07-2023

I. Introduction

Deep overbite is one of the most common malocclusions seen in children and adults[1] that affects a person's esthetic appearance and smile[2]. The prevalence of Deep overbite is 20.5% according to a study done by Muppa et al on 844 individuals in 2013. Graber (2009) has defined "Deep bite" as a condition of an excessive overbite, where the vertical measurements between the maxillary and mandibular incisors margin are excessive when the mandible is brought into habitual or centric occlusion. It is said to be one of the most deleterious malocclusions for the long-term health of the masticatory apparatus and the dental units. A variety of factors such as incisor display, smile line, vertical dimension, patient's age, etiology of the anomaly, perioral musculature, periodontal tissues, existence of the deep bite in the rest position, length of lips, OP (Occlusal plane), ideal incisor position, and the lower facial height affect the treatment plan of deep bite cases. An excessive deep bite associated with incisor wear, palatal impingement, and compromised esthetics[3] is potentially detrimental in affecting temporomandibular joint function and periodontal health. Deep overbite correction is often a major component of orthodontic treatment. Deep overbites can be corrected by four types of tooth movements[4] namely: A) Extrusion of posterior teeth – most common and easiest. B) Flaring of anterior teeth – only in patients with lingually tipped incisors. C) Intrusion of incisors[5] – the best method to correct overbites in children as well as adults, D) Surgical – in adult patients, Orthognathic surgery in combination with Orthodontics is often the treatment of choice either because of the severity of the problem or reluctance of patient to undergo lengthy treatment.

Intrusion arches act either by extrusion of posterior teeth or inhibition and relative intrusion of anterior teeth. This decision is based in part on where the clinician desires to place the occlusal plane, the amount of mandibular growth anticipated, and the vertical dimension desired at the end of treatment. Anterior deep bites

caused by overeruption of the maxillary incisors can be determined by using lateral cephalometric radiographs. If the lower lip covers more than 4 mm of the maxillary central incisors on a patient's lateral cephalometric radiographs, it is the result of maxillary incisor overeruption[6]. Depending on the diagnosis and treatment objectives, a deep overbite can be corrected by intruding the incisors, extruding the buccal segments, or combining these treatments. Extrusion of posterior teeth drops the mandible downward and backward, and the condyle assumes a new position in the temporomandibular joint articulation. In growing patients when equilibrium is achieved between function, muscles, and the temporomandibular joint after orthodontic treatment by remodeling and readaptation, the extrusion of the posterior teeth and the successful treatment of the deep overbite remain stable. However, in adults where remodeling at condyles is less, the muscles of mastication and altered occlusion lead to relapse by moving the extruded posterior teeth after treatment back to the original.

A) Maximizing desired tooth movements and minimizing undesirable side effects are important goals of orthodontic treatment.[9] B) Intrusion arches are frequently used to treat deep overbites.[7]C) Appliances for incisor intrusion include utility arch by Ricketts, Burstone intrusion arch, Connecticut intrusion arch, and J-hook headgear. The major disadvantages with these appliances include extrusion and tipping of posterior teeth, complex wire bending, and patient cooperation Nanda's Connecticut intrusion arch2 (CIA) is fabricated from a nickel-titanium alloy to provide the advantages of shape memory, spring back, and light, continuous force distribution. When the arch is activated, a simple force system results, consisting of a vertical force in the anterior region and a moment in the posterior region. Mini-implants were recently used as anchorage devices to intrude maxillary incisors, indicating that effective incisor intrusion can be achieved with few side effects.[8]

The introduction of skeletal anchorage (miniscrews) as a source of stationary anchorage to orthodontic forces has made most complex tooth movements simple. Mini implants have been used to intrude incisors since 1983 when Creekmore and Eklund reported using a metal implant to correct a deep overbite. It has been shown that mini-screws can be loaded to forces up to 500 g and yet stay intact until the end of the treatment. It has been shown that true intrusion can be achieved with simple mechanics via mini-screws with only minimal protrusion of the anterior teeth. The present systematic review has been conducted to review the articles comparing the efficacy, rate of intrusion, and amount of root resorption by intrusion arches & mini-implants for maxillary incisor intrusion.

II. Review of Literature

1. Senısık N E and Turkkahraman H in 2012[10] conducted a study to compare the skeletal and dental effects of 2 intrusion systems involving mini-implants and the Connecticut intrusion arch in patients with deep bites. The study sample consisted of 45 adults (26 women, 19 men) with deep bites. They were divided into 3 groups: 2 treatment groups and 1 untreated control group (15 subjects in each group). Hand-wrist radiographs were used to assess skeletal maturity, if required. All participants were informed of the purpose of the study, and they signed informed consent forms. The participants were divided into 3 groups with 15 subjects in each group by block randomization: the Connecticut intrusion arch group, comprising 6 men and 9 women, had intrusion with Connecticut intrusion arches; the implant group, comprising 6 men and 9 women, had intrusion with a mini-implant system; and the control group of 7 men and 8 women had no treatment. In the Connecticut intrusion arch group, 0.018 * 0.025-in brackets (series 2000; Ormco, Glendora, Calif) were placed on the patients' 4 maxillary incisors. Laceback ligatures were placed on the brackets of the 4 maxillary incisors. Aligning and leveling were not performed. A passive 0.016-in round segmental archwire (Ortho Organizers, Carlsbad, Calif) was bent for each patient to maintain the initial position of the 4 maxillary incisors. The maxillary molars were banded, and a 0.016*0.022-in maxillary long Nitanium intrusion arch (Ortho Organizers) was placed. The Connecticut intrusion arch was cinched back to prevent facial tipping of the incisors. On the incisor segment, the Connecticut intrusion arch was tied behind the lateral incisor brackets to individual arch wires. The initial intrusive force of the Connecticut intrusion arches was totally 60 g. In the implant group, 0.018*0.025-in brackets (series 2000; Ormco) were placed on the patient's 4 maxillary incisors. Laceback ligatures were placed on the brackets of the 4 maxillary incisors. Aligning and leveling were not performed. A passive 0.016-in round segmental archwire (Ortho Organizers) was bent for each patient to maintain the initial position of the 4 maxillary incisors. Two self-drilling mini-implants (diameter, 1.3 mm; length, 5 mm) (Absoanchor; Dentos, Daegu, South Korea) were inserted into the alveolar bone between the roots of the lateral incisors and canines at the mucogingival junction. The intrusion force was delivered by nickel-titanium coil springs, which were placed between the hooks of the passive arch and the mini-implants, and maintained at approximately 90 g (minimum, 35 g; maximum, 50 g) per side during the study. Pre-treatment records to compare the intrusion rates and the treatment efficiencies of the 2 intrusion systems were taken treatment time was limited to 7 months. After the treatment, the mean amounts of genuine intrusion were 2.20 mm in the Connecticut intrusion arch group and 2.47 mm in the implant group. The center of resistance of the maxillary incisors significantly moved upward and backward, and the tip of the maxillary incisors significantly moved upward and forward in both groups (P\0.05). The axial inclination of the

maxillary incisors significantly increased, and the distance between the incisor tip and stomion superioris decreased in both treatment groups (P \0.05). It is concluded that both the Connecticut intrusion arch and the mini-implant intrusion systems successfully intruded the 4 maxillary incisors and the mean amount of genuine intrusion was greater in implant group.

2. Jain R K, Kumar S P and Manjula W S in 2014[11] conducted a study to evaluate and compare the efficiency of producing intrusion of maxillary incisors using mini-implants, utility arch and J- hook headgear. In this study 30 subjects were divided into 3 Groups equally. Group 1- mini-implant anchorage, Group 2 - J- hooks headgear and Group 3- utility arch was used for intrusion of the maxillary incisors. The subjects were randomly allocated to each Group. Subject withdrawal criteria included 1) non reporting cases 2) subjects not wearing J hook headgear daily. None of the subjects were withdrawn in Group 1, one subject was withdrawn from Group 3 for not reporting and two subjects were withdrawn from Group 2 as they were not wearing J-hook head gear daily for the advised time period. In Group 1, two mini-implants 6 mm length, 1.4 mm diameter, (Absoanchor by Dentos, Daegu Korea) were used. They were placed bilaterally between the maxillary central and lateral incisor under local anaesthesia with a long hand drive. The mini-implant position was distal to the lateral incisor. Orthodontic load was applied by NITI closed coil springs (3M, Monrovia, California) of different sizes. One end of the spring was engaged on the implant and the other on the arch wire. Force was measured using a Dontrix guage and adjusted to 1.5 ounces on each side and subjects were reviewed once in three weeks. In group 2 all subjects were treated with preadjusted edgewise mechanotherapy and maxillary first premolar extraction. The base arch wire was 0.019x 0.025" ss J-Hooks were adapted on to the arch wire between the maxillary central and lateral incisors. Force was delivered by an elastic strap connected to an occipital pull headgear. The amount of force delivered was two ounces each side measured using a Dontrix gauge. Monthly appointments were given to check and adjust the amount of force applied, patient compliance and any appliance breakage. All subjects were requested to wear the headgear at night for at least 10h. In group 3 all subjects were treated with pre adjusted edge wise appliance and maxillary first premolar extraction. Ricketts utility arch made of 0.019x 0.025" Blue Elgiloy was used for intrusion of the maxillary incisors. The utility was sleeved to prevent any tissue irritation. It was also cinched back to prevent incisor proclination. The amount of force delivered was 1.5 ounces on each side. A Dontrix gauge was used to check the force applied and monthly appointments were given to adjust the amount of force applied. Lateral cephalograms were taken before treatment and at the end of intrusion. Cephalometric analysis was done to satisfy the selection criteria and to measure the amount of intrusion effects produced in all the three Groups. The parameters used to measure intrusion were Overjet, Overbite, Vertical distance from maxillary incisal edge to palatal plane (PP-U1), Vertical distance from maxillary molar cusp to palatal plane (PP-U6), Vertical distance from maxillary incisal edge to upper lip (UL-U1). The pre-treatment and post-treatment cephalograms were traced and the values were recorded. PP-U1 reduction PP-U1 measures true intrusion of the maxillary incisors, difference of PP-U1between pre and post treatment denotes the amount of true intrusion taken place. Statistically significant reduction in PPU1 between Group 1 and Group 2 (p>.05), between Group 1 and 3 (p>.05), and between Group 3 and 2 (p>.05), were noted with the highest reduction in PPU1 seen in Group 1 followed by Group 3 and least in Group 2. PP-U6 increase PP-U6 measures the extrusion of molar teeth. No statistically significant increase in PP-U6 between Group 1 and 2 (p>.05) statistically significant difference between Group 3 and Group 1 (p.05). Highest reduction in UL-U1 was seen in Group1 followed by Group 3 and least in Group 2. It was concluded that although, both mini-implants and utility arch can be used to attain significant amounts of incisor intrusion but using mini-implants will produce true intrusion without any other side effect.

3. Raj A et al in 2015 [12]conducted a study to compare the effects of incisor intrusion obtained with the aid of miniscrews and Burstone intrusive arch. In this study twenty- patients with a deep bite of at least 4 mm were divided to 2 groups. In group1 10 patients (6 male,4 female; mean age group of 14-20 years) were treated by using Burstone intrusive arches; in group 2, 10 patients (6 male,4 female; age group of 14-20 years) were treated. In both groups group the teeth were aligned and leveled with 0.016 nickel-titanium in and 0.016 x0.022-in nickel-titanium segmental wires. After leveling, a 0.017 x 0.025 stainless steel wire was bent to the maxillary anterior segment with small hooks at its distal ends for intrusion. In group 1, 10 patients were treated by using burstone intrusive arch mechanics. An anterior, passive sectional arch from the same wire was fabricated for the stabilization of the incisors 18 and activated to get intrusive force of 70 g. Control appointments were every 4 weeks, and the force levels were checked at every appointment with dynamometer. In group 2, 10 patients in the post-pubertal growth period were treated by using bone anchorage with mini-implant. The screws were loaded 2 weeks later with medium super-elastic nickel titanium closed-coil springs, and an intrusion force of 70 g was applied. Control appointments were every 4 weeks, and the force levels were checked at every appointment with dynamometer. Lateral cephalometric head films were taken at the beginning of treatment and after intrusion, for the evaluation of the treatment changes. The center of resistance (CR) of the maxillary central incisor was

determined for each patient rather than the CR of the anterior segment because of its ease of location and high reproducibility. The CR of the maxillary central incisor was taken as the point located at one-third of the distance of the root length apical to the alveolar crest were located, and measurements were made on the cephalometric tracings. Two vertical reference planes were constructed for measurement confirmation of the dental movements. The first reference was the pterygoid vertical (PTV) drawn perpendicular to the sella-nasion (SN) plane, and the second was drawn perpendicular to the constructed horizontal plane (7 to the SN plane) from the point of intersection of the anterior wall of sella turcica and the anterior clinoid process (VR). The center of resistance (CR) of the maxillary central incisor was determined for each patient rather than the CR of the anterior segment because of its ease of location and high reproducibility. The CR of the maxillary central incisor was taken as the point located at one-third of the distance of the root length apical to the alveolar crest. The changes in the center of resistance of the incisors were 4.3 mm (p 0.001 which was statistically not significant. The maxillary molar showed no movement in the miniscrew group. It was concluded that both the mini-implant and the utility arches are equally effective in intrusion of upper incisors.

4. Kumar C P, Datana Lt C S, Londhe Maj Gen S M and Kadu Maj A in 2015[13] conducted a study to compare the amount of intrusion with skeletal anchorage device (SAD) and Connecticut intrusion arch (CIA). In this study 30 patients of Class II Div 1 malocclusion with overbite of >6 mm were randomly distributed into two groups. Group 1 was treated using orthodontic microimplants, while Group 2 treated with CIA. The pre-treatment orthodontic records for all patients were collected which included study models, lateral cephalogram, and orthopantomogram. All patients were treated using 0.018 in. Roth Preadjusted Edgewise Appliance. Patients were recalled in four weeks interval for reviews. After initial alignment phase, individual canine retraction was carried out using NiTi closed coil spring in sliding mechanics on 0.016 in. * 0.022 in. stainless steel archwire. After completion of canine retraction, anterior segment consists of maxillary incisors and posterior segment consisting of maxillary first molar, second premolar, and retracted canine was consolidated with 0.010 in. stainless steel ligature on a 0.017 in.* 0.025 in. stainless steel archwires separately. In Group 1 cases, for treatment of deep bite correction, self drilling microimplants (AbsoAnchor®, Dentos, Daegu, Korea) 14,15 of diameter 1.3 mm and length 7 mm Circle Head pattern, tapered type (CH 1312–07) were placed between maxillary lateral incisors and central incisors bilaterally. Microimplants were loaded after a healing period of two weeks. 60 g of force was used for the intrusion of four upper anterior teeth. Dontrix gauge was used for calibration of force and placement of elastic chain. Two horizontal loops were placed in the distal end of anterior segment wire for placement of elastics to prevented flaring of incisors during intrusion, which could adversely affect the study. In Group 2 cases, deep bite correction was achieved using Connecticut intrusion arches (Ortho Organizer Inc., USA) of dimension 0.016 in. * 0.022 in. NiTi archwire12. Transpalatal arch was used for anchorage control. The CIA was passed through the auxiliary tube of the maxillary triple tube in posterior segment and was ligated in anterior segment gingivally with the help of 0.010 in. stainless steel ligature wire. Dontrix gauge was used to measure 60 g of intrusive force for intrusion of maxillary anterior segment. Lateral cephalograms were taken pre-intrusion (T1) and post-intrusion at the end of six months (T2). For Group 1, the mean pre-intrusion distance was 17.37 mm and post-intrusion distance measured was 14.27 mm. The overall mean amount of intrusion was 3.10 mm. The rate of intrusion for Group 1 was calculated by dividing overall intrusion by six, i.e., 3.10/6 = 0.51 mm/month. For Group 2, the mean pre-intrusion distance was 16.37 mm and post-intrusion distance measured was 14.30 mm. The overall amount of intrusion was 2.07 mm. The rate of intrusion for Group 2 was 0.34 mm/month. The mean intrusion that occurred in Group 1 was 3.10 mm (SD ± 0.67) and 2.07 mm (SD± 0.53) in Group 2 . On intra-group comparison, the average post-intrusion centroid point to PP distance is significantly lesser compared to the average pre-intrusion centroid point to PP distance in Group 1 ($P < 0.001$). The average post-intrusion centroid point to PP distance is significantly lesser compared to the average preintrusion centroid point to PP distance in Group 2 ($P < 0.001$). On inter-group comparison, the average pre-intrusion centroid point to PP distance is significantly higher in Group 1 compared to Group 2 ($P < 0.05$). The average post-intrusion centroid point to PP distance did not differ significantly between two study groups ($P > 0.05$). The average amount of change in centroid point to PP distance is significantly higher in Group 1 compared to Group 2 ($P < 0.001$) It was concluded that the amount of intrusion is significantly higher in SAD group.

5. Kaushik A, Sidhu M S, Grover S and Kumar S in 2016[14] conducted a study to compare the skeletal and dental changes obtained by incisor intrusion using three methods: utility intrusion arch (UIA), Connecticut intrusion arch (CIA), and miniscrews: A total of thirty-eight patients were divided into three groups: Group I (n = 13), UIA; Group II (n = 13), CIA; and Group III (n = 12), miniscrew. The inclusion criteria for the study were: patients having deep bite of at least 4 mm, with minimal crowding and no existing history of periodontal disease. The exclusion criteria were teeth with incomplete apexification, history of trauma, signs of root resorption prior to orthodontic treatment, history of root canal treatment, and previous orthodontic treatment. All the groups were further subdivided into maxillary and mandibular arch. Intrusion force of 60 g and 40 g was used for maxillary

and mandibular arch respectively for standardization. All patients were evaluated every 3 weeks. A logbook was maintained to keep record of all patients at every visit. The force chosen in the present study for intrusion was 15 g per maxillary incisor and 10 g per mandibular incisor and same force was maintained for all three groups at each visit. Group I (utility arch group) Custom made utility arches were made from 0.016 in.*0.022 in. blue elgiloy wire (RMO). The UIAs were constructed according to the specifications given by Ricketts. Before the placement of the utility arch, a 458 tip back to molar section was given, directly ligated into the anterior bracket slots and the arch was cinched back. Group II (CIA group) The CIA is a proprietary trademark of Ortho Organizer, San Marcos, CA 92069, a pre-fabricated intrusion arch. The CIA was fabricated from 0.01600 * 0.02200 dimension nickel titanium alloy to provide advantages of shape memory, springback, and light continuous force distribution. The maxillary and mandibular versions have anterior dimensions of 34 mm and 28 mm respectively. The intrusion arch was directly ligated into the anterior bracket slots and cinched back. Group III (miniscrews group) Two miniscrews (Biomaterials®, Korea), 1.3 mm in diameter and 8 mm in length were placed between the roots of lateral incisor and canine under local anesthesia. Standard periapical radiographs were taken to check the position of the screws in relation to neighboring roots. The screws were loaded after at least 1 week of placement with medium super elastic nickel titanium closed coil springs of appropriate length and an intrusion force of 50–80 g was applied. Control appointments were kept every 4 weeks and the force was checked at every appointment. Records were taken before the application of the mechanics and after completion of intrusion. All the patients were radiographed by using digital lateral cephalograms. Intrusion was concluded after 5–6 months or when correction was achieved. To measure linear cephalometric parameters, following planes were used as reference planes for accurate measurements: 1. Pterygoid vertical (PTV): the PTV drawn perpendicular to sella-nasion plane passing through posterior superior of Pterygomaxillary Fissure. 2. Vertical reference plane (VR): drawn perpendicular to constructed horizontal plane (78 to SN plane) from point of intersection of anterior wall of sella turcica and anterior clinoid process. Sella-nasion (SN), Frankfort horizontal (FH), mandibular plane (MP), palatal plane (PP), and occlusal plane (OP) were also used as reference planes in this study. The cephalometric hard tissue skeletal linear and angular parameters measured were: (1) sella-nasion distance, (2) anterior facial height, (3) upper facial height, (4) lower facial height, (5) posterior facial height, (6) SNA, (7) SNB, (8) ANB, (9) MP–FH, and (10) MP–SN (Fig. 1). The cephalometric hard tissue dental angular and linear parameters measured were (1) U1-VR, (2) U1-PTV, (3) U1-PP, (4) U1-SN, (5) U1-L1, (6) U1Cr-PP, (7) L1-MP, (8) overjet, and (9) overbite. There was statistically insignificant correlation in cephalometric skeletal parameters in maxillary arch on intragroup comparison in utility arch, Connecticut arch, and miniscrew group . Only Connecticut arch group showed significant increase in posterior facial height (1.33, $p \leq 0.05$) and MP angle (1.10, $p \geq 0.05$). In dental parameters, maxillary incisor to vertical reference (U1-VR) was significantly increased for CIA group (1.26, $p = 0.022$) and UIA group (2.42, $p \leq 0.05$). Similarly, U1-PTV was significantly increased for CIA group (1.54, $p \leq 0.05$) and UIA group (1.44, $p \leq 0.001$). U1 CR-PP (Cr to PP) was decreased by 2.46, $p \leq 0.001$ in MS group, 1.84, $p \leq 0.001$ in CIA group, and 1.99, $p \leq 0.001$ in UIA group, all of which were statistically significant. L1-MP was increased in allthe three groups but the change was significant in UIA group (3.833, $p \leq 0.05$). Overbite was reduced in all the groups which was statistically significant, with 4.14 in MS group, 3.20 in CIA group, and 2.99 in UIA with $p \leq 0.001$ in all the groups. In mandible, only in MS group, MP angle decreased whereas it slightly increased in CIA and UIA groups. The intergroup comparison of all 3 groups in maxillary arch and no significant cephalometric skeletal and dental changes were observed except upper incisor to SN was significant when UIA and CIA were compared and also among UIA and MS groups. Also L1-MP correlation was significant when UIA vs MS groups and CIA vs MS groups were compared with each other. Pre-treatment and post-treatment skeletal and dental changes were compared single lateral cephalograms. It is concluded that miniscrew intrusion was considered the preferred method of true intrusion to correct deep bite.

6. Dr. Pho D, Dr. Sharma A, Dr. Upadhyay S, Dr. Sharma and Dr. Vaidya A in 2018[15] conducted a study to investigate the amount of incisor intrusion obtained by two intrusion mechanics including utility arch and miniscrews. Also, to compare the amount of root resorption noticed during active intrusion phase. study was conducted in the Department of Orthodontics and Dentofacial Orthopaedics in 12 subjects undergoing orthodontic treatment and having deep bite with age group between 12-25 yrs. Subject selection criteria included patients with overbite more than 3 mm, incisor display more than 2 mm at rest and age group of 12-25yrs. Exclusion criteria were patients with active periodontal disease, root canal treated anterior teeth, patients with mutilated dentition and individuals with history of medical conditions such as asthma, hypothyroidism and diabetes. The patients were further divided into 2 groups of 6 each. In Group 1, intrusion was carried out by miniscrews; in Group 2, intrusion was carried out by using utility arch. In Group 1, brackets were bonded to the 4 maxillary incisors only, and the teeth were leveled with nickel-titanium wires starting from 0.14 NiTi upto 0.017 × 0.025 SS. Two miniscrews were placed distally to the maxillary lateral incisors under local anesthesia. After a stabilization period of 21 days, patient was recalled and J- hooks were soldered at distal aspect of 0.017'' × 0.025'' SS wire segment and miniscrews were loaded with closed coil spring in such a way that one end of spring is attached to J-hook and

another is attached to miniscrew. A total of 80 grams of force was applied, 40 gram on each side of J-hooks and a Dontrix gauge (Leone, Italy) was used for measurement of forces. In Group 2 also, upper incisors were involved and bands were cemented to the maxillary first molars. The incisors were leveled with the same wire sequence as Group 1 and it was followed by passive preformed nickel titanium utility arch which was placed for 1 month. At the end of leveling, a custom-made Rickett's TMA utility arch was made and before its placement 45° tip back, 20° toe-in and 25° buccal root torque was given and the arch was cinched back. No other treatment was performed until intrusion was completed. Two conventional lateral cephalometric headfilms of the patients, one at the beginning of intrusion (T1) and the other at the end of intrusion (T2), were obtained. Twenty-one landmarks were located and 19 measurements (9 angular, 10 linear) were made on the cephalometric tracings . Two vertical reference planes were constructed for confirmation of the dental movements. The first reference was the pterygoid vertical (PTV) drawn perpendicular to the sella-nasion (SN) plane and the second was drawn perpendicular to the constructed horizontal plane (7˚ to the SN plane) from the point of intersection of the anterior wall of sella turcica and the anterior clinoid process (VR). The center of resistance (CR) of the maxillary central incisor was determined for each patient rather than the CR of the anterior segment because it can be located easily. The CR of the maxillary central incisor was taken as the point located at one-third of the distance of the root length apical to the alveolar crest. In this study the patients were divided into 2 groups. In Group 1, intrusion was carried out by using miniscrews; in Group 2, intrusion was carried out by using utility arch. The right central incisor mean root resorption was 0.16 ± 0.25 mm and 0.58 ± 0.73 mm for miniscrew and utility arch group respectively. The left central incisor mean root resorption was 0.75 ± 1.03 mm and 0.25 ± 0.41 mm for miniscrew and utility arch group respectively. Mean difference between right and left central incisor root resorption in miniscrew group was non- significant (p=0.28). Mean difference between right and left central incisor root resorption in utility arch group was also non- significant (p=0.42). It was concluded that both miniscrew and utility arch are equally effective in carrying out intrusion of upper incisors but greater amount of root resorption was seen in utility group compared to miniscrew group.

7. Namrawy M M E and Sharaby F E, Bushnak M in 2019[16] conducted a study to compare the effectiveness and efficiency of miniscrew-supported intrusion versus intrusion arch for treatment of deep bite. The study sample consisted of 30 subjects. They were divided into 2 groups (15 subjects in each group). Group 1 underwent maxillary incisor intrusion using miniscrews, and in group 2 intrusive arch was used. The appliance used was a pre-adjusted edgewise Brackets (0.022" x 0.028") slot size and Roth prescription (series2000; Ormco, Glendora, Calif). The posterior anchor unit was supported by a transpalatal arch with wire diameter (0.04") and cemented to the first maxillary molar. The alignment was carried out in the upper arch using 0.016" and then (0.016" x 0.022") nickel-titanium wires and followed by (0.016" x 0.022") St.St. I was stabilizing arch wire (Ormco). After alignment, the brackets of the 4 maxillary incisors were laced by ligature wire, and the stainless-steel wire was cut into two buccal segments and a maxillary anterior segment. In group1 intrusion of maxillary incisors was done using two miniscrews (Jeil medical Co., Seoul, Korea), 1.4 mm in diameter and 6 mm in length. The miniscrews were placed at the mucogingival junction distal to the maxillary lateral incisors. The miniscrews were loaded 2 weeks later with medium super-elastic nickel-titanium closed-coil springs (3M UnitekTM TAD constant force coil spring 3 mm medium force). A force of 100g was measured using a calibrated Dontrix gauge (Correx; Ortho Care, Saltaire, United Kingdom). In group 2 intrusion of upper incisors was done using an intrusive arch that was fabricated using 0.017" x 0.025" TMA (Ormco) wire and placed in the auxiliary slot of the maxillary bands. It was activated with a Tweed loop plier (Pin Tech Instruments, Sialkot, Pakistan) to produce an intrusive force of 100 g as applied and measured using the same force gauge. This prospective clinical trial compared two non-compliance, segmented mechanics for treatment of deep overbite; Miniscrews-supported intrusion and intrusive arch. According to the treatment modality used, the participants were randomly allocated to the two groups. Group 1: maxillary incisor intrusion using miniscrews and group 2: maxillary incisor intrusion using intrusive arches. Control appointments were scheduled every 4 weeks, and the force level was checked at every appointment and adjusted whenever needed. No other treatment was performed until suitable overbite was achieved. Termination of the intervention was done after 6 months of treatment or if one of the following was observed 1) Reaching adequate overbite 2) Sever inflammation or miniscrews failure. The outcome measures that were evaluated were; the rate of intrusion, skeletal, dental and soft tissue effects. Also, patient tolerance and pain experience were evaluated using a questionnaire with pain assessed as mild, moderate or severe. Evaluation of the skeleton-dental changes was carried out using lateral cephalometric radiographs and study models. Figure 3: Dental and soft tissue measurements 1. U1-VCP, 2. CR-VCP, 3. U6-VCP, 4. CRVCP, 5. U1PP, 6. CR-PP, 7. U1-HCP, 8. CR-HCP, 9. U6-PP, 10. CR-PP, 11. U6-HCP, 12. CR-HCP, 13. U1-PP0, 14. U1-SN0, 15. U1-HCP0, 16. U6PP0, 17. LS-Eplane, 18. LI-Eplane. Statistical Analysis A power analysis was designed to have adequate power to apply a 2-sided statistical test of the research hypothesis (Null hypothesis) that there was no difference between the two groups. Using alpha (α) level of 0.05 (5%) and Beta (β) level of 0.10 (10%), i.e. power= 90%; the predicted minimum sample size (n) was 11 cases in each group. Over Pre- and post-treatment lateral cephalometric x-rays

and study models were made. The total rate of intrusion was 2.6 ± 0.8 for miniscrews-supported intrusion group and 2.9 ± 0.8 for the intrusive arch group. The monthly rate of intrusion was 0.49 mm/month for miniscrews supported intrusion group and 0.60 mm/month for Intrusive arch group. It was concluded that both systems successfully intruded the 4 maxillary incisors almost with no loss to the sagittal and vertical anchorage, although intrusive arch tended to proline upper incisors significantly.

INSIGHT
Research was carried by hand searching and 20 years database records based on following inclusionand exclusion criteria:

1. Inclusion criteria:

- Human Studies which compare mini-implant/miniscrew with any of the following intrusion arches- Rickets Utility Arch, Connecticut intrusion arch, Burstone intrusion arch, 3-piece intrusion arch, K-SIR arch
- Studies included are RCT, Clinical trials (Case control and COHORT study)
- All the studies assessing the efficacy of incisor intrusion in terms ofamount of intrusion, rate of intrusion, root resorption and stability

2. Exclusion criteria

- Animal Studies
- Review Article
- Case study/ Case report
- Systematic review and meta-analysis
- Comment article
- Letter to Editor
- Case series
- Unpublished articles
- Unpublished articles

Keywords: Maxillary incisor intrusion, Intrusion arch, Mini implant

Focused Question: Is there any difference in the efficacy of intrusion arches and mini-implants for maxillary incisor intrusion
AIM and OBJECTIVES: To find out if there is any difference in the efficacy of intrusion arches and mini-implants for maxillary incisor intrusion

Search Strategy:
Literature was searched systematically and studies were identified based on the-PICO (Glossary of Evidence Based Terms 2007)

- Population is limited to patients undergoing fixed orthodontic treatment.
- Intervention is done by intrusion of maxillary incisor with mini-implant and intrusionarch.
- Comparison between intrusive effect of mini-implant and intrusion arch.
- Outcomes measured: Assessment of the Efficacy of maxillary incisor intrusion in terms of amount of intrusion, rootresorption and stability.

Research Question: Is there any difference in efficacy of maxillary incisor intrusion with miniimplant and intrusion arch.

Table-I

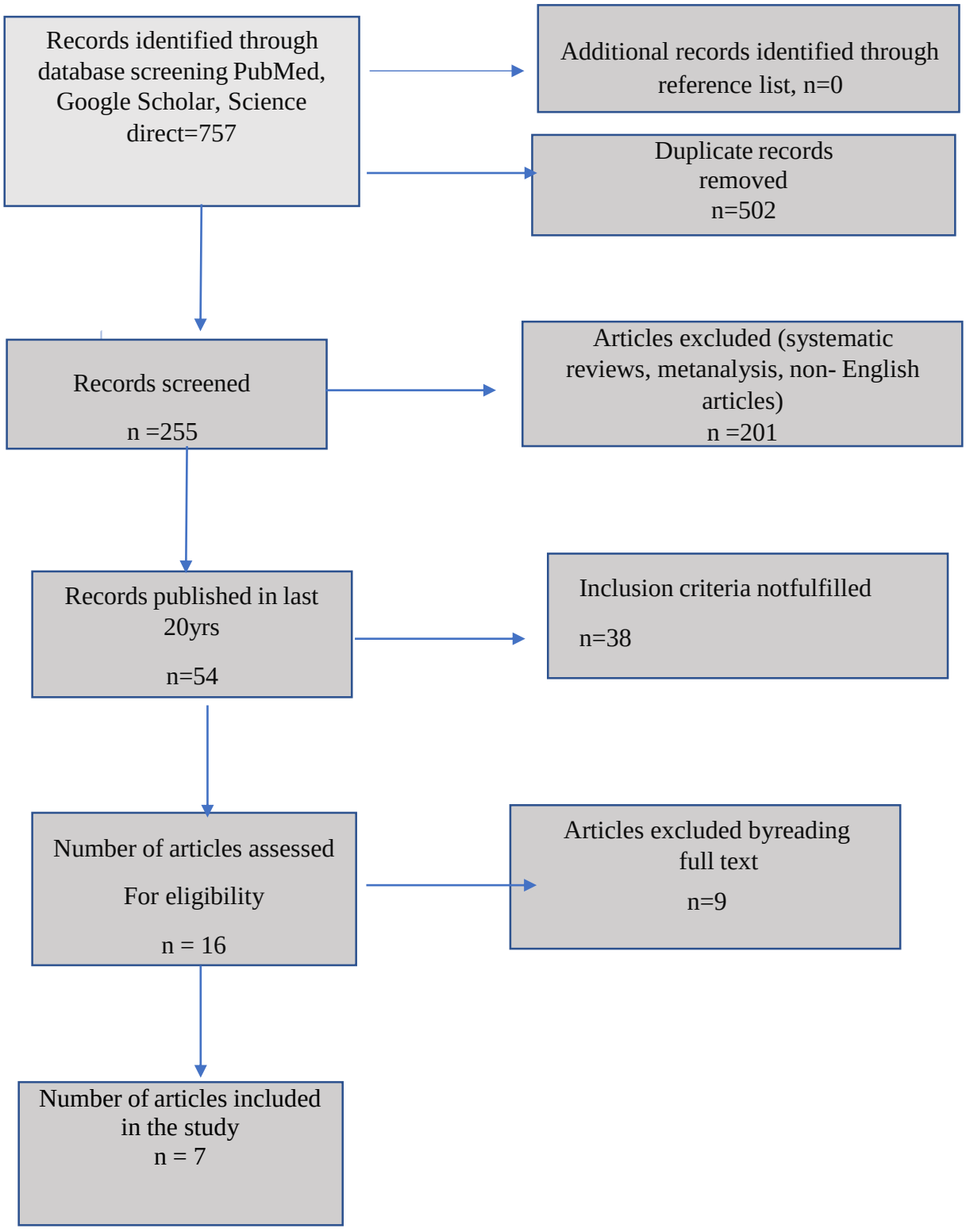
Records identified through database screening PubMed, Google Scholar, Science direct=757
Additional records identified through reference list, n=0
Duplicate records removed n=502
Records screened n =255
Articles excluded (systematic reviews, metanalysis, non- English articles) n =201
Records published in last 20yrs n=54
Inclusion criteria notfulfilled n=38
Number of articles assessed For eligibility n = 16
Articles excluded byreading full text n=9
Number of articles included in the study n = 7

Table-II
Results

S. NO	AUTHOR AND PUBLICATIONYEAR	STUDY DESIGN	PARTICIPANT CHARACTERISTICS	EVALUATION	CLINICAL OUTCOME MEASURES	CONCLUSION
1.	Senısık N E (2014)	Prospective	Probability sampling	45 adults (26 women, 19 men) with deep bites. They were divided into 3 groups: 2 treatment groups and 1 untreated control group (15 subjects in each group).	A lateral cephalometric radiograph and orthopantomograph (Planmeca, Helsinki, Finland), a set of impressions with a wax bite, and extraoral and intraoral photographs were obtained from each patient before intrusion (T0) and after intrusion (T1)	Both the Connecticut intrusion arch and the mini-implant intrusion systems successfully intruded the 4 maxillary incisors.
2.	Jain R K (2014)	Prospective study	Probability sampling	30 subjects were divided into 3 Groups equally. Group 1- mini-implant anchorage, Group 2 - j-hooks headgear and Group 3- utility arch were used for intrusion of the maxillary incisors.	Lateral cephalograms were taken before treatment and at the end of intrusion.	Both mini-implants and utility arch can be used to attain significant amounts of incisor intrusion but using mini-implants will produce true intrusion without any other side effects
3.	Kumar C P (2015)	Randomized controlled trial	Random sampling	Two group A and B when compared for treatment with mini-implant and intrusion arch when compared on cephalogram concluded that the amount of intrusion is significantly higher in SAD group.	Assessment pre and post treatment cephalometric analysis	The amount of intrusion is significantly higher in SAD group.
4.	Raj A (2015)	Prospective clinical design	Probability sampling	Twenty- patients with a deep bite of at least 4 mm were divided to 2 groups. In group1 10 patients (6 male,4 female; mean age group of 14-20 years) were treated by using Burstone intrusive arches; in group 2, 10 patients (6 male,4 female; age group of 14-20 years).	Lateral cephalometric head films were taken at the beginning of treatment and after intrusion, for the evaluation of the treatment changes.	Both the mini-implant and the utility arches are equally effective in intrusion of upper incisors.
5.	Kaushik A (2016)	Retrospective study	Probability sampling	Thirty-eight patients were divided into three groups: Group I (n = 13), UIA; Group II (n = 13), CIA; and Group III (n = 12), miniscrew. All the groups were further subdivided into maxillary and mandibular arch. Intrusion force of 60 g and 40 g was used for maxillary and mandibular arch respectively for standardization.	Cephalometric analysis of skeletal measurements.	Miniscrew intrusion was considered the preferred method of true intrusion to correct deep bite.
6.	Dr. Pho D (2018)	Prospective study	Probability sampling	The patients were divided into 2 groups. In Group 1, intrusion was carried out by using miniscrews; in Group 2, intrusion was carried out by using utility arch.	Radiographic grid was used for assessment of root resorption.	Both miniscrew and utility arch are equally effective in carrying out intrusion of upper incisors but greater amount of root resorption was seen in utility group compared to miniscrew group.
7.	Namrawy M M E (2019)	Prospective study	Probability sampling	Of 30 subjects. They were divided into 2 groups (15	Pre- and post-treatment lateral cephalometric x-	Both systems successfully intruded

				subjects in each group). Group 1 underwent maxillary incisor intrusion using miniscrews, and in group 2 intrusive arch was used.	rays and study models were made.	the 4 maxillary incisors almost with no loss to the sagittal and vertical anchorage, although intrusive arch tended to proline upper incisors significantly.

III. Discussion

Charles Burstone[17] stated, that every patient with deep bite requires a comprehensive treatment plan, which establishes how the deep bite should be corrected This decision is based in part on where the clinician desires to place the occlusal plane, the amount of mandibular growth anticipated and the vertical dimension desired at the end of the treatment. Extrusion of posterior teeth is commonly used to correct deep bite especially in growing patients, but it cannot be used in vertical growers and in adults.

Deep bite patients with extruded maxillary incisors and a gummy smile need to be treated with intrusion of the maxillary incisors[18,19]

The present review included 7 studies. Due to varying risk of bias offered by selected study designs and since it was difficult to assess outcomes and reach safe results & conclusions, strict methodology in both data extraction and quality analysis was attempted. The study concluded that both intrusion arches and mini-implant are nearly equally effective as most of studies showed that both in intrusion arch and mini-implant offer equal amount of intrusion, with exception of a single study in whichskeletal anchorage device (SAD) i.e. Mini-plant shows higher amount of intrusion. Few studies also suggested that the incidence of root resorption and incisor proclination was higher with intrusion arches.

Senisik et al (2012)[10] reported that both Connecticut intrusion arches and mini-implants led to intrusion and protrusion of the maxillary incisors. Conflicting results exist in the literature regarding the Connecticut intrusion arch[21,22] and mini-implant treatments for the mean levels of genuine maxillary incisor intrusion[23,24,25]. Several factors such as different mini-implant localizations, force magnitudes, force directions applied during maxillary incisor intrusion, treatment durations, and methods used to determine the amounts of maxillary incisor intrusion might have accounted for the different incisor intrusion rates. In this study, the center of resistance of the maxillary incisors moved backward. As a result, retraction of the maxillary incisors was obtained during maxillary incisor intrusion. This is in accordance with the recent studies available. Protrusion of the maxillary incisors might be an undesirable side effect of maxillary incisor intrusion which is reported with intrusion arches as well as mini-implants. However, the result of present systematic review suggests that more studies report Intrusion arches result in proclination of anteriors in contrast to mini implants. In contrast, both Deguchi et al and Saxena et al achieved retrusion of the maxillary incisors during maxillary incisor intrusion. In these studies, an additional force in the posterior direction was applied with the intrusive force; thus, during intrusion, retrusion of the maxillary incisors was obtained. Additionally, steepening, extrusion, and narrowing of the buccal segments were recently reported as side effects of intrusive arches. However, Senisik et al concluded , the only significant difference between the Connecticut intrusion arch and the implant groups was the change in axial inclination of the maxillary molars after the study period. The effect of the Connecticut intrusion arch treatment on the maxillary molars differed from that of the mini-implant system because of the side effects of the Connecticut intrusion arch. Kim et al reported the same result after intrusion of the maxillary incisors. In the mandibular molar area, molar extrusion induced by alveolar eruption was observed in both the implant and control groups. Conversely, spontaneous intrusion, instead of extrusion, of the mandibular molars was observed in the Connecticut intrusion arch group after treatment. In the Connecticut intrusion arch group, the maxillary molars were extruded by the Connecticut intrusion arch because of distal tipping of the maxillary molars. The reciprocal influence of maxillary molar extrusion might have caused the intrusion of the mandibular molars in the Connecticut intrusion arch group. Arch length is affected by both inclination of the incisors and distal tipping of the molars. In the Connecticut intrusion arch group, however, overbite reduction was achieved by the combined effect of maxillary incisor intrusion, protrusion, and molar extrusion. If incisor intrusion is obtained by molar extrusion in adults, the muscles of mastication and altered occlusion might move the extruded posterior teeth back to their original positions until soft and hard tissue equilibrium is obtained again, and relapse occurs. Incisor intrusion treatment with miniimplants only affects the maxillary incisor area. The position of the maxillary molars is maintained during incisor intrusion with mini-implants thus, stability of the results depends on successful retention of the incisor intrusion with the mini-implant system. In the study done by Senisik at all , similar treatment effects were achieved by both the Connecticut intrusion arch and the mini-implant intrusion systems with the exception of alteration in the axial inclination of the maxillary molars. The differences in the treatment effects of the 2 maxillary intrusion systems were statistically significant.

Jain, Kumar and Manjula (2014)[11] reported that statistically significant amount of true intrusion (PP-U1) of incisors was achieved in mini implant and the utility arch Group. The mean average true intrusion in the

implant Group achieved was 2.1 mm with a standard deviation of 0.20 mm and in one subject highest intrusion of 3 mm was achieved. The mean average true intrusion in utility arch Group was 1.33 mm with a standard deviation of 0.6mm. Statistically significant amount of extrusion of molars was achieved only in the utility arch Group. The mean average upper molar extrusion in the utility arch was 0.75 mm with a standard deviation of 0.41 mm. Hence, upper molar extrusion has significantly contributed to overbite reduction in utility arch Group. The maxillary incisal show was measured on the lateral cephalogram by the distance from the upper lip to the incisal edge of the maxillary incisor (UL-U1) both before and after the treatment as stated by Deguchi et al. The mean pre treatment values of (UL-U1) in all the three Groups were 7.33 mm, 8.9 mm and 6.08 mm respectively. Maxillary incisal show at rest was reduced in all the three Groups. But statistically significant amount of reduction was achieved only in the mini implant and the utility arch Group. The highest difference in the UL-U1values was noted in the implant Group (mean-1.91mm), this was followed by the utility arch (mean- 1.41mm) and least in 'J' hook headgear Group. Hence, of all the three methods for intruding the maxillary incisors, the mini implant assisted intrusion of maxillary incisors showed the most prominent results, attaining true intrusion without extruding the molars, and with no dependence on patient co operation. The'J' hook headgear is highly dependent on patient cooperation and this could be the primary reason for its failure. Utility arch is used for correction of deep overbite but it combines incisor intrusion along with molar extrusion for achieving the results, which may not be indicated in vertical growers. Measuring root resorption and long term follow up were not included in this study. These finding of the study coinciding with the result obtained in the present systematic review.

Raj A et al (2015)[12] reported the effects of incisor intrusion obtained with the aid of miniscrews and Burstone intrusive arch to quantify overbite correction in such a way as to allow clinically relevant comparisons of two different intervention strategies. An intrusive force that is labial to the center of resistance of the incisors would intrude them but also tip them labially. Labial tipping tends to decrease overbite because it influences the vertical incisal edge position and depending on the original inclination of the incisors, it can be advantageous in deep bite correction. Conventional intrusion-arch mechanics frequently cause labial tipping of the incisors, which does not always give favorable treatment outcomes. Counteracting movements in the molars are frequently inevitable. The mean values were compared and the mean true incisor intrusion achieved with Burstone intrusive arch was 4.3mm (7± 1.2 to 2.70±0.9) p 0.9) arch and mini implant (2.20 ± 1.13) is not statistically significant. However, these results were in accordance with the results of conventional mechanics, and the clinical setup of these studies provided a base for this study. The amounts of true maxillary incisor intrusion were not given in these articles. Also, these results were in accordance with the results of conventional mechanics, and the clinical setup of these studies provided a base for this study. The maxillary first molars showed no movement in the miniscrew group. And all the other variables included in the study like SNA, SNB, ANB, GOGN/SN, IMPA, Ls-E-Plane, Li-E-Plane showed no significant variations in both the groups.

Kumar,Datana, Londhe and Kadu (2015)[13] reported that in SAD group, overbite reduction was obtained by both maxillary incisors intrusion and retraction. The overall maxillary intrusion was 3.10 ± 0.67 mm and reduction of 0.93 ± 1.27 degree in upper incisor to SN plane angle. In CIA group, overbite reduction was achieved by the combined effect of maxillary incisor intrusion, incisor protrusion, and molar extrusion. In this group, the maxillary intrusion was 2.07 ± 0.53 mm, increase of 3.73 ± 1.28 degree in upper incisor to SN plane angle and molar extrusion of 1.20 ± 0.32 mm. The findings of this study were in agreement with the study by Senisik and Tukkahraman, except proclination of maxillary incisor in the implant group. This study was in comparison with the study by Polat-Ozsoy et al. in which the mean intrusion of incisor segment was 2.97 0.4 mm in implant group and 1.81 0.5 mm in utility arch group in relation to palatal plane.28

Kaushik, Sidhu, Grover and Kumar (2016)[14] reported that when the vertical skeletal changes (Tweed's MP angle, Steiner's MP angle) were studied, statistically non-significant changes were observed in each treatment modality. The MP angle was reduced slightly in miniscrew group, while it was increased in CIA and utility arch, though was not statistically significant. Statistically significant increase in MP angle (MP–FH) was observed for mandibular intrusion in the CIA (1.58) and UIA (2.25). These observations are in accordance with the study by Varlik et al. who reported similar increase in Steiner's MP angle (SN–MP) with utility arch intrusion. Similar increase in Steiner's MP angle (SN–MP) was also observed by Amasyali et al. in their study on CIA and utility arch. In the current study, the anterior facial height, posterior facial height, and the lower facial height increased in CIA and UIA group and not in mini implant group. A more increase was seen for UIA group as compared to CIA group. These findings of CIA and UIA group are in accordance with the previous studies. The probable cause of the increase in the facial heights was the slight extrusion of posteriors due to the anchorage taken from them in UIA and CIA. In mini implant group, there was no increase in anterior, posterior facial height and lower facial height. In mini implant group, there was no taxing of anchorage on posteriors in vertical plane, as there was no reciprocal force acting on molars in miniscrews group. When the intrusion was measured from incisal edge, the maxillary incisor intrusion was 2.41 mm, 2.44 mm, and 2.15 mm for miniscrews, CIA, and UIA respectively. According to Ng et al.,17 the use of the incisal edge or root apex for the evaluation of intrusion is not recommended because these points do not depend on any change in inclination. The axial inclination of upper

incisors in the present investigation showed a minimum increase during intrusion that was not significant for miniscrew group. In Connecticut and UIA, the axial inclination was more than miniscrew group. These findings are in accordance with McDowell and Baker and DeVincenzo and Winn.[20] Contrary to this, Senısık[21] found more inclination changes in miniscrew group than in CIA. The study of Karthik[23] also revealed statistically non-significant changes in axial inclination of incisors. An intrusive force that is labial to the Cr of incisors would intrude them but also tip them labially. Labial tipping tends to decrease overbite because it influences the vertical incisal edge position, and depending on the original inclination of incisors, it can be advantageous in deep bite correction[24,25]. Further research is required to examine the intrusion changes with larger sample size to assess the clinical stability of intrusion in all the patients. However this study suggested that 1)Miniscrews, CIA, and UIA, were effective methods of intrusion of anterior teeth. 2. True intrusion measured from Cr was maximum in miniscrew group although there was no significant difference between the intrusion achieved by utility arch and Connecticut arch. 3. There was no anchorage loss in miniscrew group while the Cr of maxillary molars was moved mesially which indicated anchorage loss in CIA and UIA group. 4. The change of axial inclination of incisors was minimal in miniscrew group followed by CIA and UIA. 5. Overbite decreased in all the three groups but was more significant for miniscrew group.

Dr. Pho, Dr. Sharma, Dr. Upadhyay, Dr. Sharma and Dr. Vaidya (2018)[15] reported that Root resorption is one of the most serious consequences of intrusion. Inflammatory root resorption is a side-effect related to the biological tissue response that enables teeth to be moved during orthodontic treatment. Deshields found no correlation with upper incisor intrusion and root resorption. Conversely, McFadden et al found mm root shortening in patients treated with utility arches. Costipoulos and Nanda noted negligible amounts of resorption with intrusion and concluded that intrusion with low forces can be effective in reducing overbite without significant root resorption. In this study, these findings prove that more amount of root resorption was seen in utility arch group as compared to miniscrew group but statistically no significant difference was found in amount of root resorption between two groups. These results are contrary to the study done by Muraleedhara Bhat, who reported greater amount of root resoption in miniscrew group compared to utility arch group. In present study, there was no significant change in the pre and post intrusion values of mean SNA, SNB and ANB either within the group or between the groups. Go-Gn-Sn values were also largely unaffected. Significant changes were observed in mean U6- SN in utility arch group, upper molars were tipped distally by 3.17º during intrusion by utility arch. This happened due to the fact that slight distal tipping of 1st molars is seen due to tip back bend in utility arch whereas in case of miniscrews, intrusion mechanics were confined to incisors only and no attachment was done on molars. Similar changes were observed in study done by Omur Polat- Ozsoy et al who reported 6.82º of distal molar tipping in utility group and no molar tipping was observed in mini-implant group. Due to distal tipping of molars in utility arch group, a significant change was noticed in Mean U6-VR. A mean change of 3.33 mm was observed in position of upper molars at post-intrusion period in utility group. Whereas a mean change of 0.16 mm was observed in miniscrew group and this change was not significant. Mean incisor proclination found in this study in case of miniscrew group was 10.16,º which was higher than that reported by Omur Polat-Ozsoy. This shows that there was mean 5.66º of greater proclination in miniscrew group compared to utility arch group. Mean incisor intrusion achieved in both miniscrews and implant group was 2.5 mm as suggested by U1-PP linear. In this study, mean increase in overjet in miniscrew group was 1.66 mm and it was 1.16 mm in utility group. Decrease in overbite was seen in both the groups but greater amount of reduction in overbite was seen in mini-implant group. Overbite decrease in miniscrew group was 2.75 mm and overbite decrease in utility group was 0.67 mm.

Namrawy, Sharaby and Bushnak (2019)[16] suggested that an intrusive force should be constant, and low load-deflection mechanisms should be used during incisor intrusion. Polat-ozsoy found that the palatal plane moved after intrusion . Overbite correction was faster in the intrusive arch group since overbite reduction was obtained by both maxillary incisor intrusion and protrusion. Repeated measures showed no statistically significant intergroup difference in the value of maxillary incisor true intrusion. Mean amount of true intrusion in the group 1 was 2.6 ± 1.9 and in the group 2 2.3 ± 1.8. These results are almost similar to Senisik in comparing miniscrews and Connecticut intrusive arch . After intrusion, in the miniscrew group, there was a statistically significant decrease in mean U1- VCPmm, CR-VCPmm, U1-PPmm, CR-PPmm, U1- HCPmm, and CR-HCPmm that show that the maxillary incisors moved upward and backwards. The possible reason for the maxillary incisor retraction could be the direction of the intrusion force, which may be applied distal to the CR of the four incisors, these results agree with those of recent studies . Further, a comparison of this study with previous reports of incisor intrusion with miniscrews cannot be made because of the differences in the direction of force application and measurements. Namrawy, Sharaby and Bushnak miniscrews placed between laterals and canines resulting in over bite correction by 2.6 ± 0.8 mm while using a mini implant placed between the maxillary central incisors by Ohnishi et al. in obtained 3.5 mm of incisor intrusion relative to the maxillary incisor tip . Kim et al. applied a segmental intrusion force between the maxillary central incisors. In the intrusive arch group, there was a statistically significant increase in mean U1-VCP mm, U1-PP0, U1-SN0, and U1-HCP0 measurements after

treatment, showing incisors proclamation of 7.70 with this intrusion mechanics. Kinzel et al found similar amounts of proclamation during incisor intrusion with conventional mechanics. The minimum amount of proclination shown in literature was by Weiland et al, using intrusion base arches. However, Vansteenbergen et al found about 80 of incisor proclination using the same arch. In contrast, Deguchi et al. achieved retrusion of maxillary incisors during maxillary incisor intrusion, which was at variance with the present study. In their study, an additional force in the posterior direction was applied with the intrusive force; thus, during the intrusion, retrusion of maxillary incisors was obtained. According to the results of this study, maxillary incisor intrusion with mini-screws was effective in reducing the amount of protrusion. The overbite was significantly reduced with intrusive arch by 2.9 ± 0.8 mm and miniscrew treatment by 2.6 ± 0.8 mm. Overbite reduction in the intrusive arch was obtained by both maxillary incisor intrusion and protrusion. However, there was no statistically significant difference between the two groups in over bite reduction. There was a statistically significant difference in over jet between the two groups after treatment. The intrusive arch group showed a significant increase in overjet while decreased in miniscrews group. First maxillary molars showed no significant changes in both groups. In miniscrew–supported intrusion there was no strain on the posterior segment while in intrusive arch group anchorage reinforcement was done due to the risk of distal molar tipping as recommended in intrusion mechanics. DeVincenzo and Winn used a Nance appliance with intrusion arches and minimized the amount of molar movement. According to the result of this study, maxillary incisor intrusion with miniscrews was effective in reducing the amount of protrusion. This study concluded, Both intrusion arches and miniscrews' supported intrusion were effective in reducing deep overbite with a total amount of upper incisors' intrusion of (2.6 ± 0.8 mm) and (2.9 ± 0.8 mm) respectively. Selection between the two techniques should be based on the pretreatment maxillary incisors' position as intrusion arches may result in a further increase in incisors' inclination contrary to miniscrews' supported intrusion.

Figure 1: Maxillary incisors intrusion using mini-screws (start of treatment)

Figure 2: Maxillary incisor intrusion using the intrusive arch (start of treatment)

Senisik et al, Raj A et al, are having conflicting result in accordance to present study and these study inferred that both mini implant and utility arch produces Same amount of intrusion. However, Jain, Kumar & Manjula and Kaushik, Sidhu, Grover & Kumar in accordance to present study inferred that mini-implant produced more intrusion compared intrusion arches.

Sidhu, Grover & Kumar concluded proclination of incisors which is in accordance with present study. Also change inclination of molar in CIA and UIA was inferred by Kumar & Manjula and Kaushik and Dr. Pho, Dr. Sharma, Dr. Upadhyay, Dr. Sharma & Dr. Vaidya root resorption was seen more in utility arch group which is in accordance with present study.

IV. Summary & Conclusion

Deep bite is a clinical Problem it must not be seen in terms of millimeters but to be seen in light of future changes in the health, function of the dentition and aesthetics. Possible complications of deep bite include, temporomandibular joint disorders, unacceptable facial aesthetics, attrition of incisors, spacing of maxillary incisors, clenching of teeth, jaw stiffness, head ache and ringing in ears. It has been established that according to diagnosis and treatment plan a deep overbite can be corrected by maxillary incisor intrusion, extruding the buccal segment or combining these treatments. It has been found that intrusion arches are most frequently used to treat deep overbite but unwanted side effects such aextrusion of the posterior teeth or flaring of the anterior teeth limit treatment efficiency. Moreover, vertical forces can easily be heavier than desired and change the balance between intrusion of the incisors and extrusion of the molars. Recently mini-implants are used as anchorage devices to intrude maxillary. This study is done to compare efficacy of maxillary incisor intrusion with intrusion arch and mini-implant.

In this study seven studies has been taken according to inclusion criteria and out of these studies three studies have suggested that both mini implant and intrusion arches are equally effective, two studies have suggested mini implant was preferred technique compared to utility arch, while one study suggested that utility arch tend to procline teeth, one of the study suggested that intrusion arches associated with root resorption compared to mini implant group and one study suggested that SAD has higher intrusive effect.

This study done to compare the efficacy of mini-implant and intrusion arches concludes that mini-implant (SAD) is better method in terms of amount of incisor intrusion also intrusion arches have more proclination effect on anteriors and extrusion of posteriors, and root resorption, change in axial inclination of molars (distal tipping) as unwanted effect. Thus, mini-implant is preferred over utility arches.

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