EVALUATION OF MAXILLARY INCISOR TRUE INTRUSION – A COMPARISON BETWEEN MINI-IMPLANTS AND CONVENTIONAL MECHANICS.

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CERTIFICATE

CERTIFICATE

This is to certify that this dissertation titled **"EVALUATION OF MAXILLARY INCISOR TRUE INTRUSION - A COMPARISON BETWEEN MINI-SCREWS AND CONVENTIONAL MECHANICS"** is a bonafide research of work done by **Dr. J.P. ANGELINE ARCHANA** Under my guidance during her postgraduate study period between 2010-2013.

This dissertation is submitted to **THE TAMILNADU DR. M.G.R. MEDICAL UNIVERSITY,** in partial fulfillment for the degree of Master of Dental Surgery in Branch V- Orthodontics.

It has not been submitted (partially or fully) for the award of any other degree or diploma.

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CONTENTS

Evaluation of maxillary incisor true intrusion –A comparison between mini-implants and conventional mechanics.

Abstract

Introduction – Recently mini-implants are being used to provide anchorage during orthodontic treatment. In this study comparison of true intrusion of incisors with mini-implants and conventional mechanics is evaluated .

Method – A proposed sample size of 15 patients for mini-implants anchorage and 15 patients for conventional mechanics is taken. Lateral cephalometric pre-treatment and post-treatment radiographs were analysed .

Results- The utility arch group and the mini-implant group individually showed significant amount of intrusion and the intergroup comparison showed that there was no significant ($p>0.05$) difference between the two groups in the quantum of intrusion achieved. There was mild proclination in the implant group .There was mild retroclination in the utility arch group.There was no molar movement in the implant group. There was mild mesialization and extrusion of molars in the utility arch group, but it was not significant.

Keywords: intrusion, mini-implants, utility arch group, maxillary incisors.

Introduction

Structural intergrity, functional stability and esthetic harmony are the three important goals of Jackson's triad .The ideal Position of the maxillary incisors on its apical base in all three planes of space plays an important role in its stability[76]. The normal angular and linear maxillary incisor position in the alveolar bone are given by different authors. The clinical significance of this position from esthetic , functional and stability point of view has been well documented and the efforts to achieve and maintain the above goal is important after orthodontic correction.

The dentoalveolar extrusion of maxillary incisors from its normal position is commonly seen in various types of malocclusions more specificaly in classI and classII case resulting in deep-bite,increased incisor exposure at rest and gingival exposure at smile . According to Bishara[85] the distribution of positive overbite among the Americans from age 8 to 50 years of age was 9% which was about 3mm and severe overbite was 8% which was about 6mm. The edge-centroid relationship of the lower incisor edge to the upper incisor centroid plays an important role in maintaining the normal position of incisors in vertical plane of space[33].

The extrusion of incisors which results in Pseudo-deep-bite can be corrected by various appliances like the utilityarch , Mulligan arch , Conneticut, three-piece intrusion arch and the latest being implants. By using implants the true intrusion is brought about by passing the force close to the center of resistance . In the conventional methods the true intrusion is obtained by maintaining the moment to force ratio. In this study the aim is to compare the intrusion brought about by rickets utility arch and by Mini-implants.

The exposure of the upper incisors beneath the lips depend on the maxillary bone, upper lip and the position of the maxillary incisors in the alveolar bone . The downward pitch of the maxilla would result in increased exposure of the maxillary incisors.

This downward pitch would result in increased anterior facial height.This in turn would increase the mandibular plane angle which would have an effect in the treatment planning to correct the deep-bite . The position of the upper and lower lip which are the immediate surrounding soft tissue in relation to the maxillary incisor has an influence on the show of the upper incisors.The length of the upper lip increases with age[76]. Care should be given to the age of the patient during incisor intrusion since the lip length increases with age till 20-24 yrs. The lip tonicity and elasticity decreases with age resulting in increased exposure of lower incisor both at rest and smile[76].

The dentoalveolar extrusion of maxillary incisors increases the amount of incisor show which could have a major influence on the soft tissue profile of the patient. Increase or decrease in the vertical dental height , influences the show of the upper incisor beneath the relaxed upper lip as well as on smile. Increase in the pitch of the occlusal cant anteriorly results in deep-bite and increased show of the upper incisor beneath the relaxed upper lip and during smile the patient would exhibit full incisor show and an increased gingival show which would result in an unesthetic smile of the individual [76].This increase in the pitch of the occlusal cant, extrusion of incisors ,vertical maxillary excess result in large interlabial gap and this could be confirmed using smile index , large interlabial gap during smile results in smaller smile index . Extrusion of incisors results in pseudo-deep-bite . Many appliances are being used to intrude the incisors but true intrusion , that is intrusion of incisors without labial tipping is difficult to achieve. But many studies claim that true intrusion could be achieved using implants easily because the force could be passed near to the center of resistance.[57,63]

The objective of this study is to compare the intrusion brought about by the Rickets utility arch and mini-implants.

Review of Literature

Leonard .I .linkow (1970)[51]describes about the use of implant in orthodontics. The use of endosseous implants in orthodontics has been relatively uncommon until recently. This is understandable, for thus far the major emphasis in implantology has been on perfecting implant designs and techniques. Now that several implant designs, notably the blade vent, have proven successful, it is possible to experiment with broadening the range of implant applications. One of the fields in which implants promise to be an exceedingly useful adjunct to conventional therapy is orthodontics.

Mark.E.Simons (1973)[60] in his 10 year post retention study of deep-bite cases concluded that Proclination of lower incisors in deep-bite correction led to relapse of the overbite.Therefore he concluded that overbite correction should not be done by proclination of incisors .Lack of vertical mandibular growth during correction of deep-bite resulted in relapse. Stability of overbite also depends on the increase in anterior and posterior dentoalveolar heights. Occlusal plane opened during correction and returned to same angulation later resulting in relapse.

P. C. Levy, et al (1977) [53]described that the activation of the basic utility arch wire with tip-back and distal molar rotation bends generated stresses of varying intensity on the lateral and central incisors. Stresses were concentrated at the lingual apical regions of these teeth, indicating the effect of intrusive lingual root movement. Lower-level stresses were observed in the mesial and apical regions of the first molars. The labial root torque placed in the anterior segment of the wire was observed to negate the lingual root movement, thus creating a more effective intrusion response. The expansion utility arch created the effect of labial root movement of the incisors, whereas the contraction arch wire produced the opposite reaction.

T.R.White(1979) [102] constructed an apparatus to measure the force delivered by an archwire and was used to study the force delivered by an utility archwire. He concluded that the prescribed bends delivered the necessary forces.Activations placed in the given part of the arch wire expresses itself between the adjacent teeth and the other teeth in the archwire are affected indirectly.force levels are unequal between central incisors and lateral incisors.a distal tipping force is initially delivered to lateral incisors. There is extrusive component of force to the molars. Wire torque in posterior segment has little influence on the tipping,extrusive and intrusive component of forces.ligation of the utility to the molar rotation bend affects the arch form.so he suggested to give slight vertical bend in the anterior for uniform distribution of forces and to reduce the arch form in the anterior when a molar rotation bend is given.

Burstone and Pryputniewicz (1980)[83] explained that the non-invasive holographic technique for measurement of tooth displacements offers three-dimensional accuracy and precision in quantifying the effects of time and force magnitude on tooth movement. The results clearly show that the force applied at the crown produces the center of rotation apical to the center of resistance; the longer the root, the further apical the center of rotation. Also, it was found that the center of rotation is moving further apically with the increasing force magnitude, for a constant M/F ratio and the same root geometry. Furthermore, the velocity curves show that the tooth is still moving at a time of 45 sec after the instant of the application of force, although much slower than at the instant of loading. The technique used in this study is a significant improvement over the previous methods, since it is non-invasive, more accurate, and three-dimensional.

Creekmore *et al* (1983)[97] conducted a study to determine if a metal implant could withstand a Constant force over a long period of time of adequate magnitude to depress an entire anterior maxillary dentition without becoming loose, infected, painful, or pathologic. The patient was a 25-year-old female with a Class I molar relationship and a very deep overbite. Maxillary incisors were very long relative to the upper lip. Maxillary lateral incisors were peg-shaped. Orthodontic appliances were placed on the maxillary teeth, a surgical vitalium bone screw was inserted just below anterior nasal spine. Ten days after the screw was placed, a light elastic thread was tied from the head of the screw to the arch wire. The elastic thread was renewed throughout Treatment, so that a continuous force was maintained 24 hours a day until the screw was removed one year later. During this time, the author noticed that maxillary central incisors were elevated approximately 6mm and torqued lingually about 25 degrees. The bone screw did not move during treatment and was not mobile at the time it was removed.

Neil.C.Murphy (1982)[69] An experimental apparatus consisting of a metal framework, a strain gauge, and a Wheatstone bridge was used to measure the retraction force delivered to the mandibular incisors by a contraction utility arch wire (0.016 by 0.016 inch blue Elgiloy). The contraction utility arch wire was activated 1 mm. and retraction forces were recorded as the deflection of a point image on an oscilloscope. The results indicated that the retraction forces at the incisor positions were reasonably within an optimal force range to move teeth quickly with minimal tissue damage and discomfort. However, the lateral incisor positions in both ovoid and narrow arch forms received significantly more force than the central incisor positions, and the narrow tapered arch form delivered more retraction force than the ovoid arch form.

Rolf berg (1983)[81] did a study with Plaster models and lateral skull radiographs of 26 orthodontically treated deep overbite cases were analysed before and after treatment and 5–9 years out of rentention. The mean age at the follow-up examination was approximately 22 years. The desired incisor relationship was achieved in the long term in 24 of the cases. The effect of several factors, reported in the literature to be important in the stability of treated deep overbite, was assessed. A considerable range of variation in the behaviour or influence of these factors was found. No marked difference was observed in the long term effects of treatment on the incisor occlusion in the 19 Class 2 Division 1 and the 7 Class 2 Division 2 cases in the sample.

Vanden bulcke in (1986)[57] did a study on twelve different systems of intrusion, based on the principle of the "segmented arch," were evaluated on a macerated human skull. The number of teeth involved in the anterior unit and the location of the application points of intrusive force were considered to be variables. Initial displacements of the anterior teeth after loading were registered by means of the laser reflection technique and double exposure holographic recordings. An attempt was made to define "this" intrusive system, achieving the most genuine intrusion without flaring of the teeth. When two central incisors were incorporated in the sectional wire, strong torque forces appeared, especially when the intrusive forces seized more distally. When four or six anterior teeth were pinned in the sectional wire, tooth movement seemed to be under better control. When the six front teeth were incorporated in the sectional wire, the center of resistance was located more to the distal side of the canines. It seemed more difficult, however, to define the center of resistance of the four incisors; it was situated approximately distal to the lateral incisors. In some of the intrusive systems, the teeth underwent independent mesial or distal rotations. This was easily observed with the laser measuring techniques used.

Birte Melsen (1986)[9] did a study on three Macaca fascicularis monkeys to find out tissue reaction following application of extrusive and intrusive forces on teeth. By means of a segmented arch approach, the upper incisors and the four first premolars were submitted to forced eruption for 8 weeks followed by 12 weeks of intrusion. On the right side of the mouth, the teeth were brushed with Chlorhexidine three times per week. On the left side, no oral hygiene was performed. After intrusion of the teeth, a 1 to 14 day retention period with passive appliance. The animals were killed and based on histological studies she concluded that intrusion of teeth does not result in decrease of the marginal bone level provided the gingival inflammation is kept to a minimum.

James.A.mcnamara (1986)[42] the utility arch is an auxillery wire developed according to the biomechanical principles of burstone and it was used to level the curve of spee in the beginning. But now it is adapted to perform many functions other than intrusion of lower incisors.It is used as passive utility arch for stabilization and space holding,intrusion of maxillary incisors, retraction and for protrusion.

John .P.De Vincenzo (1987) [43]designed A palate and first molar anchorage appliance is used to intrude upper incisors, and studied the effects on dental and skeletal variables are examined in 25 growing females and 25 matched controls. On average, the mandible was unaffected for the entire treated sample, but those with the largest reduction in overbite showed more increase in mandibular length than expected.

William .l.wilson (1987)[103] designed The bypass design of the utility arch eliminates friction and adverse buccal countermoments for excellent intrusive action. Bypass mechanics, however, confine the countermoments to the first molar, with a tipback that absorbs one-half the force intended for intrusion . This tipback requires time-consuming recovery treatment. The 3D Adapter has been designed to coordinate with a utility arch .An anti-tipback adapter is formed with simple 90º bends . When this is plugged into the 3D molar tube, molar resistance is doubled. The problem of tipback is controlled, and the anterior intrusive force is doubled . After intrusion is completed, the anti-tipback adapter is removed, and uncut 3D Adapters are inserted and adjusted for buccal quadrant expansion, buccal movement of bicuspids or second molars, or other tooth movements. Appliance functions are now reversed. The utility arch is expanded to control molar countermoments while permitting a number of tooth movements .

Christian demange (1989) [18]explained about a simple theoretical approach to the equilibrium situations encountered in biomechanics. Basic differences between the moment of a force and the moment of a couple are described. The concept of the center of resistance is defined and applied to the case of a force system (R,). Three equilibrium situations are schematically described: the off-center V bend, the centered V bend, and the step bend. Two clinical examples are detailed (one from the Begg technique and one from the Ricketts technique) to demonstrate clinical applications of force in these three situations.

Birte melson (1989)[8] did a study in thirty patients characterized by marginal bone loss and deep overbite were treated by intrusion of incisors, three different methods for intrusion were applied: (1) j hooks and extraoral high-pull headgear, (2) utility arches, (3) intrusion bent into a loop in a 0.17 x 0.25~inch wire, and (4)base arch as described by burstone. the intrusion was evaluated from the displacement of the apex, incision, and the center of resistance of the most prominent or elongated central incisor.Change in the marginal bone level and the amount of root resorption were evaluated on standardized intraoral radiographs. the pockets were assessed by standardized probing and the clinical crown length was measured on study casts. the results showed that the true intrusion of the center of resistance varied from 0 to 3.5 mm and was most pronounced when intrusion was performed with a base arch. the clinical crown length was generally reduced by 0.5 to 1 .o mm. The marginal bone level approached the cementoenamel junction in all but six cases all cases demonstrated root resorption varying from 1 to 3 mm. the total amount of alveolar support-that is,the calculated area of the alveolar wall-was unaltered or increased in 19 of the 30 cases. The dependency of the results on the oral hygiene, the force distribution, and the perioral function was evaluated in relation to the individual cases. it was obvious that intrusion was best performed when (1) forces were low (5 to 15 gm per tooth) with the line of action of the force passing through or close 1.0 the center of resistance, (2) the gingiva status was healthy, and (3) no interference with perioral function was present.

Michael Mcfadden (1989)[64] expained that apical root shortening is one of the most common complications of orthodontic treatment. Force magnitude has been suggested as an important factor. Studies on the occurrence of root resorption show equivocal results. In his study was to evaluate the relationship between intrusion with low forces (25 gm) using utility arches in the bioprogressive technique and root shortening. Age, sex, facial type, treatment time, extraction versus nonextraction therapy, width of the symphysis, and the angle of the incisors to skeletal deference planes also were studied for their relationship to intrusion and root shortening. Root shortening was found to average 1.64 mm for maxillary incisors and 0.61 mm for mandibular incisors subjected to intrusive force. Intrusion of incisors in a population exhibiting growth was found to be one of “holding against growth” and in the upper arch to a change in angulation of the maxillary incisors. Furthermore, when extraction was a part of the orthodontic treatment, it was related to intrusion of maxillary incisors but not to intrusion of mandibular incisors. No relationship was found between the amount of root shortening andof intrusion achieved. However, a long treatment time was significantly correlated to root shortening.None of the other characteristics studied were related to either intrusion or root shortening. In the present study, it was found that intrusion with the utility arch type of technique is not related to amount of root shortening. The degree of root shortening was markedly higher in the maxilla than the mandible. In general, treatment time was the most significant factor for occurrence of root shortening. A review of cases exhibiting the most severe root shortening indicated that there are persons with high resorptive potential in whom root shortening occurs in both the mandible and ,the maxilla. In these patients the intrusion achieved was significantly related to the amount of root shortening observed. It may be concluded that control of treatment time is of importance especially when intrusion in the maxilla is performed. Furthermore, there are patients with a high resorptive potential in both the maxilla and mandible who need to be carefully monitored during intrusion.

Marc vandenbulke (1990) [104] did a research to attain a better understanding of the initial reaction forces induced by an intrusion mechanism (acting on the anterior teeth) on the posterior unit and to examine how these forces can be neutralized. The experiments were performed on the dentition of a dry human skull and initial tooth displacements were registered by means of two laser measuring techniques, namely holographic interferometry and the laser reflection technique. It was established that of all reaction forces induced by the intrusion arch, distal tipping of the first molars is the most pronounced. A transpalatal bar connecting the teeth does not counteract this movement. The stabilization of the posterior unit with a transpalatal bar, buccal sectionals, and high-pull headgear proved to be the most effective technique.

RAYMOND (1991)[77] illustrated some of the changes which occur during the treatment of Class II division 1 malocclusions complicated by a deep bite, and reviews the significance of these changes in relation to concepts of deep bite treatment. Particular reference is made to mandibular growth rotation and consequent differential tooth eruption in assessing factors involved in initial bite opening and consolidation of the opened bite. The cases shown illustrate that although an initial bite opening may occur by incisor intrusion and molar eruption, when viewed over a longer period of time rotational mandibular growth and associated differential eruption of teeth in which molars erupt more than incisors may be a more significant factor. Differential eruption which takes place in response to vertical condylar growth under guidance of the appliance would appear to be a significant factor in treatment of deep bite.

William cadwell (1992)[101] developed a utility arch that allows differential movement of the lower molars along with space closure, while avoiding labial flaring of the incisors. The arch is constructed of .016" wilcock special wire, bent with a No. 139 bird-beak plier. A 35º gable bend is made 5mm anterior to the buccal tube. Toe-in or toe-out may be incorporated if desired. The gingival loops must be wide enough to permit the insertion of power thread if required for Class I mechanics. These loops can also be activated to procline or retrocline the incisors. If buccal sleeves are added, they should be long enough so as not to inhibit anterior molar movement. The lower bicuspids and cuspids are not bonded to avoid binding and to allow movement of the buccal segments. Cuspid and molar corrections can be achieved rapidly.

Stanley braun (1995) [86]Modern orthodontics requires defined treatment goals. To achieve them, known force systems must be used to control the active units (teeth being moved) and the reactive units (anchorage teeth). This article discusses the methods of controlling the force systems through the variables of spring design and anchorage selection. Continuous and segmented arch treatment are contrasted in their ability to achieve optimal and defined force systems with minimal side effects.

Moshe davidovitch(1995)[66] stated that utility arch is a two-couple intrusion arch wire used for control of anterior deep overbite. It is similar to a one-couple intrusion arch in that it is commonly made with rectangular wire, attached to the teeth only at the molars and the incisors and is activated for incisor intrusion by a molar tip back bend. It differs from a one-couple intrusion arch by the insertion of the incisor segment into the incisor brackets. This results in a fixed point of application of the intrusion force anterior to the incisors and, therefore, incisor rotation by the moment of the force. In addition, insertion of the rectangular wire into the incisor brackets usually creates a third-order couple for incisor rotation. Depending on how it is used, the moment of this couple may be activated in either direction and the resulting associated equilibrium forces will either supplement or reduce the vertical equilibrium forces created by the activation bends at the molars.

Michael S. Block (1995)[62] developed a new device to provide anchorage for orthodontic tooth movement. It is a disk, textured and hydroxylapatite coated on one side, with an internal thread on the other side. It is placed on palatal bone and, after integration, can be connected to teeth for anchorage. This article reviews a dog study demonstrating unilateral tooth movement towards the “onplant” and a monkey study mimicking its use to anchor the molars for anterior retraction.

Christopher parker (1995)[19] did a retrospective study of 132 treated orthodontic cases presenting at least 70% overbite was conducted using dental casts and lateral cephalometric radiographs from before and after treatment. These were 61 Class I, 27 Class

II, Division 1, and 44 Class II, Division 2 malocclusion patients. Six different treatment modalities for the correction of the deep bite were compared. On the basis of the analysis of cephalometric measurements, no statistically significant differences were observed between the various treatment mechanics in the correction of the deep bite. Only in the Class II, Division 2 sample, total anterior face height increased significantly ($p < 0.01$) with all treatment modalities. The data were then grouped according to Angle classification regardless of the type of mechanics used. Within each Angle class, the changes from before to after treatment were statistically significant for almost all of the cephalometric measurements. These significant changes were due to both anticipated growth and orthodontic treatment. The treatment of overbite primarily affected the proclination of incisors and the extrusion of molars.

Greg Costopoulos (1996) [29] developed a new radiographic method was developed for measuring changes in root length. With this technique, orthodontic intrusion was investigated as a potential cause of apical root resorption of maxillary incisors. The experimental group consisted of 17 patients with excessive overbite who were treated with a Burstone-type intrusion arch, which delivered a low level of force (about 15 gm per tooth). A control group was made up of 17 patients in full-arch fixed appliances who were randomly selected. After a period of approximately 4 months, the intrusion group had only slightly more root resorption than the controls, 0.6 mm versus 0.2 mm (statistically significant difference). Intrusion measured at the center of resistance of the central incisor averaged 1.9 mm. The amount of resorption was not correlated with the amount of intrusion. Results of this study seem to indicate that intrusion with low forces can be effective in reducing overbite while causing only a negligible amount of apical root resorption.

Ryuzo kanomi (1997)[82] did a case report of A 44-year-old male patient felt pain on the maxillary incisal papilla from biting with the mandibular incisors. Both mandibular second premolars and the maxillary right second molar were missing . Because of the severe curve of Spee and the deep bite, the treatment plan was to intrude the mandibular incisors. After four months , the mandibular incisors had been intruded 6mm . Neither root resorption nor periodontal pathology was evident. The patient, who had not complained of any discomfort during treatment, was satisfied with the overbite reduction.

E.Levander (1998) [50] did a study was to evaluate the sensitivity of digital radiographs for detection of (i) simulated root resorption cavities in an experimental model and (ii) orthodontically-induced apical root resorption *in vivo*. The severity of root resorption after 3 and 6 months treatment was studied in relation to root form. The experimental study cavities, drilled in mandibular roots in a dry skull, were recorded in conventional and digital radiographs. *In vivo* root resorption was evaluated on digital radiographs of 92 maxillary incisors after 3 and 6 months treatment with fixed appliances. The results showed a similar sensitivity for the two methods. Sensitivity increased significantly with cavity size. After 3 months apical root resorption was detected in only a few teeth. The number had increased significantly after 6 months. There was a higher degree of root resorption in teeth with blunt and pipette-shaped apices. In such teeth a 3-month radiographic control is recommended.

Akin-Nergiz (1998)[2] Studied Functional and morphologic reactions of peri-implant bone surrounding screw implants in three dogs by loading the implants with continuous forces of 2 N (about 204 gm) and 5 N (about 510 gm). Eight implants were inserted to an endosseous length of 12 mm and placed about 10 mm apart in the region of the lower premolars. The fixtures healed in a closed environment for 12 weeks, after which they were uncovered and loaded with abutments and orthodontic devices to produce horizontal distraction with a force of 2 N (about 204 gm) for 12 weeks. The continuously loaded implants showed no significant displacement with any force level. The mobility of the fixtures increased slightly by about 1 Periotestvalue (PTV) at the end of the experiment. No significant peri-implant pocket could be seen in implants loaded by continuous or masticatory forces. Osseointegrated implants have potential as a firm osseous anchorage for orthodontic treatment and can resist continuous horizontal forces of at least 5 N (about 510 gm) during a period of several months.

Birte melsen (1999) [12] did a study on macaca fascicularis . He stated that Direct and indirect resorption are perceived as reactions to an applied force. This is in contrast to the view of orthopedic surgeons, who describe apposition as a reaction to loading of bone. A histomorphometric study of the circumalveolar bone reaction to a force system generating translation of premolars and molars of five *maccaca fascicularis* monkeys is described. Three force levels (100 cN, 200 cN, and 300 cN) were applied for a period of 11 weeks. Undecalcified serial sections were cut parallel to the occlusal plane, and a grid consisting of three concentric outlines of the root intersected by six radii was placed on each section. Areas anticipated to be submitted to different stress / strain distributions were isolated. A-posteriori tests were used in order to separate areas that differed with regard to parameters reflecting bone turnover. Based on these results, a new hypothesis regarding tissue reaction to orthodontic forces is suggested. Direct resorption could be perceived as a result of the lowering of the normal strain from the functioning PDL and as such, as a start of remodeling, in the bone biological sense of the word. Indirect remodeling could be perceived as a sterile inflammation attempting to remove ischemic bone under the hyalinized tissue. At a distance from the alveolus, dense woven bone was observed as a sign of a RAP (regional acceleratory phenomena). The apposition could, according to the new hypothesis, be perceived as a result of the bending of the alveolar wall produced by the pull from the Sharpey fibers. The above suggested interpretation of tissue reaction would be shared with bone biologists.

Noriaki in (2001)[71]The purpose of this study was to determine the location of the center of resistance and the center of rotation of the maxillary central incisors under the influence of a single simple force and to investigate related geometric parameters of the teeth and the surrounding periodontal tissues. By measuring the initial displacement of the central incisors with a magnetic sensing system, the location of the center of resistance and the centers of rotation associated with various forces were determined in 3 human subjects. The results show that the location of the center of resistance of the maxillary central incisor depends on the palatal bone level and is at approximately two-thirds of the palatal alveolar bone height, measured from the root apex. A greater moment-to-force ratio is needed for any controlled movement of the maxillary incisors during retraction in patients with reduced palatal alveolar bone height. This study suggests a method for estimating the location of the center of resistance.

Michael .R. Marcotte(2001)[63]The purpose of this article is to describe how an orthodontic mechanical plan can be implemented with the segmented arch technique. The mechanical plan has been divided into an initial stage, an intermediate stage, and a finishing stage of treatment.. The importance of the anteroposterior position of the T-loop retraction spring is stressed. The finishing stage of treatment is actually completed early-on because the preliminary bracket alignment stage ideally aims to align the teeth intrasegmentally. A simulated mechanical plan for a patient is designed by using the terms and principles shown in the article .

David Sarver(2001)[21] that *smile arc* is defined as the relationship of the curvature of the incisal edges of the maxillary incisors and canines to the curvature of the lower lip in the posed smile. The ideal smile arc has the maxillary incisal edge curvature parallel to the curvature of the lower lip. Evaluation of anterior smile esthetics must include both static and dynamic evaluations of profile, frontal, and 45° views to optimize both dental and facial appearance in orthodontic planning and treatment. This article presents the concept of the smile arc and how it relates to orthodontics—from the recognition of its importance, to its impact on orthodontic treatment planning, to how procedures and mechanics are adapted to optimize the appearance of the smile.

Faltin (2001)[27] in his ultrastructural study applied 50 and 100 Cn of force to upper premolars with super elastic Ni-Ti wires He found degeneration of cell structures, vascular components,and extra-cellular matrix in the cementum and PDL towards the apical region in proportion to the magnitude of force.Resorptive areas are found in the roots of intruded teeth.thus reduction of force magnitude should be considered to preserve the integrity of the periodontium.

Ivanoff (2001) [40] conducted a study on twenty-seven patients . 2 micro implants were placed each during implant surgery. One micro implant was blasted with 25 micron sized particles of TiO(2); the other was a turned surface. Before insertion the surface topography was characterized with an optical confocal laser profilometer. Titanium miniplates were fixed at the buccal cortical bone around the apical regions of the lower first and second molars on both the right and left sides. The lower molars were intruded about 3 to 5 mm, and open-bite was significantly improved with little if any extrusion of the lower incisors. No serious side-effects were observed during the orthodontic treatment. The system was also very effective for controlling the cant and level of the occlusal plane during orthodontic open-bite correction.

Ohmae and Kanomi (2001) [74]conducted a study to determine the anchorage potential of the titanium mini-implant for orthodontic intrusion of the mandibular posterior teeth. Six mini-implants were surgically placed around the mandibular third premolars on each side in 3 adult male beagle dogs. In 6 weeks, an intrusive force (150 g)was applied between inter radicular implants on the buccal and the lingual sites by closed coil springs which ran across the crowns of the third premolars. After 12 to 18 weeks of orthodontic intrusion, the animals were killed and their mandibles were dissected and prepared for histologic and fluorescent observation. The morphometrical findings indicated that the calcification of the peri-implant bone on the loaded implants was equal to or slightly greater than those of the controls.

Charles burstone (2001) [15]Correction of deep overbite can be accomplished in different ways depending on the treatment goals chosen for individual patients. The 2 primary methods of correction are intrusion of anterior teeth or extrusion of posterior teeth. Successful intrusion of the incisors depends on careful control of the force system used. Low force magnitude, force constancy, a properly selected single point of force application, and control of force direction are all important factors to consider. The design of the intrusion arch may be continuous, or a 3-piece intrusion arch may be selected depending on the needs of the patient. Alternatively, extrusion of posterior teeth may be indicated in patients who are still actively growing and who have short vertical facial dimensions.

N.Yoshida (2001) [106]determined the centre of resistance of the two- and four-incisor units were approximately at the same position, whilst that of the six-tooth unit was observed to be more incisal. Clinically, this finding indicates that translation can be achieved with a smaller amount of moment-to-force ratio in en masser etraction than in two- or four-incisor retraction. The results also indicate that the location of the centre of resistance of the anterior segment during retraction may depend on the palatal alveolar bone height, rather than on the labial alveolar bone height.

Abdulaziz (2002)[1] assessed and differentiated the effects on mandibular incisors and molars during leveling of the curve of Spee in patients treated with either continuous archwires or utility archwires. Two groups of patients, in whom either round/rectangular continuous archwires with a slight reverse curve of Spee (n = 28) or utility archwires (n =19) were used to level the curve of Spee, were studied. Mandibular study casts and lateral cephalometric radiographs were taken prior to treatment (T1) and after the curve of Spee was leveled (T2). The casts were used to measure arch dimensions, and the cephalometric superimpositions were used to measure mandibular incisor and mandibular molar movements relative to a coordinate system. **Results:** In the continuous archwire group, the mandibular incisors proclined, with the incisal edge moving downward and forward, while the mandibular molars extruded and tipped, with the root apices moving further forward than the mesiobuccal cusp tip. The utility archwire group demonstrated intrusion and retroclination of the mandibular incisors, while the mandibular molar mesiobuccal cusp tipped by moving distally and extruding.The two techniques had different effects on the mandibular incisors and molars during leveling of the curve of Spee, which needs to be considered when defining specific treatment objectives for a patient.

Becker and Sennerbye (2002)[5] conducted a study on the clinical and histologic findings for smooth-surfaced titanium turned micro implants which were placed in one stage and loaded after healing. Five one-piece micro implants were placed in a fully edentulous mandible. Three were placed in one stage and extended through the keratinized mucosa for 3 mm. After 3 months of healing, three test implants were loaded for an additional 3 months. He concluded that smooth-surfaced, titanium threaded micro implants placed in one stage and loaded for 3 months demonstrated excellent Osseo integration, with varying bone-to-implant contact.

James baldwin (2003)[41]explained forces and moments applied during orthodontic treatment. He explained that there is a point where application of a single force would cause pure translation . This is called centre of resistance. In the paraboloid root it should lie about four tenths of the distance from the alveolar crest to the root apex. If there is a force in the periodontal membrane, and if the response to this distribution is uniform, the tooth will move bodily. If the force vector misses the center of resistance, a varying stress distribution will allow the tooth either to tip or rotate . The tendency for tipping or rotation will occur in direct proportion to the distance of the vector from the center of resistance.

Hee-moon kyung (2003)[31] stated that successful orthodontic treatment has always required intraoral anchorage with a high resistance to displacement. Extraoral traction can be an effective reinforcement, but demands exceptional patient cooperation. The size, bulk, cost, and invasiveness of prosthetic osseointegrated implants have limited their orthodontic application. Conventional bone screws can be used with bone plates to provide intraoral anchorage, but the screw heads fail to protect the gingiva from the impingement of ligatures or attached elastics and make it difficult to attach coil springs and other orthodontic forces .We have developed a narrow titanium micro-implant, the Absoanchor, that has a buttonshaped head with a hole for ligatures and elastomers. Its small diameter allows its insertion into many areas of the maxilla and mandible that were previously unavailable, such as between the roots of adjacent teeth .

Yi Jane(2004)[105] conducted a nonsurgical orthodontic treatment study on an adult patient with deep overbite and underlying skeletal Class II discrepancy. He had a hypodivergent facial pattern, Class II Division 2 malocclusion, and traumatic deep overbite due to supereruption of the mandibular anterior teeth. Deep overbite was corrected by proclining the mandibular incisors; this helped to level the exaggerated curve of Spee. The posttreatment occlusion significantly improved, both functionally and esthetically, with stable interincisal contacts. However, the improvement in occlusion and esthetics was achieved at the expense of reduced periodontal support for the mandibular anterior teeth.

Liou (2004)[52] conducted a study on sixteen adult patients with miniscrews (diameter = 2 mm, length = 17 mm) as the maxillary anchorage to find out whther miniscrews are an absolute anchorage device .Miniscrews were inserted on the maxillary zygomatic buttress as a direct anchorage for en masse anterior retraction. Nickel-titanium closed-coil springs were placed for the retraction 2 weeks after insertion of the miniscrews. Cephalometric radiographs were taken immediately before force application (T1) and 9 months later (T2). Miniscrews are a stable anchorage but do not remain absolutely stationary throughout orthodontic loading. They might move according to the orthodontic loading in some patients. To prevent miniscrews hitting any vital organs because of displacement, it is recommended that they be placed in a non-tooth-bearing area that has no foramen, major nerves, or blood vessel pathways, or in a tooth-bearing area allowing 2 mm of safety clearance between the miniscrew and dental root.

Cope JB (2005)[20]The first successful screw shaped implant used exclusively for orthodontic anchorage was reported in 1983. In this report maxillary incisor intrusion was accomplished in a deep-bite patient with a miniscrew for anchorage. Since that time many miniscrew designs have been developed, and there has been a dramatic increase in use and popularity. It has been argued, however, that their utilization has preceded a thorough understanding of the biology involved and their mechanical potentials.

Huda Al-Buraiki (2005)[34] stated that Correction of deep overbite with subsequent achievement of long-term stability is difficult and he investigated the effectiveness and long-term stability of overbite correction with incisor intrusion mechanics. The mechanics used were effective in overbite correction. During the posttreatment period, overbite increased by 0.7 mm. Although this change was statistically significant, the amount was small and is considered clinically insignificant, given the severity of the overbite pretreatment. Furthermore, a net overbite correction (T3-T1) of 3.3 mm and postretention overbite on 2.6 mm is an excellent clinical outcome.

Mihri (2005) [65] conducted a study to compare the effects of two different arches, the Connecticut Intrusion Arch (CIA) and the Utility Intrusion Arch (UIA). A total of 20 patients (15 girls and 5 boys) having Class I or Class II malocclusions with deep bite were divided into two groups. Lateral cephalograms were obtained before treatment and after intrusion of upper incisors. The CIA and UIA were both effective in the intrusion of incisors and can be used successfully in the treatment of deep overbite. Extrusion of molars increased the anterior and the posterior facial heights so additional anchorage mechanics should be used in order to minimize this effect in dolichofacial patients. The skeletal, dental and soft tissue effects of the appliances are almost the same. Being the last generation of intrusion appliances, CIA is made of super elastic Nitinol and provides an alternative for the treatment of deep overbite. It does not have any different effect than the UIA, but being a prefabricated appliance, it reduces chair time which is an advantage for both the patient and the clinician.

Antonio costa (2005) [4]To determine ideal sites for the placement of temporary anchorage devices (TADs), the depths of the hard and soft tissues of the oral cavity were evaluated in 20 patients. The bone depth was quantified by volumetric computed tomography (VCT). The mucosal depth was quantified by a needle with a rubber stop. The results indicate that bone thickness will allow TADs 10 mm in length only in the symphysis, retromolar, and palatal premaxillary regions. TADs 6 to 8 mm in length can be placed in the incisive fossa, in the upper and lower canine fossae. These TADs (4-5 mm) only engage monocortically, whereas the others have the ability to engage bicortically. When placing TADs in mobile alveolar mucosa, the results suggest that a transmucosal attachment may be required to traverse the thickness of the soft tissue.

Steven (2005)[93] investigated differences in outcomes from two common procedures used to reduce deep overbite: maxillary incisor intrusion using an intrusion arch and posterior tooth eruption using an anterior bite plate. Pretreatment and postoverbite correction records were gathered from 20 patients who presented with deep overbite malocclusions to the Virginia Commonwealth University orthodontic clinic. Both the intrusion arch and bite plate procedures effectively reduced overbite significantly over a relatively short period of treatment. Intrusion arch patients displayed significant reductions in maxillary incisor display (lip to tooth) accompanying documented incisor intrusion. Half of the patients in both groups experienced flattening of the smile arc in agreement with previous studies showing similar changes in orthodontic patients in general. There was no greater tendency for flattening to occur in either group. Changes in the smile arc are likely due to other factors involved in orthodontic tooth alignment and are not necessarily attributable to the overbite correction method employed during treatment.

Van steenburg (2005)[94] determined the magnitude of intrusive force to the maxillary incisors influences the rate of incisor intrusion or the axial inclination, extrusion, and narrowing of the buccal segments. Twenty patients between the ages of nine and 14 years who needed at least two mm of maxillary incisor intrusion were assigned to one of two equal groups. In group 1 patients, the teeth in the maxillary anterior segment were intruded using 40 g, whereas in group 2 patients, 80 g was used. Records were taken from each patient at the beginning and end of intrusion. There was no statistically significant difference between the 40- and 80-g groups in the rate of incisor intrusion, or the amount of axial inclination change, extrusion, and narrowing of the buccal segments.

Birte melsen (2005)[7] described about the evolution of implants, about the material and design ,indications of the implants, about the selection of size and location of the implants,insertion procedure and also about the screw related problems and patient related problems.

Ioanis in (2005)[39] gave the review about the location of CR of maxillary incisor given by different authors .Christiansen and Burstone (1969), as well as Burstone and Pryputniewicz (1980) report that the CR lies at a point that equals 40% of the tooth root length measured from the alveolar crest in a two-dimensional model with parabolic root shape or at 33% of the tooth root length in a three-dimensional model with paraboloid of revolution root shape. Nikolai (1974) locates the CR at a distance equal to 45% of root length in a two-dimensional model made for theoretical analysis, whereas Davidian (1971) places it at 40% and Halazonetis (1996) at 42%.

Tamur (2005)[95] concluded that though information about center of resistance of a particular segment can be obtained by considering the axial inclination, root morphology and bone support of the teeth to be intruded .This study analyzed the relationship in orthodontically treated adults between upper central incisor displacement measured on lateral cephalograms and apical root resorption measured on anterior periapical x-ray films. Mean apical resorption was 1.36 mm. Mean horizontal displacement of the apex was -0.83 mm .mean vertical displacement was 0.19.

Hidetake ohinishi (2005) [32] did a study on a 19-year-old female patient with anterior crowding. There was a moderate arch length discrepancy in the lower dental arch, a significant deep overbite, and a ''gummy smile.'' An orthodontic mini-implant as anchorage for the intrusion of the upper incisor segment, followed by alignment of the upper and lower dental arches with an edgewise appliance without tooth extraction. The overbite was corrected from 17.2 mm to 11.7 mm by upper incisor intrusion, and the gummy smile was improved. Good occlusion and facial esthetics were achieved, and these results have been maintained for two years after completion of the active treatment.

Major PW (2005) [55] did a meta-analysis to quantify the amount of true incisor intrusion attained during orthodontic treatment. He concluded that true incisor intrusion is achievable in both arches, but the clinical significance of the magnitude of true intrusion as the sole treatment option is questionable for patients with severe deepbite. In nongrowing patients, the segmented arch technique can produce 1.5 mm of incisor intrusion in the maxillary arch and 1.9 mm in the mandibular arch.

Camilllo Morea (2005) [14] designed a guide to place mini-implantOptimal positioning has always been critical to the effectiveness of dental implants. The choice of location depends on the initial diagnosis, the purpose of the implant therapy, the proximity of adjacent structures such as the mandibular nerve and maxillary sinus, and esthetic factors, and often involves collaboration among the prosthodontist, radiologist, and oral surgeon. Several devices have been developed to provide three-dimensional control of the surgical bur, making the procedure safer and more accurate.Orthodontic mini-implants require a less complex surgical procedure.Still, if the quantity of interproximal bone and the inclination and proximity of the roots are incorrectly evaluated, there is a risk of root perforation. A careful clinical and radiographic assessment before implant placement is therefore a necessity. Another critical factor in orthodontic mini-implant placement is the angle of insertion. Recommended angles of the implant to the long axes of the teeth have ranged from 10-20º in the mandible and from 30-40º in the maxilla . The procedure is illustrated in a 13-year-old female patient who presented with a Class II, division 1 malocclusion and was treated with four first bicuspid extractions. A headgear was prescribed to provide anchorage, but was not effective due to poor compliance. Orthodontic mini-implants were then used to complete the upper anterior retraction without loss of anchorage.

Ulricke schutz (2006)[100]The aim of this study was to evaluate the long-term stability of corrected deep bite and mandibular anterior crowding in a sample of 62 subjects (30 patients and 32 controls). The patients began treatment at a mean age of 12.2 years (SD 1.56). The treatment consisted of non-extraction and fi xed appliances in 23 subjects and functional appliances in seven. The treatment group was compared with the control group with normal molar occlusion, normal overjet and overbite, no crowding, and without an orthodontic treatment need. The registrations were made on four occasions: before treatment (T1), after treatment (T2), and at two long-term follow-ups (T3 and T4). Four registrations were also made in the control group. All measurements were undertaken on plaster models and lateral cephalograms. Treatment was found to have normalized the overbite and overjet and to have eliminated the space defi ciency in the mandibular anterior region. At T4, there was a minor relapse in overbite in the treatment group (mean 0.8 mm). In the control group, the overbite underwent reverse development (bite opening by 0.7 mm) during the same period. The available mandibular incisor space, however, was − 0.9 mm in the treatment group and − 1.8 mm in the control group. The long-term stability of the treatment results was thus good.

Kwangchul (2006) [48] determined the centre of resistance (Cres) of the upper anterior segment was located 14.5 mm apical and 9.5 mm distal from the incisal edge of the central incisors. A linear *functional axis* (a trace of the measured Crot) was recorded. The *functional axis* maintained an angle of 14.5 degrees to the vertical axis of the anterior segment passing through the Cres of the segment. The Crot constant, which determines the tipping sensitivity of the segment, was 23 mm^2. The results demonstrate that the upper anterior segment may be slightly intruded when a horizontal force is applied and is less prone to tipping than a single tooth.

Tae –woo Kim (2006) [96] conducted a study on a boy, aged 10.5 years, with a Class II molar relationship and a very deep overbite, complaining of a gummy smile and anterior crowding, was treated nonextraction with a mini-implant and Twin-block and edgewise fixed appliances. Severely extruded and retroclined maxillary incisors were intruded and proclined with a nickel-titanium closed-coil spring anchored to a mini-implant and segmented wires; this resolved the gummy smile and deep overbite efficiently without extruding the maxillary molars or opening the mandible. The mandibular incisors were proclined without direct orthodontic force during intrusion of the maxillary incisors; this helped the nonextraction treatment of mandibular incisor crowding. The Twin-block appliance with high-pull headgear promoted mandibular growth, restrained maxillary growth, and changed the canine and molar relationship from Class II to Class I. The patient's overbite and overjet were overtreated, and, 1 year postretention, the patient maintained a good overbite and overjet.

Shingo kuroda (2007)[87] In this study evaluation of the clinical usefulness of miniscrews as orthodontic anchorage was done Examination of their success rates, analyzed factors associated with their stability, and evaluated patients' postoperative pain and discomfort with a retrospective questionnaire.. The success rate for each type of implant was greater than 80%. The analysis of 79 miniscrews with a 1.3-mm diameter showed no significant correlations between success rate and these variables: age, sex, mandibular plane angle, anteroposterior jaw-base relationship, control of periodontitis, temporomandibular disorder symptoms, loading, and screw length. Most patients receiving titanium screws or miniplates with mucoperiosteal-flap surgery reported pain, but half of the patients receiving miniscrews without flap surgery did not report feeling pain at any time after placement. In addition, patients with miniscrews reported minimal discomfort due to swelling, speech difficulty, and difficulty in chewing . Miniscrews placed without flap surgery have high success rates with less pain and discomfort after surgery than miniscrews placed with flap surgery or miniplates placed with either procedure.

Kevin (2007)[45] Examined the concept of orthodontic anchorage and focuses on ways skeletally derived anchorage is gained. A brief history of the different skeletal anchorage systems to date is given. The article gives an emphasis on the use of one particular skeletal anchorage technique—the micro-implant—to assist with orthodontic anchorage and active tooth movement. Advantages and disadvantages of this new technique are discussed. An illustration of the use of micro-implants is given with reference to a case where they have been used in a novel manner to provide distal movement of maxillary molars.

Toru Deguchi (2008) [99] compared the effect of incisor intrusion, force vector, and amount of root resorption between implant orthodontics and J-hook headgear. Lateral cephalometric radiographs from 8 patients in the implant group and 10 patients in the J-hook headgear group were analyzed for incisor retraction. The estimated force vector was analyzed in the horizontal and vertical directions in both groups. Root resorption was also measured on periapical radiographs. In the implant group, significant reductions in overjet, overbite, maxillary incisor to palatal plane, and maxillary incisor to upper lip were observed after intrusion of the incisors. In the J-hook headgear group, significant reductions in overjet, overbite, maxillary incisor to upper lip, and maxillary incisor to SN plane were observed after intrusion of the incisors. There were significantly greater reductions in overbite, maxillary incisor to palatal plane, and maxillary incisor to upper lip in the implant group than in the J-hook headgear group. Furthermore, significantly less root resorption was observed in the implant group compared with the J-hook headgear group. **t**he maxillary incisors were effectively intruded by using miniscrews as orthodontic anchorage without patient cooperation. The amount of root resorption was not affected by activating the ligature wire from the miniscrew during incisor intrusion.

Chen HY (2007) [17] conducted animal experiments were used to evaluate the stability of miniscrews placed with intentional root contact. The root repair was evaluated after screw removal. Seventy-two miniscrews were surgically placed in the mandibular alveolar bone of six adult mongrel dogs with metabolic bone labeling at 3-week intervals. Miniscrews of the experimental group were placed so that they contacted the root of the adjacent teeth, were retained for different time durations, and were then removed. The insertion torque, clinical measurements, removal torque, and histological findings were analyzed. Result were miniscrews contacting the roots showed a significantly higher insertion torque than those without contact; (2) there was a significant difference in the removal torque measurements based on the mobility of miniscrews and the state of root contact; and (3) miniscrews contacting the root were at greater risk of failure.

Kyu-Rhim (2008) [49]To show the effectiveness of the osseointegration-based miniimplant (C-Implant) in managing anterior torque control during en- masse retraction of anterior dentition. Severe gable bends can be applied on utility archwire that is directly engaged in the hole of CImplants to generate anterior torque on the anterior segment of teeth to resist lingual tipping during en masse retraction. This treatment mechanics is called the biocreative therapy type I technique. Partial osseointegration of C-Implants on the anteroposterior alveolar ridge. The resistance to rotation force of the C-Implant can be used for anterior intrusion during retraction without concern of extrusion on posterior anchorage teeth. The biocreative therapy type I is a simple and quick technique for anterior torque control. is stable enough to resist intrusive force, vertically, and retraction force, anteroposteriorly, at the same time.

Madhur upadhyay (2008)[56] in their case report described the treatment of a 16-year-old post pubertal male patient with a severe Class II division 2 malocclusion and 100% deep bite. In the first phase of treatment, a ‘Jones-Jig’ molar distalization appliance was used to distalize the maxillary molars by more than 6 mm, to achieve a Class I molar relation. In the second phase of treatment, miniimplants were inserted between the roots of the maxillary lateral incisor and canine to intrude all the maxillary anterior teeth en masse in a single step. Four millimetres of intrusion was achieved. The implants remained stable throughout treatment. In the mandibular arch the incisors were proclined to alleviate the severe crowding. Good overjet and overbite was achieved and has been maintained one year after completion of active orthodontic treatment.

Sofia (2008)[91] The aims of this review are twofold, firstly, to give an overview of the general and local risk factors when using temporary anchorage devices (TADs) and the prerequisites for placement and, secondly, to illustrate the orthodontic indications of various TADs. General risk factors are factors concerning general health. Bone quality and oral hygiene are local risk factors. Aspects of the placement procedure discussed were: primary stability, loading protocols, pre-drilling diameter and whether or not to make an intra-oral incision. A selection of published case reports is given to illustrate some orthodontic indications of TADs.: Temporary anchorage devices have a place in modern orthodontics. Careful treatment planning involving radiographic examination is essential. Consultation with an oral surgeon is advisable if a soft tissue flap is required. Excellent patient compliance, particularly avoidance of inflammation around the implant, is an important consideration for successful use of TADs.

Roberto carillo (2008)[78] A closed-coil spring can be anchored to a miniscrew to apply light force for molar intrusion. Because of the short distance between the two points of force application, it can be difficult to activate the spring sufficiently, especially as the distance spanned by the spring gradually decreases during intrusion. Most miniscrew manufacturers are now producing closed-coil springs with eyelets sized to fit over the heads of the screws. Fitting an eyelet over the head of the miniscrew at the anchorage site makes placement and removal of the spring easier and faster, but it is still challenging to attach the opposite end of the spring to a bracket, an archwire, or an appliance during intrusion mechanics.

Hyo sang (2010) [37]The midpoints between the roots were located distally to the contact point and from the cervical to the apical areas. The lines connecting these midpoints from the cervix to the apex of the roots in the mandibular arch had more distal inclination than in the maxillary arch. To minimize root contacts, microimplants need to be inclined distally about 10 to 20degrees and placed 0.5 to 2.7mm distally to the contact point to minimize root contact according to sites and levels, except into palatal interradicular bone between the maxillary first and second molar.

Hugo (2008) [35]Skeletal anchorage now makes it possible to intrude one or more teeth. If miniscrews are used, they should be inserted at a distance from the roots, according to the amount of intrusion needed. In such a location, the head of the screw is usually surrounded by mobile mucosa, which increases the risk of bacterial infiltration and local infection. With modified miniplates, the screws can be inserted at a safe distance from the root apex, so that the extension will perforate the mucosa close to the mucogingival margin, causing less mobility of the surrounding soft tissues. This reduces the risks of infection, bone loss, and screw loosening. Moreover, a connecting bar with a round section facilitates oral hygiene in the area where it penetrates the soft tissues. Another disadvantage of using miniscrews for intrusion is the connection between the skeletal anchor and the orthodontic appliance. A closed-coil spring or elastic, attached directly between the miniscrew head and the elastic hook on the molar tube or bracket,allows little control over molar crown tipping. Additional mechanics such as a second intrusive force applied on the palatal side will be required to generate a moment of lingual crown tipping to neutralize the labial crown tipping. Depending on the curvature of the palate, the horizontal component of force tends to be more critical on the palatal side than on the buccal side. This implies the need for a second miniscrew in the palate. In the technique presented here, only one bone anchor is needed. Because of the rigidity of the skeletal anchorage and the firm connection to the tooth with a nearly full-size wire in the headgear tube, no auxiliaries are required. In the anterior segment, one or more teeth may be intruded along a rigid connection to a bone anchor on the paranasal ridge. When intrusion of more teeth or the complete anterior segment is needed, however, a conventional auxiliary intrusion arch should be engaged in the fixation unit of the bone anchor. This will eliminate reaction forces and unwanted movement of the posterior teeth during intrusion.

Iosif sifakakis (2009)[38] evaluated the comparative intrusive forces and torquing moments in the sagittal plane generated during anterior intrusion using different incisor intrusion mechanics in the maxillary and mandibular anterior teeth. Five wire specimens were used for each of the following intrusive arches:non–heat-treated, 0.016 x 0.016-inch blue Elgiloy utility arch, 0.017 x 0.025-inch TMA utility arch, and 0.017 x 0.025-inch TMA Burstone intrusion arch. The wires were constructed according to the specifications given by their inventors and were inserted on bracketed dental arches on Frasaco models, segmented mesial to the canines. Simulated intrusion from 0.0–1.5 mm was performed on the Orthodontic Measurement and Simulation System (OMSS), and forces and moments were recorded at 0.1 mm vertical displacement increments. All measurements were repeated five times for each specimen, and maximum values recorded at 1.5 mm for all wires were used for all statistical evaluations.The 0.017 x 0.025-inch TMA Burstone intrusion arch exerted the lowest intrusive forces,followed by the 0.017 x0.025-inch TMA utility and the 0.016 x 0.016-inch blue Elgiloy utility arch. The lowest anterior moment in the sagittal plane in this experiment was generated from the 0.017x 0.025-inch TMA Burstone intrusion arch and the intrusive forces, as well as the generated moments, were always higher in the mandible.

Birte melson (2009)[11] stated that the primary goal of orthodontic treatment was to position the maxillary left premolar and molar for prosthetic reconstruction with one premolar implant behind the maxillary left canine. The patient would then have full occlusion on two pairs of premolars and one pair of molars on the left side. This plan involved mesial movement of the extruded maxillary left second molar into the neutral position of the extracted first molar, requiring extradental anchorage .. The tooth would be intruded, and space would be created for the implant in the left first premolar region through distal movement of the second premolar. The distal relation of the maxillary and mandibular right first molars and the neutral canine relations would be maintained. Minor spaces would be left distal to both maxillary canines because of the tooth-size discrepancy. The smile would be improved through closure of the anterior diastema, leveling and alignment, and coordination of the dental midlines. Careful biomechanical planning is needed to determine how, when, and where the skeletal anchorage should be incorporated into orthodontic treatment.Anchorage problems should not be addressed simply by increasing the number of miniscrews, nor should TADs be used as a crutch to compensate for problems due to poor planning. Rather, a strategy should be developed for attaining treatment goals using as few miniscrews as possible, thus minimizing risks, treatment time, and costs while maximizing patient comfort.

Omur polat (2009) [72] did a study to investigate if true incisor intrusion can be achieved using miniscrews.Eleven patients (three males and eight females; mean age: 19.8

± 4.8 years) with normal vertical dimension showing a pre-treatment deep bite of 5.9 ± 0.9 mm and a 'gummy' smile were enrolled in the study. After levelling of the maxillary central and lateral incisors with a segmental arch, an intrusive force of 80 g using closed coil springs was applied from two miniscrews placed between the roots of the lateral and canine teeth. The amount of incisor intrusion was evaluated on lateral cephalometric headfi lms taken at the end of levelling (T1) and at the end of intrusion (T2). The mean upper incisor intrusion was 1.92 mm and the mean overbite decrease 2.25 ± 1.73 mm in 4.55 months. Upper incisor angulation resulted in a 1.81 ± 3.84 degree change in U1-PP angle and a 1.22 ± 3.64 degree change in U1-NA angle. However, these were not statistically signifi cant .True intrusion can be achieved by application of intrusive forces close to the centre of resistance using miniscrews. However, studies with a larger number of subjects and long-term follow-up are necessary.

Rekha mitlal (2009)[80] conducted clinical study to quantify the amount of the true incisor intrusion achieved during orthodontic treatment using mini-implants (TADs) to correct the dental deep overbite in adult patients, as well as to assess the overall treatment time period in achieving a true incisor intrusion The treated group consisted of fifteen subjects with a dental deep bite of at least 4mm (mean overbite, 4.44mm and mean age 21 years). After initial alignment of anterior teeth, a mini-implant was placed below the anterior nasal spine and was used to intrude the maxillary incisors on a segmented archwire connecting the four incisors and molars together.Lateral cephalograms and study models were taken before and immediately after the bite opening to assess the amount of true intrusion achieved. A significant amount of intrusion resulting in overbite reduction was achieved following the usage of a mini-implant with a mean value of 2.8 mm, when measured from centroid point (I1) in relation to palatal plane ($p<.001$). Molars were not extruded following the intrusion of anterior teeth. No increase in lower facial height was observed (+0.3mm, NS). The results of the study revealed that mini-implants (TAD's) serve as an efficient source of anchorage for achieving true incisor intrusion of anterior teeth in deep overbite correction. It does not have any deleterious side effects on the posterior segment, especially in patients with unfavorable growth patterns and non-growing patients.

Richard ,cousley (2009) [79] developed The Infinitas mini-implant is fabricated from surgical-grade 5 titanium alloy (Ti-6Al-4V). Its head has a multifunctional design (patent pending), combining cross-slots and external and internal undercuts on a single vertical plane . In contrast to conventional screw head designs, the Infinitas head has a low profile that still allows direct attachment of various types of traction auxiliaries and archwires with dimensions as large as .021" x .025". For example, a standard nickel titanium coil spring can be attached to one corner of the bracket-like head within the internal undercut . The screw head's low profile not only improves patient comfort, but reduces the risk of undesirable tipping moments by limiting the ratio of the head and neck length to the body length.The coronal part of the Infinitas neck has a pentagonal shape that closely matches the internal contours of the insertion screwdriver . Because the screw head is small, the screwdriver engages only the neck, which helps avoid breakage. The apical part of the neck is tapered to enable mini-implant insertion at both perpendicular and oblique angles to the cortical plate, with only slight compression of the adjacent mucosa . Recent research indicates that an oblique insertion angle of about 25º provides the highest insertion torque values for self-drilling

Birte melsen (2009) [11] gave a review on the causes of failure of implant . Incorrect insertion technique has been identified as a primary cause of failure in implant dentistry.For orthodontic miniscrews, transmucosal flapless insertion after decontamination of the site with a chlorhexidine rinse is standard procedure, since flap surgery or mucoperiosteal incisions would cause more pain and discomfort.Inadequate irrigation of the surgical site, excessive drill speed, wiggling movements of the screwdriver, and insufficient placement torque are among the most common mistakes. Operator experience is thus an important factor in reducing failure rates.Patient-related causes of possible failure should be thoroughly evaluated before miniscrew placement. On the other hand, anatomical issues seem to be highly significant. Insertion sites with extremely thin cortical bone provide less primary stability, but thick soft tissue may reduce the proportion of the miniscrew engaged in the bone and increase the torsional moment on the implant, due to the increased distance between the point of force application and the screw's center of resistance As in general implant dentistry, systemic diseases associated with increased bone metabolism or negative bone balance, such as osteoporosis and uncontrolled diabetes, can also reduce the chances of success. Inflammation of the peri-implant soft tissues is another potential factor that caused the loosening of four miniscrews in the present study. Strict oral hygiene, including thorough brushing of the miniscrew head with a soft toothbrush after every meal, is needed to minimize the risk of inflammation. Insertion of the device in the attached gingiva is recommended to avoid interference with the functional movements of the soft tissues apical to the mucogingival line. Anti-inflammatory drugs should not need to be routinely prescribed. Although miniscrews are now designed to withstand standard orthodontic forces of torsion and flexion,improper insertion or removal can cause breakage, as with two screws in our sample The risk of injury to dental roots during placement is one of the greatest concerns with orthodontic mini-implants, especially when they are inserted between teeth. Placement of a miniscrew too close to a root can also result in insufficient bone remodeling around the screw and transmission of occlusal forces through the teeth to the screws, which can lead to implant failure. Even though periodontal structures can heal after being injured by TADs, it is important to select insertion sites carefully, using thorough clinical and radiographic evaluation of their anatomical details.

Deepak chandran (2009) [23] stated that a gummy smile is probably one of the most common causes of an unaesthetic smile. Causes include overeruption of maxillary anterior teeth and maxillary vertical excess. Intrusion of maxillary anterior teeth with Orthodontics and Le forte I superior repositioning may form a part of the solution. Of late the use of micro implants have improved the smile esthetics of borderline surgical cases by allowing the Orthodontist to intrude teeth more than what was possible with conventional Orthodontics.

Matheos Milo (2009)[58] Described, step by step, how to manufacture an adjustable surgical guide to facilitate the placement of orthodontic mini-screws, thus reducing the risk of injury to roots and important anatomical structures. Mini-screws are small enough to be inserted into narrow spaces that could not be used for endosseous implants, such as the alveolar bone between the roots of adjacent teeth. Mini-screw placement into these sites can be challenging because of the risk of root damage.

Cheol Hyun (2010)[16] The objective of this research was to determine which clinical and skeletal factors are related to the success rate of orthodontic mini-implants in the maxillary and mandibular posterior buccal areas. The overall success rate was 79.0%. Almost 80% of the failures occurred within the first 4 months. The clinical variables sex, age, soft-tissue management, sagittal skeletal classification, archlength discrepancy, and side did not show significant differences in the success rate. In the skeletal variables, average upper gonial angle (84.2%) had a significantly higher success rate than low

(75.7%) and high (71.2%) upper gonial angles . High Frankfort-mandibular plane angle and low upper gonial angle groups showed significant lower odds ratios than did the other types.Vertical skeletal pattern might be an important factor for the success of orthodontic mini-implants placed in posterior buccal areas.

Dr. Krishna nayak (2010)[46] did a study in Seven patients with deep overbite and with increased upper incisor/anterior gingival displaywere the sample for our study. After leveling of the maxillary central and lateral incisors with a segmented arch, an intrusive force of 50 gms using Niti closed coil springs was applied from a mini-implant placed between the roots of the two central incisors. The amount of intrusion was evaluated on lateral cephalograms taken at the end of leveling (T1) and 4 months later (T2).The mean incisor intrusion achieved with mini-implants was 3.29mm . The mean molar extrusion seen with mini-implants was 0.29. The mean of the change in incisor inclination is 0.14degrees . The results of this study revealed that true incisor intrusion can be achieved with the use of mini-implants.

Omar polat (2011) [73]The aim of this prospective study was to compare the effects of incisor intrusion obtained with the aid of miniscrews and utility arches. Twenty-four patients (10 male, 14 female) with a deepbite of at least 4 mm were divided to 2 groups. In group 1, 13 patients (3 male, 10 female) in the postpubertal growth period were treated by using miniscrews; in group 2, 11 patients (7 male, 4 female) were treated with utility arches. Lateral cephalometric headfilms were taken at the beginning of treatment and after intrusion for the evaluation of the treatment changes. Intrusion lasted 6 months for group 1 and 6months for group 2. The changes in the center of resistance of the incisors were 1.7for group 1 and 0.86 for group 2). In the miniscrew group, the incisors were protruded 0.79

mm relative to pterygoid vertical and 3.8 relative to the palatal plane. In group 2, the incisors showed 3.9of protrusion relative to pterygoid vertical and 13.55 relative to the palatal plane. The maxillary first molars showed significant distal tipping in group 2 .Unlike with utility arches, true maxillary incisor intrusion can be achieved by application of intrusive forces close to the center of resistance by using miniscrews with no counteractive movements in the molars.

Hyo-sang(2011) [37]developed a new traetment mechanics in his study in a 29-year-old woman with a deepbite was treated with the aid of microimplant anchorage. Microimplants placed between the maxillary second premolars and first molars were used as anchorage to apply a distal force to the anterior teeth to correct the Class II canine and molar relationships. A distal force was applied to long hooks that were crimped between the lateral incisors and the canines. By applying a backward force to the long hooks, the maxillary anterior teeth experienced palatal root movement with no change in the vertical and anteroposterior positions of the incisal edges. The distal extrusive movement of the maxillary second molars achieved by disengaging the second molars from the archwire during distal force application and an anterior bite-block bonded on the lingual surface of the maxillary central incisors produced the increase in vertical dimension. The distal force to the long extended hooks from the microimplants was possibly good mechanics for obtaining the palatal root movement and correcting the Class II canine and molar relationships. The anterior bite-block and disengagement of the maxillary second molars during distal force application were effective for increasing the vertical dimension.

Neslihan(2012) [68]the purpose of this study was to compare the skeletal and dental effects of 2 intrusion systems involving mini-implants and the Connecticut intrusion arch in patients with deepbites. Both the Connecticut intrusion arch and the mini-implant intrusion systems successfully intruded the 4 maxillary incisors. Although the movement of the maxillary molars led to the loss of sagittal and vertical anchorages during intrusion of the incisors in the Connecticut intrusion arch group, these anchorages were maintained in the implant and control groups.

Amipraviz (2012)[3]The purpose of this study was to measure the efficacy of anchorage control between differential moments mechanics and temporary anchorage devices in a clinical trial. Forty-six patients requiring extraction of maxillary first premolars were allocated into 2 treatment groups. The differential moments group (G1) received a nickel titanium (NiTi) intrusion arch and a 150g NiTi closing coil spring for separate canine retraction, followed by a continuous mushroom loop archwire for the retraction of the incisors. The TAD group (G2) received one miniscrew placed between maxillary second premolars and first molars with a 150 g NiTi closing coil spring connecting the miniscrew to a hook placed in the archwire between the lateral incisor and canine. There was a statistically significant change in upper lip from T1 to T2 but no difference between the two groups. Moreover, there was a significant distal molar tipping and lingual incisor tipping in G2. There is a significant difference in the amount of anchorage control using differential moments mechanics compared to TADs. Although statistically significant retraction of upper lip was observed in both groups, there was no significant difference between the two groups.

Materials and Methods

Materials used in this study (Fig 1)

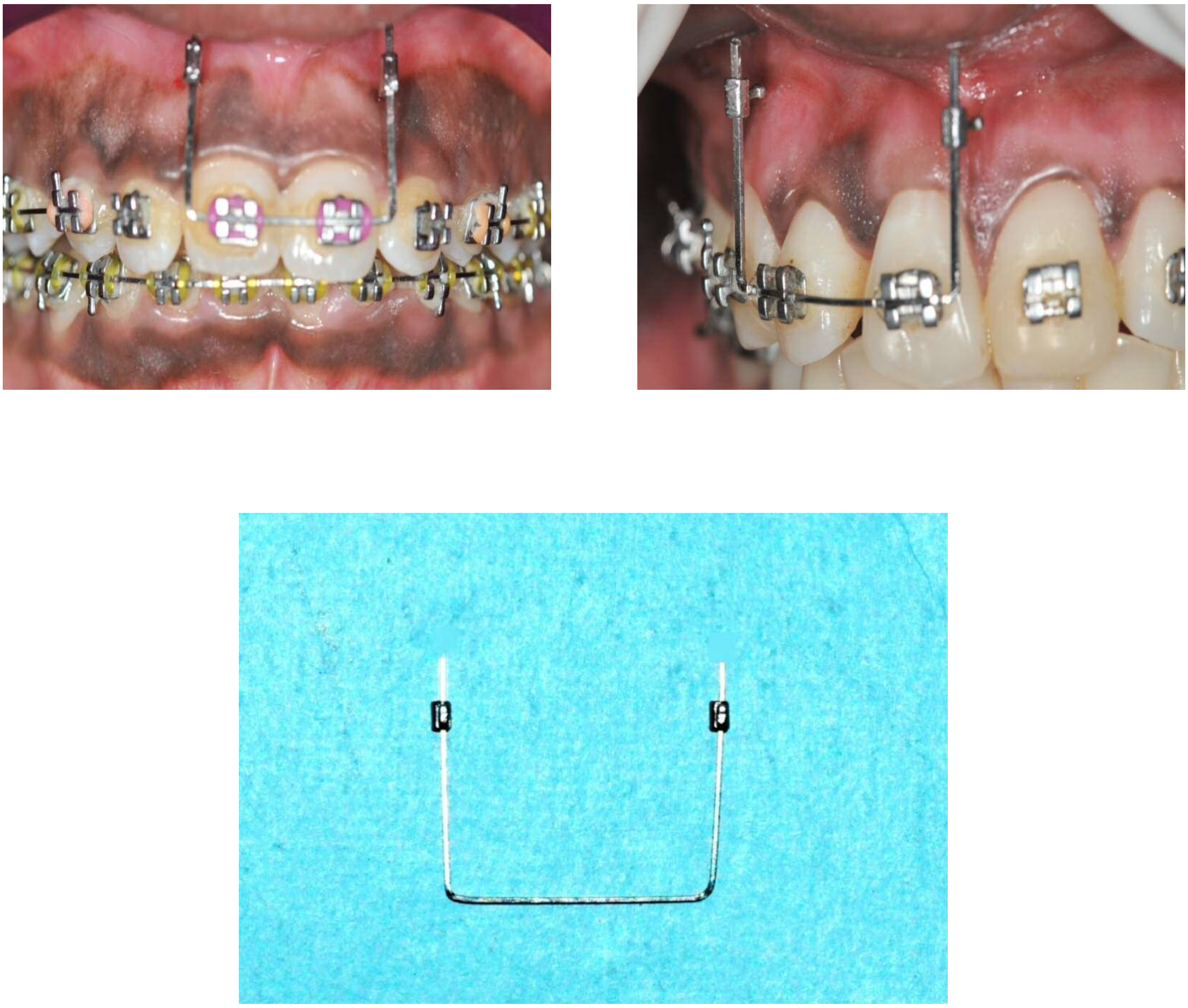
- Mini-implants-1.5mm in diameter & 6mm in length (according to Park)
- Mini-implant driver
- Sterile gauze
- Guide for implant placement.
- Betadine solution, Syringe and local anesthetic solution.
- Normal saline
- Ricketts intrusion arch-0.016*0.022 stainless steel(according to Brudon)
- Weingart plier
- Bird beak plier
- Turret
- Mouth mirror
- Explorer
- Periodontal probe
- Tweezers.

<u>MATERIALS USED (Figure:1)</u>

Custom made mini-implant guide (Fig 2)

The custom made guide was used to mark the point of insertion of implant and it also served as a guide to orient the implant holder perpendicular the occlusal plane . The implant should be placed in the anterior region such that it is parallel to the occlusal plane and not angulated due to less interdental space and chances of perforation of the nasal floor is possible.The custom made guide is made with 19X 25 stainless steel .It consists of a horizontal segment and a vertical segment. The horizontal segment is perpendicular to the vertical segment.The vertical segment consists of the crimpable hook attached to it which is parallel to the occlusal plane. The guide is placed in the bracket slot of the four incisors to be intruded. After aligning, the bracket slots become parallel to the occlusal plane , therefore the bracket slots could be taken as a guide to orient the implant guide parallel to occlusal plane. The horizontal arm can be adjusted along the maxillary incisor slots according to the placement of the implant. The crimpable hook on the vertical arm can be moved vertically accordingly where the implant has to be placed. After the placement of guide an IOPA is taken to confirm the point of placement of implant. If the hook of the guide is seen near to the roots, then the guide could be adjusted by measuring from the bracket the distance to be adjusted and an another IOPA could be taken and confirmed . Therefore this guide can definitely be considered as a reliable, easy to fabricate guide.

CUSTOM MADE GUIDE (Figure:2)



Methodology

The objective of this study is to compare and evaluate the amount of true intrusion achieved between mini-implants and utility arch.

A sample of 30 patients who came to the department of orthodontics and orthopaedics in Sri Ramakrishna dental college and Hospital , Coimbatore for orthodontic treatment were selected and divided into 2 groups with 15 patients in each group . GroupA (utility arch) and Group B (mini-implants) .The patients selected for true intrusion were clinically evaluated .The clinical evaluation includes :

- Deep –bite more than 4mm
- Pseudo - deep bite cases
- Excessive gingival display
- Normal upper anterior facial height.
- Normal angulation of upper incisors to nasal floor. according to Rakosi $=70^{\circ}\pm5$.

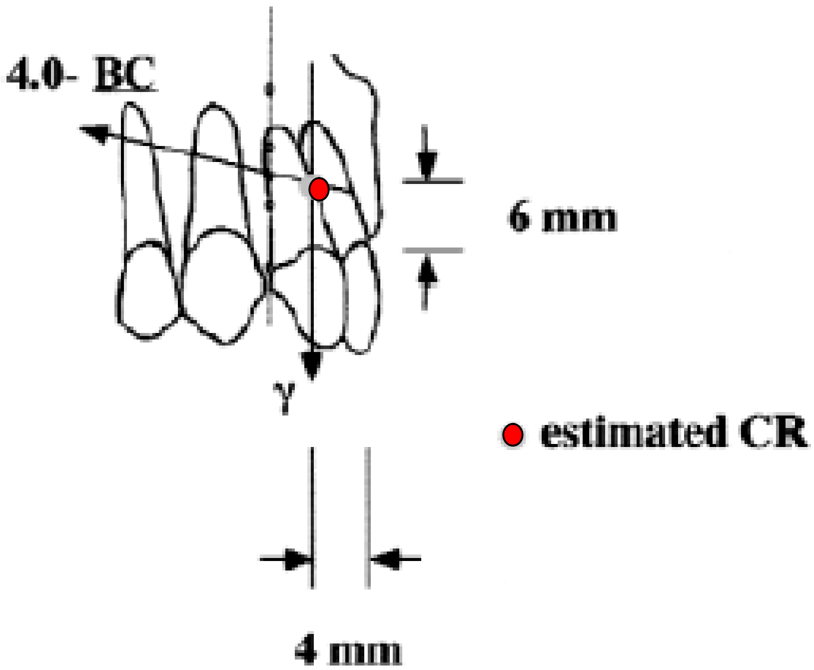
Patients who were excluded from this criteria were:

- Short upper lip after growth completion
- Vertical maxillary excess
- Proclined incisors
- Deep bite less than 5mm and
- True deep- bite

To confirm the clinical diagnosis , photographs and lateral cephalograms were taken and measurements were done .

The treatment sequence is as follows:

After initial leveling and aligning 19x25 stainless steel segmented archwire in the incisor segment was inserted. Another sectional rectangular stainless steel wire (0.019 x 0.025 SS arch wire) was placed in the right and left posterior segments. The center of resistance for upper incisors for intrusion was located 4mm saggitally from the midsaggital plane and 6mm vertically from the labial alveolar crest of the central incisor according to **Matsui**[59] . The implant was placed such that the vector of force passes through this center of resistance. The implant with a diameter of 1.5mm and a length of 6mm used in this study. The head of the implant consisted of slot and a hole which is used for insertion of ligature wires.



Implant insertion procedure

Methodology of implant placement - manual method[54]

Two mini-implants of 1.5 mm in diameter and 6mm in length were placed distal to the root apices of central incisor roots and mesial to apices of lateral incisor root at the mucogingival junction .

Steps follwed while insertion of mini-screws in manual method:

- Assesment of insertion area.
- Determining insertion site
- Insertion angle
- Cortical bone peneteration
- Obtaining mechanical stabilization

ASSESSMENT AND DETERMINING THE INSERTION AREA USING GUIDE. (Fig 3)

Prior to the insertion of mini-implants , the central & lateral incisors are leveled and aligned . The slots were filled with rectangular 19 x25 SS for 3 Dimensional control of the anteriors prior to true intrusion . Implant placement guide is ligated to the brackets and positioned such that the vertical arm is distal to the central roots and the crimpable hooks are adjusted vertically such that it is at the mucogingival junction and it is parallel to the occlusal plane. An IOPA is taken to confirm the point of insertion of the mini-implant.

IMPLANT PLACEMENT USING GUIDE (Figure;3)

FORCE APPLIED FOR INTRUSION OF MAXILLARY INCISORS (Figure:4)

INSERTION ANGLE

The implant is inserted such that the implant is parallel to the occlusal plane

CORTICAL BONE PENETERATION

The screw is inserted by drill free method into the bone. This method is done without any surgical trauma. The torsion vector is also kept very minimal to prevent damage to the bone. The torsion vector is the vector product of length and force. Since a long handled driver is used in this method , the force was kept minimally to prevent damage to the bone.

ESTABILISHING PRIMARY STABILITY

This process can be finished by engagement of the screw threads inside the bone purely by rotational force and the implant was inserted completely upto the desired length exposing the head of the mini-implant above the soft tissue.

POST SURGICAL PROCEDURES.

Post-operative IOPAs were taken.E-chain was immediately loaded with 30 grams of intrusive force for the incisor intrusion.Crimpable hooks were attached to the segmented 19x25 SS wire with hooks facing lingually . E-chain from the implant was inserted to the crimpable hooks.The segmented wire was cinched back distally to the lateral incisors.The patients were given proper oral hygiene instructions and were given mouth wash. Antibiotics were given for a week. Patients were given appointments at 3-4 week intervals and e-chain was changed every appointment and re-loaded with 30 grams of force for incisors intrusion. (Fig 4).

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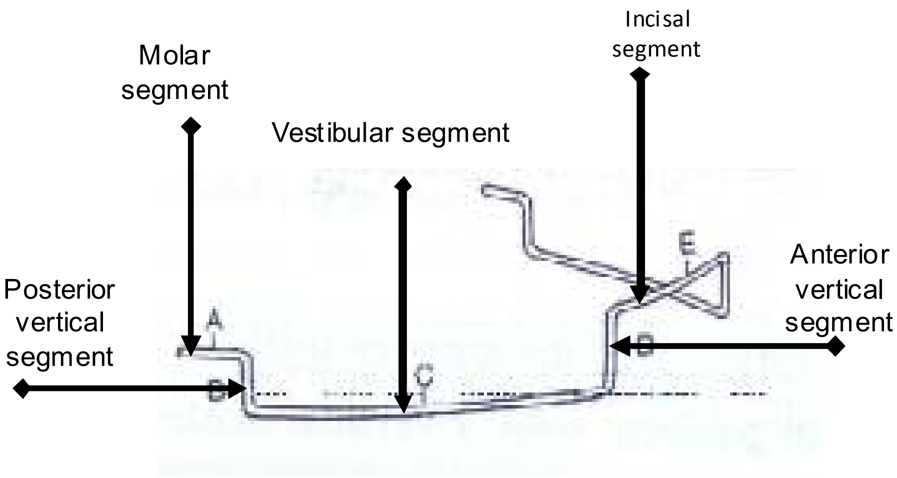
MINI-IMPLANT

PRE-TREATMENT (Fig:4A)

POST-TREATMENT (Fig:4B)

UTILITY ARCH

This auxiliary archwire was developed and refined by Ricketts for bioprogressive therapy.[84] The utility arch engages only two molars and the four incisors. It is commonly known as a 2 X 4 appliance.

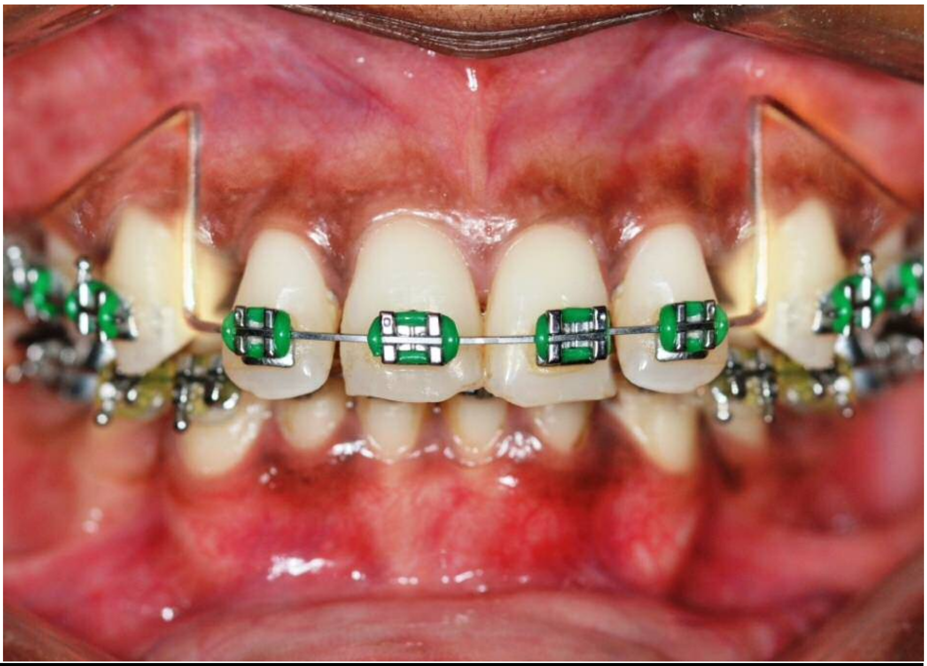


PARTS OF UTILITY ARCH

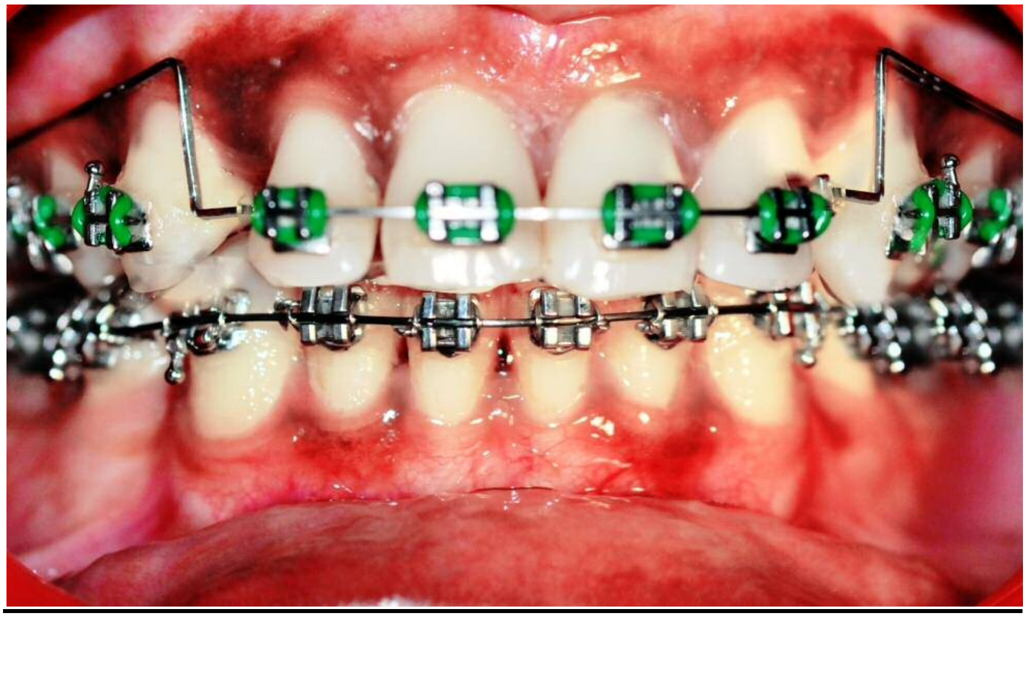
The utility arch is made with 16x22 blue elgiloy wire.Since the elasticity of stainless steel resembles the blue elgiloy, stainless wire of 16x 22 dimension is used to fabricate utility arch.Activation of the utility arch was done by placing a tip back bend in the molar segment. The tip back bend causes the incisal segment of the archwire to lie in the vestibular sulcus. The intrusive force is created by placing the incisal segment of the utility arch into the bracket of the incisors that allows for the long action of the lever arm of the utility arch to intrude the incisors. The anterior segment was angulated inwards to about 5 to 10 degrees to prevent labial tipping of incisors and to keep the roots in the medullary bone.Buccal root torque was given to the molar

UTILITY ARCH

PRE-TREATMENT (Fig:5A)



POST-TREATMENT (Figure:5B)



segment. The vestibular segment was flared to prevent impingement on the vestibule when the utility arch is placed. Patients were recalled once in every 3-4weeks interval.

RECORDS TAKEN

- ORTHOPANTOMOGRAM
- LATERAL CEPHALOGRAM
- FRONTAL CEPH
- IOPA RADIOGRAPHS
- PHOTOGRAPHS

The pre-treatment X-rays and photographs before intrusion (T1) and the post treatment X-rays and photographs were taken after intrusion (T2).

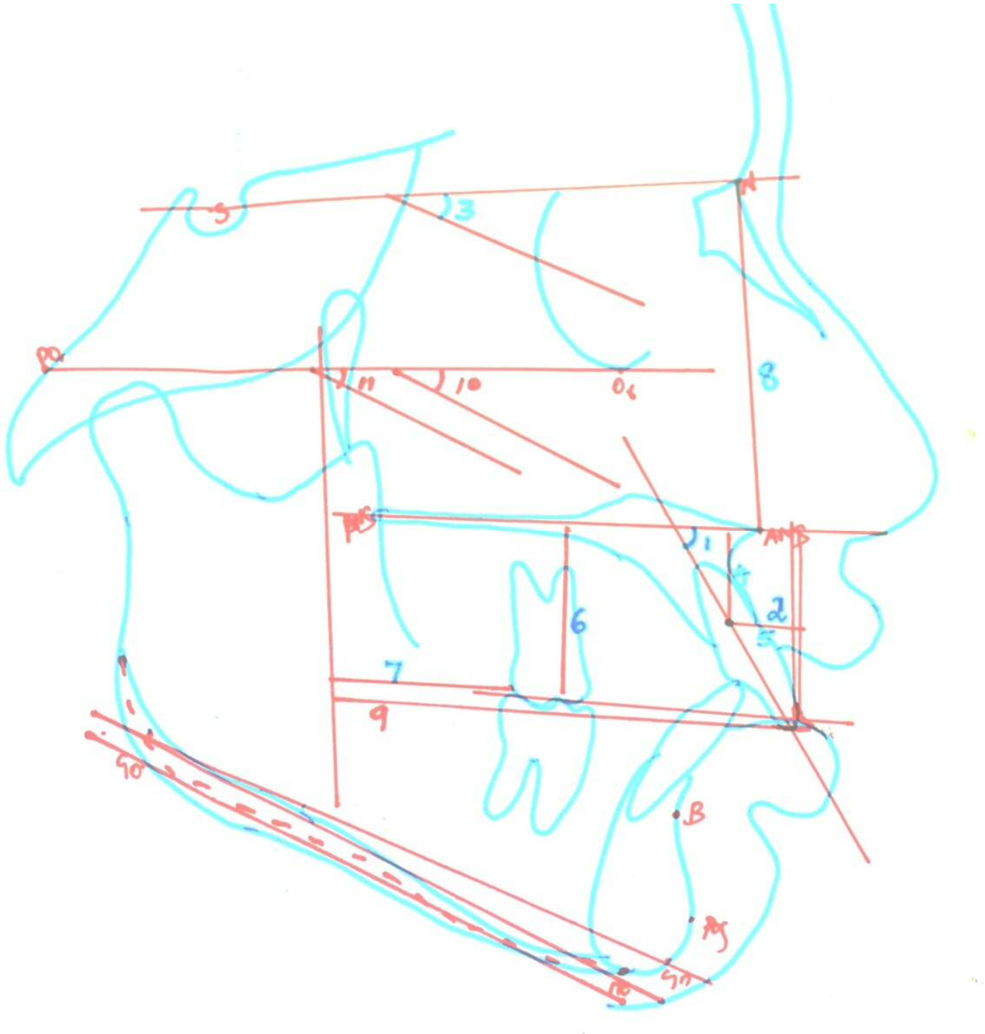
CEPHALOMETRIC ANALYSIS

Lateral cephalometric radiographs were traced on matt acetate film and were traced by the same operator using a lead pencil .The right and left structures were averaged and the usual landmarks for cephalometric analysis were identified on the tracing . The linear measurements and angular measurements were taken.

Linear and angular measurements are; (Fig 6)

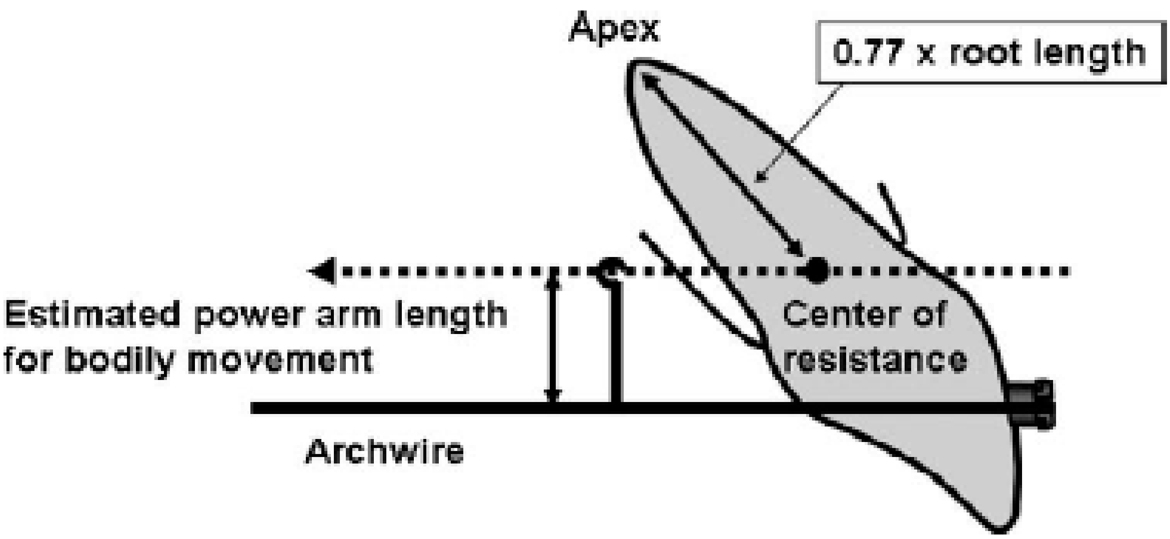
- upper incisor to palatal plane(linear)
- Upper incisor to paltal plane(angular)
- Upper molar to palatal plane(linear)
- CR of upper incisor to palatal plane(linear)
- Upper lip length(linear)
- Upper incisor exposure(linear)
- Anterior facial height(linear)

PARAMETRS USED IN THE STUDY (Figure:6)

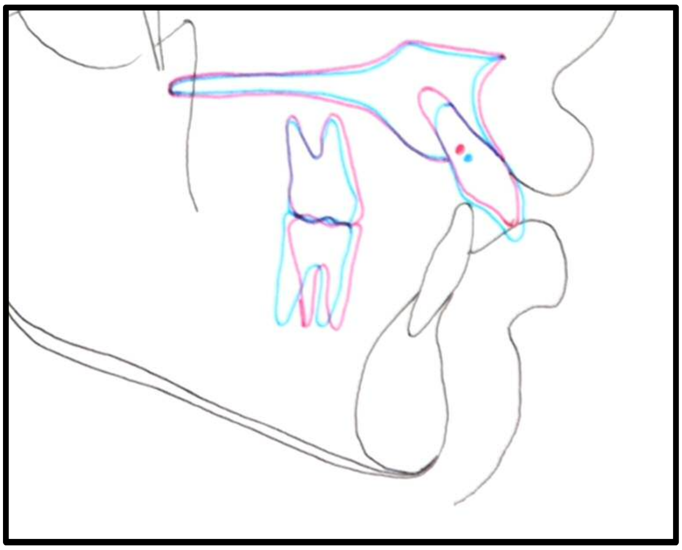


1.U1-PALATAL PLANE (ANGULAR) 2 .U1- PALATAL PLANE (LINEAR) 3.SN-GOGN 4.CENTER OF RESISTANCE TO PALATAL PLANE 5. .CENTER OF RESISTANCE - POINT OF FORCE APPLICATION 6.U6-PALATAL PLANE. 7.U6-PTV 8.N-ANS. 9.U1- PTV 10.MPA 11.FMA.

The center of resistance of the upper incisor was located on the lateral cephalogram using the formula0.77xroot length from the apex as given by **Sia et al** [88]. 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[73]. (Fig 7). The initial T1 and final measurements T2 for all cephalometric variables were tabulated and changes were calculated. The initial and final tracings were also superimposed to evaluate the changes that had occurred during the study.

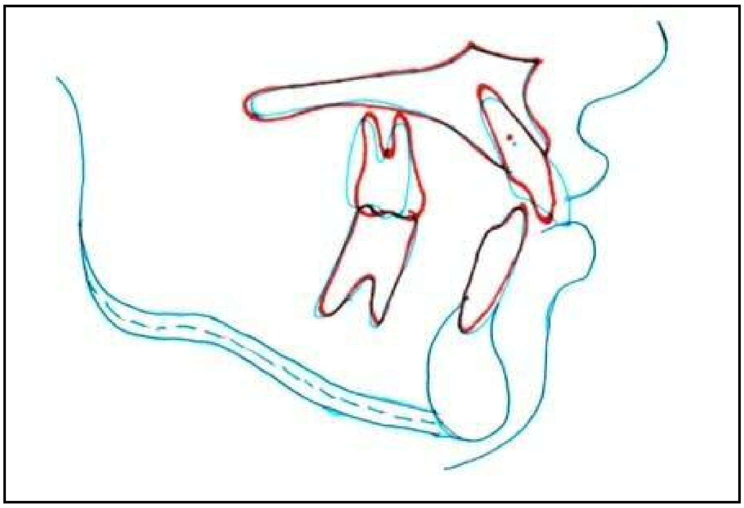


PALATAL PLANE SUPER-IMPOSITION OF THE PATIENT WITH MINI-IMPLANT (Figure:7A)



Blue – pre-treatment
Pink -post-treatment

PALATAL PLANE SUPERIMPOSITION OF THE PATIENT WITH UTILITY ARCH (Figure:7B)



Blue – pre- treatment
Pink -post-treatment

Results

Maxillary incisor intrusion lasted 6months in group I and group II.There was statistically significant amount of intrusion in both the groups.. The change in the vertical position of the CR showed significant changes in group I (-1.73±1.71) (P< 0.05)and groupII(-1.65±1.06) (P<0.05).But the intergroup comparisons were not significant (P>0.05).

T1 and T2 values are given by Table 1.

The sagittal movements of the maxillary incisors were different during intrusion between the groups.The incisors of the mini-implant group protruded -8.67±5.95 according to PP ; 1.13±1.88 according to center of resistance to palatal plane and 2.53 ±2.47 according to PTV and the P values were also significant (P<0.05). In the utility arch group there was statistically significant retroclination (P< 0.05). According to palatal plane it retroclined about 3±3.35 ; -2.24±2.17 according to center of resistance to palatal plane and -2.41±2.74 according to PTV. The intergroup comparisons were also significant (P< 0.05)

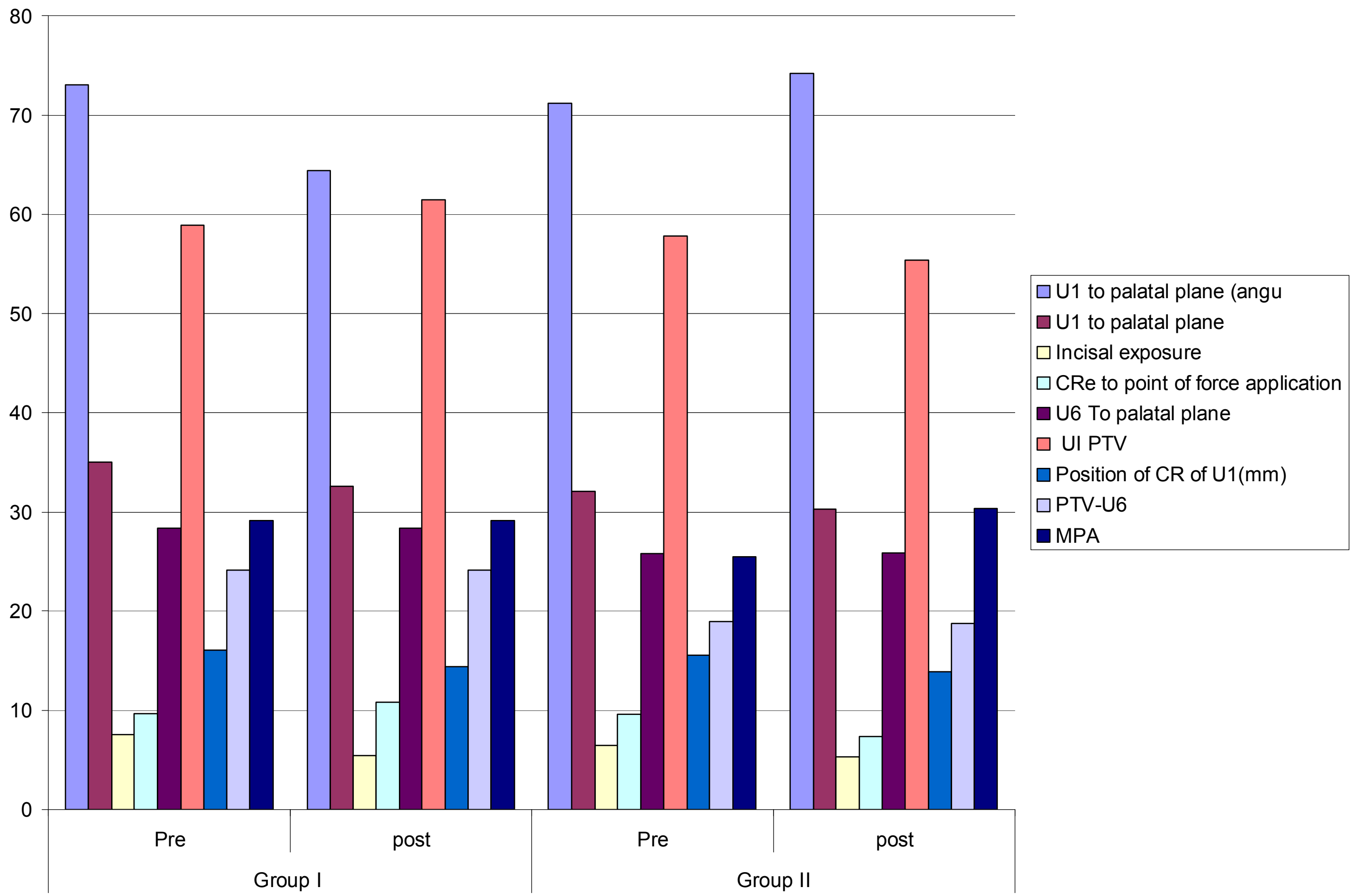
The difference in vertical position of the maxillary incisors from pre-treatment to post treatment relative to the PP were -2.4 ±1.59 for group I (P<0.05) and -1.88 ±1.05 for group II(P<0.05).The differences between the two groups were not significant according to palatal plane(P> 0.05).

The movements of the maxillary first molars were different between the groups.They showed no significant changes in the implant group(28.33±3.02 for U6 to PP,24.13±5.19 for U6 to PTV at TI and 28.33±3.02 for U6 to PP,24.13±5.19 for U6 to PTV at T2 ;P>0.05).

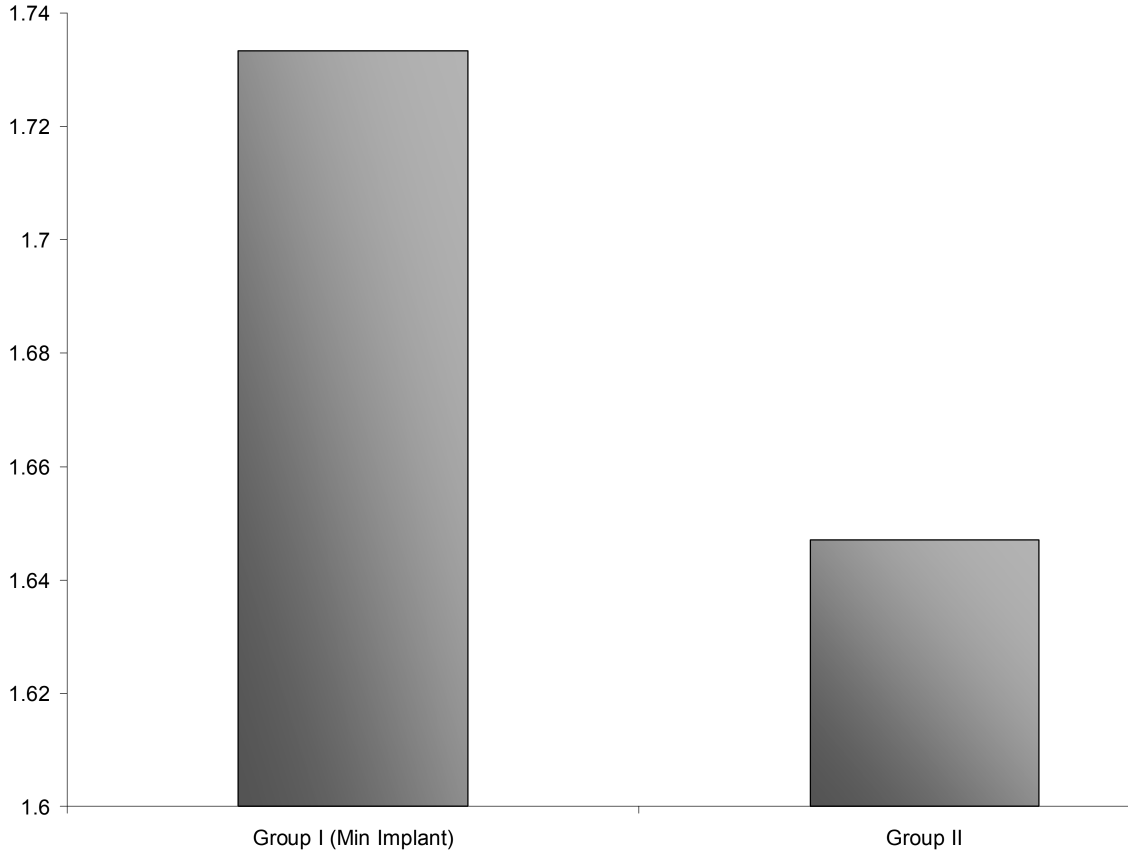
GoGn to SN,PMA and mandibular plane angle did not show any significant change in both the groups.P>0.05). The intergroup comparisons were also not significant(P>0.05).

	Group 1		P value for comparison of Pre post within group 1	Group 2		P value for comparison of Pre post within group 2	Differences Pre Post		P value for comparing group 1 and group 2 based on Post observations
	Pre (Mean ± SD)	Post (Mean ± SD)		Pre (Mean ± SD)	Post (Mean ± SD)		Group 1 (Mean ± SD)	Group 2 (Mean ± SD)	
U1 to palatal plane (angular)	73.07 ± 5.7	64.4 ± 5.94	0.000	71.24 ± 14.18	74.24 ± 13.62	0.002	-8.67±5.95	3±3.35	0.000
U1 to palatal plane	35 ± 3.02	32.6 ± 3.02	0.000	32.12 ± 3.82	30.24 ± 4.13	0.000	-2.4±1.59	-1.88±1.05	0.282
Incisal exposure	7.53 ± 3.52	5.4 ± 3.14	0.000	6.47 ± 3.14	5.29 ± 2.71	0.015	-2.13±1.25	-1.18±1.78	0.092
CRe to point of force application	9.67 ± 1.05	10.8 ± 1.66	0.035	9.59 ± 1.5	7.35 ± 1.87	0.001	1.13±1.88	-2.24±2.17	0.000
U6 To palatal plane	28.33 ± 3.02	28.33 ± 3.02	NA	25.76 ± 4.19	25.88 ± 3.92	0.735	0±0	0.12±1.41	0.749
UI PTV	58.93 ± 5.55	61.47 ± 5.19	0.001	57.82 ± 4.49	55.41 ± 3.78	0.002	2.53±2.47	-2.41±2.74	0.000
Position of CR of U1(mm)	16.07 ± 5.02	14.33 ± 4.5	0.002	15.53 ± 2	13.88 ± 2.09	0.000	-1.73±1.71	-1.65±1.06	0.863
PTV-U6	24.13 ± 5.19	24.13 ± 5.19	NA	18.88 ± 5.5	18.76 ± 4.97	0.874	0±0	-0.12±3.02	0.881
MPA	29.07 ± 5.55	29.07 ± 5.55	NA	25.53 ± 8.58	30.35 ± 5.52	0.051	0±0	4.82±9.45	0.051
SN-GO GN	27.33 ± 5.35	27.33 ± 5.35	NA	25.94 ± 3.53	26.41 ± 4	.149	0±0	0.47±1.28	0.149
FMA	26.8 ± 5.72	26.8 ± 5.72	NA	27.12 ± 3.5	27.53 ± 3.86	.110	0±0	0.41±1	0.110

GRAPH:1


80
70
60
50
40
30
20
10
0
Pre
post
Pre
post
Group I
Group II
U1 to palatal plane (angu
U1 to palatal plane
Incisal exposure
CRe to point of force application
U6 To palatal plane
UI PTV
Position of CR of U1(mm)
PTV-U6
MPA

AMOUNT OF MAXILLARY INCISOR INTRUTION (CENTRE OF RESISTANC
GRAPH 2



Discussion

The position of the maxillary incisor with the upper lip plays an important role in determining the treatment of deep-bite. Deep-bite is corrected by intrusion of extruded maxillary incisors in patients with increased exposure of the maxillary incisors at rest[21], inspite of having a normal lip length and vertical maxillary height. There are several mechanics which are used for intrusion of extruded maxillary incisors. In our study we compared the skeletal and dental changes brought about by mini-implants and standard utility arch during intrusion of maxillary incisors, to conclude which of the following mechanics are showing least adverse effects during intrusion[68,73].

In our study to place the implant for intrusion the center of resistance of the maxillary incisors were taken as 4mm from the mid-saggital plane and 6mm from the labial alveolar crest of the incisor according to **Matsui et al(2000)**[59] and was placed bilaterally on either side of the midline,at the level of the center of resistance of the anteriors to avoid any cant during the intrusion of the incisors.

The implant was placed using a customized mini-implant guide.The pre and post treatment incisor vertical changes were analysed for both the groups by the movement of center of resistance of the maxillary incisor in the lateral cephalogram. The formula 0.77xroot length which was given by **Sia et al(2007)**[88] using an in-vivo magnetic sensing technique was used to mark the CR from the root apex.

In the utility arch group the biomechanics and force levels were standardized ,for all the patients during the intrusion period and periodic reactivation of the 16x 22 SS wire was done for all the patients as and when necessary in order to maintain a normal intrusion force of 30 grams. Since there will be an reciprocal countermoment on molar during intrusion ,the saggital and vertical molar position were analysed.

Comparing the results of this study with the other studies using mini-implants for intrusion , there were differences in the amount of intrusion and the angular change in the incisors. This was because of the differences in the direction of force applications and measurements. There were controversies in the location of center of resistance of the maxillary incisors. Studies done by **holographic technique and laser reflection technique** by **Vandenbulke(1986)**[57] which stated that the center of resistance for the incisors were located distal to lateral incisors.; **Kwangchul(2006)**[48] determined the center of resistance of the maxillary incisors at 14.5 mm apical,9.5mm distal from the incisal edge of the maxillary incisor**; N.Yoshida (2001)**[106] determined the center of resistance of the maxillary incisors to be at 4.3±0.3mm apical to the palatal bone; **Pederson et al (1991)**[95] states that the CR of maxillary incisors lies 5mm apical to the bracket of incisors **Gjessing et al (1994)**[95] stated that the CR lies 7mm distal and 9-10mm gingival to the lateral incisor bracket.. In our study to place the implant for intrusion the center of resistance of the maxillary incisors were taken as 4mm from the mid-saggital plane and 6mm from the labial alveolar crest of the incisor according to **Matsui et al(2000)**[59] . The force applied was 30 gms of force according to **Profit.**[76] and the implants were loaded immediately since orthodontic implants mainly depend on mechanical retention.[54]

The implant was placed using a customized mini-implant guide . There are different guides available which were designed by various authors like **Camillo (2005)**[14] **,Matheos Milo(2009)**[58]**,Sergia estella et al(2006)**[89] .The amount of intrusion achieved and the amount of Proclination of incisors were measured using the center of resistance of maxillary incisors in the lateral cephalogram.The studies were done to locate the center of resistance of the maxillary incisor. **Noriaki et al(2001)**[71] did in-vivo study using magnetic sensing system and inferred that the CR of maxillary incisor lies at two-thirds the palatal alveolar bone height from the root apex; according to **James Baldwin(2003)**[41] it is four tenths the distance from alveolar crest to the root apex; **Ioanis (2005)** [39] gives review about the location of center of resistance given by various authors.in this articale he states that **Burstone in 1980** gave a formula of 0.33 x root length to locate the CR from the alveolar crest and **Nikolai in 1974** stated the formula of 0.45x root length from the alveolar crest to locate the CR of maxillary incisor.The formula 0.77xroot length which was given by **Sia et al(2007)**[88] using an in-vivo magnetic sensing technique was used to mark the CR from the root apex. The distance from the center of resistance to the palatal plane was measured for T1 and T2 . The Difference between them was given as the amount of intrusion.

The amount of intrusion achieved was 1.73±1.72mm and this was similar to the studies done by **Omur Polat(2010)**[68] **, Nelishun(2012)**[73] **, Dr.Krishna Nayak (2010)**[46] **reported intrusion of 3mm , Rekha mitlal (2009)**[80]**reported an intrusion of 2.8mm, Omar Polat (2009)** [72] **reported an intrusion of 1.92mm**. In the other studies more than 3mm of intrusion achieved was reported because the incisal edge was used to measure the intrusion. **Hidetake ohinishi (2005)**[32] reported 6mm of intrusion,;apex of the incisor was used to determine the intrusion achieved ; **Deepak Chandran (2009)** [23] reported an intrusion of 6 mm to 7mm of intrusion;**Madhur Upadhay (2008)**[56] reported an intrusion of 4mm.The apex was not taken because it could false reading if there was only Proclination and not intrusion.

The amount of Proclination was calculated from the CR perpendicular to the point of force application.This was done similar to the study done by **Omur Polat(2010)**[73] who compared the amount of intrusion achieved by implants and utility arch .There was Proclination of the incisors in the implant group of about 1.13±1.18 from the CR to point of force application .This is similar to studies by **van steenberg (2005)**[94] who observed

8°increased in the axial inclination of the incisors, **Christopher parker(1995)**[19] also inferred that there was Proclination of teeth in his study.

There was no bias between the utility arch group and the implant group with the methods of measurement of the linear and the saggital changes and the amount of force application. There was significant amount of intrusion obtained by utility arch which was about 1.65±1.06mm from CR to PP. According to **Mihri et al (2005)**[65] who compared the intrusive effects utility arch and connticut arch there was intrusion of 3mm from the incisal tip to palatal plane. **Major PW(2005)**[55] reported 1.5 mm in the maxillary arch and 1.9mm of intrusion can be achieved in the mandibular arch; **Abdulaziz et al(2002)**[1] compared continuous arch and utility arch for leveling curve of spee and found intrusion with utility arch while there was Proclination with continuous arch; **Iosif Sifokakis (2009)**[38] compared 16x16 blue elgiloy utility arch,17x25 TMA utility arch,17x25 TMA burstone intrusion arch and reported that 16x16 bue elgiloy wire utility arch has the intrusion rate and the lowest was 17x25 TMA Burstone intrusion arch.

In our study the anterior step of the utility arch was angulated inward for about 10 to 15 degrees to prevent labial tipping of incisors which caused the retroclination of the incisors, was also reported by **Nelishun et al (2012)**[76]; a buccal root torque for molar anchorage and a tip back bend according **to Rickkets bioprogressive therapy**[84]**.** Though there was mesial tipping of molars due to the cinch back [76] it was insignificant statistically and therefore there was no increase in the mandibular plane angle.

In this study there was significant intrusion of 1.73±1.71mm in the mini-implant group and about 1.65±1.06 mm in the utility arch group . This was close to the results obtained by a similar study done by **Omur Polat (2010)**[73] with mini-screws and utility arch..There was proclination of the incisors in mini-implant groups. This was similar to the results obtained by **Neslihan et al (2012)**[68] who compared intrusion achieved using conneticut intrusion arch and implants. **Toru Deguchi (2009)**[99] concluded that mini-implant had better amount of intrusion than the J-hook head gear. There was retroclination of incisors in the utility arch group since the anterior segment of the utility arch was angulated inwardly about 10 to 15 degrees according to **BPT** [84] to counteract the tipping and to keep the roots in the medullary bone , could have caused the retroclination. This was also similar to the study done by **Nelishun et al (2012)**[68]where there was retroclination of incisors.

There was no movement of the molars in the implant group. A buccal root torque was given in the utility arch for the patients for anchorage purpose as recommended by **Ricketts in BPT**[84]. There was mesial movement of the molars in the utility arch group as proved by various studies like **Moshe davidovitch(1995)**[66] **Nelishan et al (2012)**[68] in his utility arch group also experienced mesial movement of molars due to the mesial force caused by the cinch back of the utility arch . But it was proved insignificant statistically in this study.. **Amirparviz et al (2012)**[2] compared the anchorage control between the differential moments and the mini-implants during retraction and concluded that there was no significant statistical difference in anchorage control between them.

The most important disadvantage of the intrusion mechanics is root Resorption[24,25,29,50]. According to **Edward.F.Harris (2000)**[29] stated that The strongest single association with apical root resorption seems to be a person's genotype. Familial studies show that a person's genotype accounts for about two-thirds of the variation in the extent of periapical resorption. The other causes for root Resorption are due to heavy force,occlusal traumas and have root resorption could also be due to abnormal tongue and lip functions.**Greg Costopolis (1996)**[25] also stated that with low force levels good amount of overbite reduction with negligeable root resorption can be done. OPGs were taken at T1 and T2.There was root blunting in 2 patients of the mini-implant group . The force was kept constant for all the patients belonging to the two groups and since only two patients showed apical root resorption it could be due to the patients genotype.

In our study we also encountered an implant fracture and an implant failure. The implant fracture was due to increased torsion caused due to increased force while drilling the implant manually inside the alveolar bone.The implant failure was due to the drugs which was taken by the patient.The patient was under carbamizapine tablets for epilepsy. Since this drug has an effect on bone turnover it could have led to implant failure.

Summary and Conclusion

This in-vivo study was done to evaluate the true intrusion of maxillary incisors that was achieved by mini-implants and utility arch. .On the basis of our results it was found that there was significant amount of true intrusion in both the groups . The difference between the amount of intrusion between the 2 groups was found to be statistically insignificant.

In spite of maintaining the normal intrusive force for the maxillary incisors and passing the force close to the center of resistance ,there was mild proclination observed in the mini-implant group as experienced by other authors [73,68]. In the utility group a mild amount of retroclination was observed as result inward deflection of the anterior segment in order to pass the force closer to the center of resistance[84]. This mild lingual inclination was favorable in patients who had mild proclination.

There was an extrusive moment created in the molars due to the tip back bend given in the molar segment of the utility arch but it was statistically insignificant. The mesial movement of the molars was due to the mesial force created due to the cinch back given in the molar segment to prevent the labial tipping of the incisors as observed by others[73,68].

According to the results of this study though both the groups showed adequate intrusion , there was mild proclination in the mini-implant group due to the inherent drawback of not being able to pass the force through the center of resistance. In both the groups a better control of intrusion of anteriors was observed with minimum untoward tooth movement.

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