

Comparative Evaluation of Rate of Intrusion and Amount of Periapical Root Resorption with Temporary Anchorage Devices and Connecticut Intrusion Arch in Adult Population- A Prospective Interventional Study

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ABSTRACT

Introduction: Deep bite is a complaint where there is an increase in the vertical overlap between the upper and lower arch front teeth. Deep bite is a relatively short face with a square gonial angle and flat mandibular plane are related to the skeletal dimensions that influence this condition. An untreated, deep overbite leads to the problems such as: abnormally increased wear and harm to the teeth, periodontal complains issues with occluding and chewing food, headaches and Temporomandibular Disorders (TMD), painful sores or ulcers, loss of tooth structure and tooth itself. There are various treatment modalities which aid in correction of these anomalies. Such as: mini screw implants Temporary Anchorage Devices (TADs) and various intrusion arches.

Need of the Study: Due to the paucity of evidence regarding rate of intrusion and the correlation of root resorption with use of bilateral TADs and Connecticut Intrusion Arch (CIA), with the aid of Cone Beam Computed Tomography (CBCT), the present study will be conducted to provide an insight into the efficacy of both treatment modalities to correct deep bite and identify which of the two modalities provide less damage to the root and surrounding structure.

Materials and Methods: The following prospective interventional study will be conducted in the Department of Orthodontics and

Dentofacial Orthopaedics, Sharad Pawar Dental College, Sawangi, Meghe, Wardha, Maharashtra, India. The duration of study will be two years. A sample of 20 patients will be split into two groups to perform the study. Bilateral TADs will be implanted in group A, while CIA will be placed in group B to allow for the intrusion of front teeth. All the patients will be started with initial levelling and alignment using MBT 0.022" bracket prescription. After leveling and alignment miniscrew implants (TADs) will be placed in the labial cortical plates in between the lateral and canine bilaterally in Group A and CIA will be placed in patients allotted to Group B. CBCT records will be collected in the following time intervals: Before applying intrusion mechanics (T_0), After one month of applying intrusion mechanics (T_1), three months after applying intrusion mechanics; (T_2) six months after applying intrusion mechanics (T_3). Rate of intrusion and amount of root resorption will be assessed and compared between these time intervals.

Expected Outcome: The rate of intrusion using different intrusion mechanics have been assessed by other studies, however, they have not been correlated with the amount of root resorption caused by these technique. Therefore, the present study intends to evaluate and compare the rate of intrusion and the amount of root resorption of maxillary anterior teeth using TADs and CIA and thereby assessing better modality in correction of deep bite.

Keywords: Deep bite, Miniscrews, Temporomandibular disorders, Overbite

INTRODUCTION

Deep bite is a condition caused by skeletal proportions that generate a relatively short face with a square gonial angle and flat mandibular plane. If complains of deep bite is not treated, it can lead to further complications such as: abnormally increased wear and harm to the teeth, periodontal complains, issues with occluding and chewing food, headaches and TMD, painful sores or ulcers, loss of tooth structure and tooth itself [1]. There are different types of overbite: skeletal, dental and combination or both. Treatment of dental deep overbite can be achieved by intrusion and extrusion of anterior and posterior teeth respectively or by combining the two approaches. Idea; such as the position of incisor tooth, clip-to-tooth relationships and the lower vertical dimension are the key determining factors for taking the decision [2].

According to study conducted by Nanda R et al., he stated that as the intrusion arch is not directly engaged in the incisal brackets, its action of force delivery is significantly different. The intrusion arch

will not only tip the molars in backward direction but also intrude the incisors simultaneously when designed properly. Further, only a single design is able to solve multiple problems without requiring changes in the wire and with no or minimal adjustment of the appliances [2]. There are various treatment modalities which aid in correction of these anomalies. Such as: mini screw implants (TADs) and various intrusion arches.

The TADs compose a broad range of implants used to sustain orthodontic treatment. As currently claimed, all TADs are aggressively used treatment modalities and are best for treating complaints that cannot be managed with the traditional mechanism. Recently, miniscrews are manufactured using titanium (Ti) or titanium alloys, constructed with a smooth, machined surface designed in a way that it does not osseointegrate. By definition, TADs are temporary devices; no long-term functional or aesthetic role is planned [3].

Utility arches have many uses in different stages of orthodontic treatment. It was developed according to the biomechanical

principles described by Bur Stone and were then refined for its incorporation in bioprogressive therapy. There has been use of utility arches for the intrusion of maxillary anteriors as well [4].

NiTi alloys are presently the materials of choice for conveying light, uninterrupted forces under great activation. NiTi alloys have great memory and decreased load-deflection rates, creating smaller increments of deactivation over the period of time. This helps to reduce activation appointments and provides greater patient compliance [5].

The most common application of the CIA is for the intrusion of front teeth, but it can also be used for a variety of other purposes, including molar tipback for Class II correction, incisor flaring, treating minor open bites, levelling anterior occlusal cants, and finishing [2]. It is necessary to choose the optimal orthodontic therapy in order to prevent harm to the tissue structures nearby. Therefore, before its clinical use, biomechanical computation and validation of the defined orthodontic force system is recommended [6].

Orthodontic treatment can cause some amount of root resorption, well-known as External Apical Root Resorption (EARR). The forces that are applied for the correction or alignment of the teeth or movement of teeth causes a mechanical effect that leads to resorption at the root apex. Another cause of resorption is said to be due to deviated root shapes or excessive orthodontics forces [4].

Different modalities have differences in the rate and duration at which the teeth intrude. A study was conducted by Arora A et al., where they compared the rate of intrusion between unilateral TADs and utility arch and found significant intrusion with both modalities, while TADs provided greater intrusion amongst the two [4]. However, there was no mention regarding the root resorption caused by either of the intrusion mechanics.

Due to the paucity of evidence regarding rate of intrusion and the correlation of root resorption with use of bilateral TADs and CIA, with the aid of CBCT, the present study will be conducted to provide an insight into the efficacy of both treatment modalities to correct deep bite and identify which of the two modalities provide less damage to the root and surrounding structure.

The aim of the present research is:

- To evaluate the rate of intrusion in males and females using CIA-1, 3, and 6 months after application of intrusive forces
- To evaluate the rate of intrusion in males and females using Tads-1, 3, and 6 months after application of intrusive forces.
- To compare the rate of intrusion caused by both intrusion techniques in males and females-1, 3, and 6 months after application of intrusive forces.
- To evaluate root resorption of upper anterior teeth in males and females after using TADs-1, 3, and 6 months after application of intrusive forces.
- To evaluate root resorption of upper anterior teeth in males and females after using CIA-1, 3, and 6 months after application of intrusive forces.
- To compare the amount of root resorption in males and females caused by both intrusion techniques before application of intrusive forces and 1, 3 and 6 months after application of intrusive forces.

MATERIALS AND METHODS

The following prospective interventional study will be conducted in the Department of Orthopaedics, and Dentofacial Orthopaedics, Sharad Pawar Dental College, Sawangi Meghe, Wardha, Maharashtra, India. The duration of study will be two years. The present study has been approved by the Institutional Ethics Committee (IEC) of Datta Meghe Institute of Medical Sciences, Deemed to be University with reference number: DMIMS (DU)R&D/2022/277.

Inclusion criteria:

- Patients with increased overbite. (i.e., ≥ 5 mm).
- Patients having reduced lower anterior facial height less than 64 mm for males and less than 57 mm {i.e., Anterior Nasal Spine to Gnathion (ANS to Gn) i.e., less than 68.6 mm \pm 3.8 mm in males and less than 61.3 mm \pm 3.3 mm in females}.
- Patients of post pubertal age.

Exclusion criteria:

- Patients with persistent or recurrent periodontal diseases.
- Endodontically treated anterior teeth. In a study carried out by Esteves T et al., the results showed that 50% of endodontically treated teeth had a greater root resorption compared to the vital group, however the other 50% showed more resorption in the vital teeth group [6]. The authors also mention that all teeth show some degree of resorption during orthodontic tooth movement. Patients having any systemic disease.
- Patients with previous orthodontic treatment.
- Patients with bone deformities.
- Patients having malformed roots.

Sample size calculation: Sample size formula for difference between two means:

$$n = \frac{(Z\alpha + Z\beta)^2 (\sigma_1^2 + \sigma_2^2 / K)}{\Delta^2}$$

Where;

Z α is the level of significance at 5% i.e.,

95% Confidence Interval=1.96

Z β is the power of test=80%=0.84

σ_1 =SD of central incisor in mini implant group=1.095

σ_2 =SD of central incisor is utility arch group=0.742

Δ =Difference between two means=23.55-22.28=1.27

K=1

$$n = \frac{(1.96 + 0.84)^2 (1.095^2 + 0.742^2 / 1)}{1.27^2}$$

=8.59

=> n=10 patients needed in each group.

Study Procedure

Random selection of patients (patients coming in Department of Orthodontics OutPatient Department (OPD) will be selected on the basis of the inclusion criteria, following which males and females will be separated and chits (lucky draw method) will be picked allot particular treatment modality to each patient) [7]. A sample of 20 patients- 10 men and 10 women- will be split into two groups to perform the study. Bilateral TADs will be implanted in group A, while CIA will be placed in group B to allow for the intrusion of anterior teeth. Complete case history and study records will be obtained from both groups, after obtaining approval from the Institutional Ethics Committee and informed consent from the selected patients. All the patients will be started with initial leveling and alignment using MBT 0.022" bracket prescription, following the wire sequences- 0.016" Niti followed by 0.016 \times 0.022" Niti and 0.017 \times 0.025" Niti wires, further placing 0.017 \times 0.025 SS wires, followed by placement of 0.019 \times 0.025" SS wires. After leveling and alignment, it will be made sure that the maxillary incisors are in the center of the cancellous bone and are not in contact with the cortical bone. Following this miniscrew implants (TADs) will be placed in the labial cortical plates in between the lateral and canine bilaterally in group A and CIA will be placed in patients allotted to group B.

Cone Beam Computed Tomography (CBCT) records will be collected in the following time intervals:

1. Before applying intrusion mechanics (T_0)
2. After one month of applying intrusion mechanics (T_1)
3. Three months after applying intrusion mechanics (T_2)
4. Six months after applying intrusion mechanics (T_3)

Four CBCT exposure in a period of 6 months=Four Intra-Oral Periapical Radiograph (IOPA) in 6 months.

As stated in White, Stuart C Oral Radiology [8], Dental Panoramic Radiograph=9-26 μ Sv and CBCT (focus field of view) for dentoalveolar region is 5-38.3 μ Sv. His field of view is smaller than the panoramic view i.e., only maxillary six anteriors. Hence, the exposure is reduced. All the measures will be taken to reduce the exposure, as much as possible by the use of lead jackets, collars etc.,

Rate of intrusion and amount of root resorption will be assessed and compared between these time intervals. CBCT is readily available to dentists and has shown high accuracy in calculation of root volume and is considered as a gold standard in identifying root anatomy. This accuracy is mainly due to its 3D imaging, and CBCT voxels are isotropic [9].

Expected Outcome

The rate of intrusion using different intrusion mechanics have been assessed by other studies, however they have not been correlated with the amount of root resorption caused by these technique. Therefore, the present study intends to assess and compare the amount of intrusion and the amount of root resorption of upper anterior teeth using TADs and CIA and thereby, assessing better modality in correction of deep bite.

STATISTICAL ANALYSIS

All data will be analysed using Social Package for the Social Sciences (SPSS) statistical software (27.0), GraphPad Prism (7.0). All the descriptive and inferential data will be subjected to statistical analysis, which will be done using Chi-square test.

DISCUSSION

A study was conducted by Barros SE et al., where he retracted the central incisors with and without skeletal anchorage to evaluate the amount of root resorption caused by these retraction techniques [3]. The study was non randomised control type, inclusive of 37 patients diagnosed with anterior retraction more than normal and treated with two upper arch bicuspid. Total of 22 patients i.e., 11 women and 11 males were included in group 1 in whom non skeletal anchorage was provided for the retraction of anterior teeth. Fifteen patients were included in group 2 (3 men, 12 women) that were provided with skeletal anchorage for anterior retraction. IOPA was considered as a diagnostic tool to assess amount of root resorption by a scoring system. After evaluation, the number of patients with increased resorption in the 1st group was significantly higher.

A study was conducted by Kumar P et al., on 30 subjects with Class II Division 1 malocclusion having an overbite of more than 6 mm [9]. In the present study, he treated group 1 using TADs and group 2 using CIA. Rate of intrusion of 0.51 mm/month was achieved using TADs and 0.34 mm/month using CIA. He established that the amount of intrusion is higher in the group using TADs.

In a study conducted by Bhat M, Madhur V with an aim of comparing the degree of root resorption in patients getting orthodontic treatment to intrude the anteriors with the help of utility arches and TADs in maxilla [1]. Study sample consisted of two groups, i.e., group A and group B with 10 patients in each

group. Titanium TADs were placed in group A and 0.017x0.25" TMA was used in group B. Study models and Radio Visio Graphy (RVG) was recorded twice to maintain diagnostic records, T1 (before placement of TADs or utility arches) and T2 (6 months later). Intrascan DC software was used for comparison of the pre and post radiographic images. Root resorption was evaluated by calculating the difference between the pre and post-treatment total tooth length. As SPSS 16.0 software was used for the presen study study, the values of this study remains concealed.

It was established by the results that, there was visible amount of root resorption in both the groups. Higher scale of resorption was seen in the group A. TADs outperformed utility arches in terms of better or more effective effects while treating deep bite. Thus, it was determined that small implant intrusion was more efficient at intruding the incisors than utility arch, although it caused greater root resorption [1].

For the evaluation of root resorption of front teeth following miniscrew aided en masse retraction in grown-up biolveolar protrusion patients, Chen Y and Liu D undertook a retrospective, analytical examination in 2020 [10]. The research included 36 adult patients with bimaxillary protrusion who underwent extraction of all four first premolars and subsequent implantation of miniscrews to provide anchoring. CBCT scans were done both before and after the therapy (T1 and T2) (T2). A novel improvement project for the 3D CBCT registration evaluation of root morphology was offered. To compare changes from T1 to T2, a paired t-test was utilised. Pearson's correlation coefficient analysis was used to analyse the association between root resorption and anterior tooth movement. Significant changes were only identified in the apical third of the root, and the palatal and distal sectors always show the most resorption in the apical third of the root. The quantity of anterior tooth retraction and intrusion were found to have significant relationships in root loss in the distal and palatal sectors, root length, and volume.

Li W et al., conducted a study in which they measured the amount of root resorption caused after doing intrusion using a molar mini-screw implant [11]. He measured the amount of root resorption using CBCT as it provided volumetric measurements. The study was done with a sample size of eight patients. Pre and post-treatment results from the CBCT were compared for the amount of evaluation of the root resorption caused by the particular treatment modality. He concluded that the difference between the CBCT results of pre and postintrusion was statistically significant for the roots that were investigated.

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