EVALUATION OF LABIAL ALVEOLAR BONE THICKNESS IN BIMAXILLARY PROTRUSION CASES BEFORE AND AFTER ORTHODONTIC RETRACTION USING SLIDING MECHANICS-A CBCT STUDY

By

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2020-2023

DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation/thesis entitled "***Evaluation of Labial Alveolar bone thickness in bimaxillary protrusion cases before and after orthodontic Retraction using sliding mechanics: A CBCT study***" is a bonafide and genuine Research work carried out by me under the guidance of ***Dr. Binnoy Kurian***, Professor &HOD, Department of Orthodontics& Dentofacial Orthopaedics, St. Gregorios Dental College, Chelad, Kothamangalam.

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This is to certify that the dissertation entitled "***Evaluation of labial alveolar bone thickness in bimaxillary protrusion cases before and after orthodontic retraction using sliding mechanics: A CBCT study"*** is a bonafide research work done by ***Dr.SREENATH U.P***, in partial fulfillment of the requirement for the Degree of Master Of Dental Surgery.

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ENDORSEMENT BY THE HOD, PRINCIPAL/HEAD OF THE INSTITUTION

This is to certify that the dissertation entitled "***Evaluation of labial alveolar bone thickness in bimaxillary protrusion cases before and after orthodontic retraction using sliding mechanics: A CBCT study" is*** a bonafide research work done by ***Dr.Sreenath U.P*** under the guidance of ***Dr. Binnoy Kurian***, Professor & HOD, Department of Orthodontics & Dentofacial Orthopaedics.

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ABSTRACT

BACKGROUND:

Orthodontic tooth movement is a process whereby the application of a force induces bone resorption on the pressure side and bone apposition on the tension side. In view of this fact, the study was designed to quantitatively evaluate the alveolar bone thickness of the anterior teeth after en-masse retraction in bimaxillary dentoalveolar protrusion cases using Cone Beam Computed Tomography.

OBJECTIVES:

To estimate the labial alveolar bone thickness in the anterior region after orthodontic retraction in 1st premolar extraction cases by using sliding mechanics.

To evaluate the change in thickness of the labial and lingual alveolar bone after en- masse retraction of maxillary anterior teeth.

MATERIALS AND METHODS:

CBCT images of 12 patients were collected from the existing Cone Beam Computed Tomography records in the Department of Orthodontics and Dentofacial Orthopaedics, St.Gregorios Dental College, Kothamangalam. Cone Beam Computed Tomography records of patients with bimaxillary dentoalveolar protrusion and treated with all 4 first pre-molar extraction was taken for the study.

RESULTS AND CONCLUSION:

There was a significant increase in the alveolar bone thickness on the labial side of the maxillary central incisors and a decrease in palatal or lingual side. The findings of this study indicate that tooth moves within the alveolar process in the direction of the force applied.

KEYWORDS:

Alveolar bone thickness, Cone Beam Computed Tomography, Maxillary Central Incisors, Remodelin

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S.NO	ABBREVATION	FULL FORM
1	CBCT	CONE BEAM COMPUTED TOMOGRAPHY
2	CT	COMPUTED TOMOGRAPHY
3	LC	LATERAL CEPHALOGRAPH
4	MRI	MAGNETIC RESONANCE IMAGING
5	MBT	MCLAUGHLIN BENNET AND TREVISI
6	NiTi	NICKEL TITANIUM
7	PEA	PRE ADJUSTED EDGEWISE APPLIANCE
8	S1	SLICE 1
9	S2	SLCIE 2
10	S3	SLICE 3
11	L1	LABIAL 1
12	L2	LABIAL 2
13	L3	LABIAL 3
14	P1	PALATAL 1
15	P2	PALATAL 2
16	P3	PALATAL 3

Introduction

INTRODUCTION

Orthodontic tooth movement is a process whereby the application of a force induces bone resorption on the pressure side and bone apposition on the tension side. The rate of tooth movement, the degree of change in inclination and the extent of intrusion are some of the factors related to changes in alveolar bone thickness during retraction.[1] Alveolar bone loss and some dehiscence's are some of the consequences expected during retraction of the anterior teeth.[2]

In terms of alveolar bone remodeling, there are two perceptions in orthodontic tooth movement. If the bony remodeling is occurring in coordination with resorption and deposition, then the bone remodeling and tooth movement will occur at a 1:1 ratio, and the tooth will stay in the alveolar covering. This type of movement of a tooth is termed as ''with-the-bone.'' On the other hand, if there is no equilibrium between resorption and deposition of the alveolar bone during the tooth movement, then the tooth will tend to come out of the alveolar covering. This type of movement of a tooth is termed as ''within-the-bone''. Thus, a careful assessment of alveolar bone and roots of the anterior teeth should be done after en masse retraction to determine the therapeutic limitation of orthodontic tooth movement based on the ''with-the-bone'' and ''through-the bone'' concepts.[3]

But there is a controversy on whether all the alterations that occur during tooth movementin anterior alveolar bone always pursues the path as well as degree of tooth movement.[4] The debate and controversy is whether the alveolar bone follows the direction of tooth movement or there is an actual loss of supporting alveolar bone. In severe protrusion where maximum retraction is required, the tooth tends to breach the cortical plate exposing roots and also leading to loss of alveolar bone. Compensation for the bone loss that occurs by remodelling capacity of alveolar bone is questionable in each and every case. Even though autopsy findings have shown that dehiscence and fenestration occurred on individuals who have undergone treatment with retraction, the bony defects were simply not identified or were not evident through radiographic or clinical examination.

In 1986, Schroeder reported the volume as well as the shape of the alveolar process is determined by the form of teeth, their axis of eruption and eventual inclination since the alveolar process is a tooth dependent tissue that develops in conjunction with the eruption of teeth. The rate of tooth movement, the degree of change in inclination and the extent of intrusion are some of the factors related to changes in alveolar bone thickness during retraction. Alveolar bone loss and some dehiscence's are some of the consequences expected during retraction of the anterior teeth.

Paulo Roberto had conducted a study regarding the changes in alveolar bone thickness by comparing patients submitted to retraction of anterior teeth in extraction and non extraction cases and concluded that there were no changes in alveolar bone thickness, except for an increase in labial alveolar bone thickness at the cervical third of the maxillary incisors.[5]

It is widely accepted that whenever an orthodontic tooth movement occur, the bone around the alveolar bone remodels to an extent which brings about changes in the vertical position of the teeth, which can be intrusion or extrusion of teeth. Udom Thongudomporn in his study found that the change in vertical position of teeth is a direct factor that is affected during the change in alveolar bone thickness. He stated that during extrusion, the tooth enters the narrower part of the alveolar bone housing and it has occurred during the remodelling process.[6]

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In 1986, Keating defined bimaxillary dentoalveolar protrusion as the concomitant proclination of both upper and lower dental arches of the same face. While Farrow and co-workers (1993) and Bills and co-workers (2005) defined the condition as flaring of upper and lower teeth with the resultant protrusion of lips and convexity of face. It is seen commonly in African American and Asian populations, nevertheless, can be seen in almost every ethnic group. Because of the negative perception of protrusive dentition and lips in most cultures, many patients with bimaxillary protrusion seek orthodontic care to decrease this procumbency and thus bimaxillary protrusion is a malocclusion which is treated with the most widely accepted plan including extraction of all first premolars and retraction of anteriors. To overcome the objectives of treatment, anterior teeth are extremely retracted but the alveolar bone remodelling with such a type of tooth movement varies with each patient. When the area for retraction is very less, constant application of force to the tooth may cause incisor roots to touch the cortical plate thereby leading to cortical plate resorption and root exposure.[7]

The introduction of new technological advances in imaging, such as Cone Beam Computed Tomography, has been proven to minimize errors in superimposition and magnification which occur on conventional cephalograms. The ability to perform precise measurements of various cross-sectional areas and three-dimensional (3D) reconstructions are some of the advantages of CT technology when compared with Cephalometric techniques. [8,9,10]

No material is available in the literature which elaborates the change in the alveolar bone thickness of anteriors that may take place due to the retraction mechanics. Hence the study was taken up to evaluate the labial alveolar bone thickness and the changes that occur in alveolar bone thickness of the maxillary anterior teeth after en-masse retraction in adult patients with bimaxillary dentoalveolar protrusion using Cone Beam Computed Tomography (CBCT).

Aim &Objectives

AIM AND OBJECTIVES

1) To estimate the labial alveolar bone thickness in the anterior region after orthodontic Retraction in 1st premolar extraction cases by using sliding mechanics.

2) To evaluate the change in thickness of alveolar bone after en-masse retraction of maxillary anterior teeth.

Background & Review of literature

BACKGROUND OF THE STUDY

The soft tissue profile of patients with bimaxillary protrusion may not be considered esthetically pleasing. These patients characteristically have dentoalveolar flaring of the maxillary and mandibular anterior teeth, with resultant protrusion of the lips and convexity of the face. To reduce the facial convexity and allow the anterior teeth to move into a more pleasing and stable position, retraction of anterior teeth after extraction of four premolars is considered the most common treatment modality.

When the area for movement is limited, uncontrolled force will cause the roots to touch the cortical plate of the alveolus, leading to resorption of the cortical bone and exposure of the root. Excessive lingual movement of maxillary and mandibular incisors should be avoided to prevent irreversible damage to the lingual cortex, which would leave the tooth with less bone support. The awareness about thickness of labial cortex prevents the incidence of perforation, fenestration, and dehiscence during orthodontic treatment

REVIEW OF LITERATURE

De Angelis in 1970 conducted a study to observe the response of alveolar bone to orthodontic force and concluded that the change in alveolar bone thickness induced by orthodontic force is due to the bones undergoing active migration or “drift”, as a result the movement of the tooth within the bone should be of actively synchronized tooth movements which should have the same amount of bone present on the apposed side to that of the bone that has been resorbed. [21]

Michael Wainwright et al. conducted a study in 1970 to investigate histologically the effects of faciolingual tooth movement, in particular any damage, healing, and other tissue response as the root apex is moved through the cortical plate and into the soft tissue and then back into the cancellous bone, changes in root resorption, as well as to any changes in the pulp, periapical, and periodontal tissue, or in the periosteum, cortical plate, or cancellous bone. The effects of retaining the root apex in these positions were also studied. They concluded that root resorption was present on the buccal surface when it was under pressure and on the lingual surface upon reversal of the force system. The resorption ‘was increasingly severe toward the root apex. The extent of root resorption on the buccal and lingual surfaces of the roots that were moved back into the alveolus was similar.[6]

Shinji Katagiri et al. in 1987 conducted a study regarding the application of computed tomography for diagnosis of alveolar bony defects and concluded that application of computed tomographic scanning is useful for understanding bony defects three dimensionally and for ascertaining diagnosis of the periodontally involved teeth. Since computed tomographic scanning has become more widely available and is recognized in many specialties as an important diagnostic tool for fractures, neoplasm of the oral region and alveolar bony defects.[1]

E. Bimstein CD et al. conducted a study in 1990 to determine the morphologic changes in the buccal alveolar bone that resulted from orthodontic treatment. Theyconcluded that there is an increase in the amount of buccal alveolar bone as a result of orthodontic treatment that involves lingual positioning ofprocumbent mandibular permanent central incisors. This increase, however, may be hindered by the simultaneous orthodontic intrusion of the mandibular incisors.[7]

Fuhrmann and coworkers in 1994 conducted a study to assess the dento alveolar process with high resolution commuted tomography imaging of dentoalveolar defects and concluded that none of the defects could be evaluated on conventional dental radiographs and high resolution computed tomographic scanning would be useful in assessing buccal and lingual alveolar bone morphology and in diagnosing larger dehiscences.[10]

Chester S. Handelman in 1995 conducted a study on the anterior alveolus, its importance in limiting orthodontic treatment and its influence on the occurrence of iatrogenic sequelae and concluded that the mandibular incisors more frequently than the maxillary incisors are the causes of limitation in treatment because of the thinness of their alveolar housing and a thin alveolus may be encountered in any skeletal type but is more frequently encountered in patients with long lower face height and severe bimaxillary protrusion cases.[14]

Heinrich Wehrbeine et al. conducted a study in 1996 to investigate the tooth movements of lower incisors and to describe the morphologic findings, radiologic observations and results of scanning electron microscopy (SEM) analysis of incisors, alveolar bone, and symphysis, respectively, after orthodontic treatment with a fixed appliance. They concluded that the morphologic findings of the incisor/alveolar bone/symphysis complex of the dry mandible after routine orthodontic treatment with an edgewise appliance suggest that in case of a narrow and high symphysis a reduced bone support may already be present before treatment not only labial but also lingual to the roots, and pronounced sagittal incisor movement and de-rotation seems to be critical with the potential risk of progressive lingual and labial bone loss.[8]

Jens Kragskov et al. conducted a study in 1997 to compare the reliability of anatomic cephalometric points from conventional cephalograms and 3-D CT.They concluded that for standard lateral and frontal cephalometric points, there is no evidence that 3-D CT is more reliable than the conventional cephalometric methods in normal skull, and the benefit of 3-D CT cephalometric is indicated in the severe asymmetric craniofacial syndrome patients, as conventional cephalometrics is known to be inferior in these cases.[9]

Alexander D Vardimon et al. conducted a study in 1998 to analyze the changes that the labial maxillaries undergoes during maxillary incisor retraction associated with tip (R&Tp) and torque (R&Tq) movements, and to evaluate the B/T ratio in the two groups. They concluded that when using R&Tp mechanics, a B/T ratio of 1:2 was obtained, when using R&Tq mechanics, a B/T ratio of 1:2.35 was obtained. The retraction component in the R&Tp mechanics reduced the hazards of approximation of the apex of the maxillary central incisors in the labial cortical plate. In R&Tq movement, approximation of the coronal two thirds of the root of the maxillary central incisors to the palatal cortical plate is of major concern. It is recommended to use the 1:2 B/T ratios to assess the prognosis of an A-P or P-A movement of the maxillary central incisors.[9]

Marcelo G.P. et al conducted a study in 1999 to evaluate the measurement accuracy of three dimensional volumetric images from spiral computed tomography in vitro. The results showed no statistically significant differences between 3D - CT and the physical measurements. They concluded that measurement of the skull and facial bone landmarks by 3D reconstruction is quantitatively accurate for surgical planning and treatment evaluation of craniofacial fractures.[1]

Jason B. Cope, Richard Harper and Mikhail Samchukov in 1999 conducted a pilot study on experimental tooth movement through regenerative alveolar bone and concluded that the tooth movement occurs within the regenerative alveolar bone through bone remodeling and stated the most probable reasons for “walking teeth” are osteotomy placement and tooth root anatomy. Osteodistractions of the maxilla or mandible provides new horizons to the orthodontist in treating crowded dental arches by increasing the arch length or circumference, possibly reducing extraction therapy, required in severely crowded cases.[29]

C. Verna, D. Zaffe, and G. Siciliani in 1999 conducted a histomorphometric study of bone reactions during orthodontic tooth movement in rats and concluded that the orthodontic force interferes with the activation-resorption- formation sequence and the orthodontic force is not exclusively inducing resorption on one side of a tooth and formation on the other. On the contrary, mechanical perturbation initially causes an increased activation frequency around both the orthodontically moved and the adjacent teeth, reflected by the decrease in bone fraction.[35]

Birte Melson in 1999 conducted a study based on the biological reaction of alveolar bone to orthodontic tooth movement and stated that a direct resorption can be perceived as an activation of remodeling and the undergoing resorption as a repair to trauma and the following apposition of bone thickness can be taken as a reaction to bending of the alveolar bone.[13]

Simten Sarikaya et al. conducted a study in 2002 to evaluate the changes that occurin alveolar bone as a result of maxillary and mandibular incisor retraction in patients with bimaxillary protrusion. They concluded that when maxillary andmandibular incisors are retracted, the risk of adverse effects may be present. These changes cannot be identified by cephalograms or clinical macroscopic examination but are clearly recognized by specially designed CT scans.[10]

CA Lascala et al conducted a study in 2004 to evaluate the accuracy of the linear measurements in CBCT images in dentomaxillofacial as well as in other cranial areas. They concluded that the CBCT image underestimates the real distances between skull sites, differences are only significant for the skull base and therefore it is reliable for linear evaluation measurements of other structures more closely associated with dentomaxillofacial imaging.[11]

Gregory L Adams et al conducted a study in 2004 to evaluate and compare a 3- D imaging system and traditional 2D cephalometry for accuracy in recording the anatomical truth as defined by physical measurements with a calibrated caliper on human dry skulls. They concluded that the 3D evaluation was much more precise, within approximately 1 mm of the gold standard and 4 to 5 times more accurate than the 2D approach.[2]

Birte Melson in 2005 conducted a study on the factors for the development of dehiscence's during labial movement of mandibular incisors and concluded that if orthodontic treatment is carried out under controlled biomechanical and periodontal conditions, the risk of periodontal damage secondary to protrusion of incisors is small. Only 15% of the teeth experiences development or aggravation of recession and local factors related to anatomy and periodontal health could be applied to identify patients at risk.[34]

David T. Garlock et al.conducted a study in 2006 **to** evaluate marginal alveolar bone height in the anterior mandible after orthodontic treatment and to assess any correlations between morphologic and treatment changes .They concluded that Orthodontic treatment causes changes in alveolar bone height and cortical bone thickness around the mandibular incisors.

Mazyar Moshiri and coworkers in 2007 conducted a study to compare the accuracy of linear measurements made on photostimulable phosphor cephalograms with 3 methods for stimulating lateral cephalograms with cone beam computed tomography. They concluded that CBCT derived from two dimensional LCs proved to be more accurate than LCs for most linear measurements calculated in the sagittal plane. No advantage was found over single frame basis images in using raysum generated cephalograms from the CBCT volumetric data set.[40]

Theodore J. Kula et al. in 2007 conducted a study to compare, relative to A-point, (1) bone thickness over the most forward maxillary incisor (MFMI) in 2 dimensions vs. 3 dimensions, and (2) bone thickness and inclination of each maxillary incisor in 3 dimensions**.** They concluded that thickness of alveolar bone overlying the root apices of the maxillary central incisors appears to never estimated in 2D cephalograms compared with 3D CBCT images, ANS interferes with bone measurements over maxillary incisors in 2 dimensions and as the inclination of the incisors increase, the thickness of alveolar bone overlying the maxillary incisor root apices increase.

Danielle R. Periago et al conducted a study in 2008 to compare accuracy of linear measurements made on cone beam computed tomographic (CBCT) derived 3- dimensional (3D) surface rendered volumetric images to direct measurements made on human skulls. They concluded that while many linear measurements between cephalometric landmarks on 3D volumetric surface renderings obtained using Dolphin 3D software generated from CBCT datasets may be statistically significantly different from anatomic dimensions, most can be considered to be sufficiently clinically accurate for craniofacial analyses.[5]

Kazem. S et al conducted a study in 2009 to test the hypothesis that the magnitude of alteration in the position of point A is not associated with proclination of the upper incisors in Class II division 2 malocclusion. They concluded that the hypothesis is rejected. The position of point A is affected by local bone remodeling associated with proclination of the upper incisor in Class II division 2 malocclusion, but this minor change does not significantly affect the SNA angle.[12]

Rasha Al-Abdwani et al conducted a study in 2009 to identify and evaluate changes in the cephalometric position of points A and B due to an incisal inclination change caused by orthodontic treatment. They concluded that the effects of incisal inclination changes, due to orthodontic treatment, are of no clinical relevance to the position of point A and B, eventhough they may be statistically significant.[13]

Yoonji Kim et al conducted a study in 2009 to test the hypothesis that there is no difference in the vertical alveolar bone levels and alveolar bone thickness around the maxillary and mandibular central incisors in surgically treated skeletal Class III malocclusion patients. They concluded that the hypothesis is rejected. For the skeletal Class III patients undergoing orthognathic surgery, special care should be taken to prevent or not aggravate preexisting alveolar bone loss in the anterior teeth, especially in the mandible.[14]

Mauricio Berco et al. conducted a study in 2009 to determine the accuracy and reliability of 3-dimensional craniofacial measurements obtained from cone-beam computed tomography (CBCT) scans of a dry human skull. They concluded that CBCT allows for clinically accurate and reliable 3-dimensional linear measurements of the craniofacial complex. Moreover, skull orientation during CBCT scanning does not affect the accuracy or the reliability of these measurements.[3]

Cynthia C et al. conducted a study in 2009 to evaluate the accuracy and reliability of cone-beam computed tomography (CBCT) in the diagnosis of naturally occurring fenestrations and bony dehiscence's. In addition, they evaluated the accuracy and reliability of CBCT for measuring alveolar bone margins. They concluded that CBCT alveolar bone height can be measured to an accuracy of about 0.6 mm, and root fenestrations can be identified with greater accuracy than dehiscences.[15]

Bruno Fraza Gribel et al.conducted a study in 2011 to compare the accuracy of craniometric measurements made on lateral cephalograms and on cone beam computed tomography (CBCT) images.They concluded thatCBCT craniometric measurements are accurate to a subvoxel size and potentially can be used as a quantitative orthodontic diagnostic tool.[4]

Zongyang Sin et al in 2011 conducted a study on the effect of bone thickness on alveolar bone height measurements from cone beam computed tomography images and concluded that alveolar bone-height and thickness measurements can be achieved from CBCT images with good to excellent repeatability. When alveolar bone thickness is greater than CBCT voxel size (0.4 mm), alveolar bone-height measurements are likely to be overestimated by 0.5 to 1 mm. When alveolar bone thickness is near or smaller than CBCT voxel size (0.4 mm), alveolar bone-height measurements are likely to be underestimated by 0.9 to 1.2 mm. With these measurement inaccuracies, using 0.4-mm resolution CBCT images, the severity of alveolar bone-height loss associated with rapid palatal expansion is likely to be overestimated by 1.5 to 2 mm. Decreasing CBCT voxel size from 0.4 to 0.25 mm can improve the accuracy of alveolar bone linear measurement from the CBCT images.11

Lund H et al in 2012 evaluated marginal alveolar bone before and after orthodontic treatment combined with premolar extractions and noticed large bone-height changes among teeth. Lingual surfaces, followed by buccal surfaces, showed the largest changes.

Yoon-Ah Kookao et al. conducted a study in 2012 to test the hypothesis that there is no difference in vertical alveolar bone loss and alveolar bone thickness around maxillary and mandibular central incisors in normal occlusion samples and skeletal Class III malocclusion patients. They concluded that the hypothesis is rejected. Vertical alveolar bone loss was greater in the skeletal Class III subjects, In both groups, vertical bone loss was more severe in the mandibular incisors than areas. They concluded that the CBCT image underestimates the real distances between skull sites, differences are only significant for the skull base and therefore it is reliable for linear evaluation measurements of other structures more closely associated with dentomaxillofacial imaging.[11]

Hyo-Won Ahn et al conducted a study in 2013 to evaluate the morphometric changes in the alveolar bone and roots of the maxillary anterior teeth (MXAT) after en masse retraction with maximum anchorage (EMR-MA).They concluded that During EMR-MA in cases with CI-DAP(Class I dentoalveolar protrusion), ABA (alveolar bone area), and VBL (vertical bone level) on the palatal side and RL (root length) and RA (root area) of MXCI and MXLI were significantly decreased.[19]

Nuengrutai Yodthonga et al. conducted a study in 2013 to investigate the factors related to changes in alveolar bone thickness during upper incisor retraction. They concluded that rate of tooth movement, change in inclination, and extent of intrusion are significant factors that may influence alveolar bone thickness during upper incisor retraction. These factors must be carefully monitored to avoid the undesirable thickening of alveolar bone.[1]

Nayak Krishna US et al. conducted a study in 2013 to evaluate the changes in alveolar bone as a result of maxillary and mandibular incisor retraction in patients with bimaxillary protrusion by means of using lateral cephalograms and computed tomography (CT) scans and to investigate any occurrence of bony defects like dehiscence and fenestration. They concluded that when incisors are retracted, the risk of adverse effect is present. This must be carefully monitored to avoid negative iatrogenic effects. This study needs follow up after 6 months or 1 year after completion of the orthodontic treatment to assess the long-term consequences.[20]

Yu-lou Tiana et al. conducted a study in 2015 to assess the labial and lingual alveolar bone thickness in adults with maxillary central incisors of different inclination by cone-beam computed tomography (CBCT). They concluded that Lingual-inclined maxillary central incisors have less bone support at the level of the root apex and a greater frequency of alveolar bone defects than normal maxillary central incisors. The bone plate at the marginal level is also very thin.[21]

Udom Thongudomporn et al. conducted a study in 2015 to investigate changes in maxillary alveolar bone thickness after maxillary incisor proclination and extrusion during anterior crossbite correction in a group of growing patients with Class III malocclusion. They concluded that in a group of growing patients with Class III malocclusion undergoing anterior crossbite correction, controlled tipping mechanics accompanied by extrusive force may produce successful tooth movement with minimal iatrogenic detriment to the alveolar bone.[22]

Michelle Sendyk et al. in 2017 conducted a study to find out the correlation between buccolingual tooth inclination and alveolar bone thickness in subjects with class III dentofacial deformities and concluded that the alveolar bone thickness was thick in the palatal surfaces of the maxillary central incisors and thinner in the labial surface of the mandibular central incisors which states that a significant correlation exists between inclination and thickness of teeth.38

Henry Ohiomoba et al. in 2017 conducted a study on quantitative evaluation of maxillary alveolar cortical bone thickness and density using computed tomographic imaging and concluded that the cortical bone density and thickness significantly increase from the coronal (2 mm) to the apical (8 mm) regions of the alveolar bone on an average, palatal cortical bone is thicker and denser compared with buccal; this difference is greatest in the anterior part of the maxilla. Increased BMI is significantly associated with increased bone thickness and density. Alveolar buccal cortical bone is thickest and densest between the first molar and second molar interradicular bone, followed by between the second premolar and first molar interradicular bone.39

Akash S et al. in 2017 conducted a study on the changes in alveolar bone thickness during upper incisor retraction and concluded that as the maxillary anterior teeth were retracted, the labial bone thickness at crestal and apical level and total bone thickness at mid-root and apical level were statistically significantly increased ($p < 0.05$). The changes in alveolar bone thickness were significantly associated with rate of tooth movement and initial alveolar bone thickness. The changes in inclination showed no significant association with changes in thickness of alveolar bone ($p > 0.05$). When tooth movement is limited, forcing the tooth against the cortical bone may cause adverse sequelae. Rate of tooth movement and initial alveolar bone thickness are the significant factors that may influence alveolar bone thickness during upper incisor retraction.

Sun Hyung Kim et al in 2018 conducted a study combining virtual mode and CBCT to assess periodontal changes after anterior tooth movement and conclude that the nature of tooth movement can be accurately assessed by comparing sectional CBCT images than virtual models. Gingival thickness was decreased in patients who underwent previous orthognathic surgery, and Alveolar bone thickness was decreased in cases of proclination. Gingival thickness and Alveolar bone thickness can be accurately assessed by comparing sectioned CBCT images and virtual models.8

Seong Min Bae, HoJim Kim and Hee Moon Kyung in 2018 had conducted a study based on the long term changes of the anterior palatal alveolar bone after treatment with bidentoalveolar protrusion, evaluated with computed tomography and concluded that significant alveolar bone apposition was seen on the palatal surface of bidentoalveolar protrusion cases by retraction using mini-implants.9

Priyakorn Chaimongkol, Udom Thongudomporn and Steven J. Lindauer in 2018 conducted a study on alveolar bone response to light-force tipping and bodily movement in maxillary incisor advancement and concluded that maxillary incisor advancement with light-force tipping and bodily movement in growing patients resulted in labial alveolar bone thickness and labial and palatal alveolar bone height changes. The palatal and total alveolar bone thicknesses at the midroot and apical levels were decreased in the tipping group but not in the bodily movement group. The labial and palatal alveolar bone heights were maintained in both the tipping and bodily movement groups

M Sathya Prakash et al. in 2018 conducted a study to measure alveolar bone thickness of the labial of maxillary central incisor teeth in Indian population using CBCT. They concluded that the thickness of the labial plate of alveolar bone was greater at the apex and least at the cervical for central incisors. This gives awareness about the thickness of labial cortex which prevents the incidence of perforation, fenestration, and dehiscence during implant placement

Relevance

RELEVANCE

Patients with bimaxillary dentoalveolar protrusion generally have perfectly good occlusion and the orthodontic treatment is often solely sought to correct the protrusive profile and improve the facial esthetics. The most common therapy for this condition involves extracting the four 1st premolars and then retracting the incisors to acceptable inclinations. Handelman claims that a thin tooth alveolus or an inappropriate alveolar cavity for the amount of desirable tooth movement must be considered as a risk for the occurrence of unfavorable sequelae to orthodontic movement, especially fenestration, bone dehiscence and root resorption.[14] According to him unlimited tooth movement was not possible during retraction of the incisors, especially the mandibular incisors. This is due to the restriction imposed by the symphyseal bone which consists of a dense cortical plate on the labial and lingualsurfaces near the roots of the incisors. In fact, the incisors can be moved labially or lingually to only a very limited extent.

When the area for movement is limited, uncontrolled force will cause the roots to touch the cortical plate of the alveolus, leading to resorption of the cortical bone and exposure of the root. Excessive lingual movement of maxillary and mandibular incisors should be avoided to prevent irreversible damage to the lingual cortex, which would leave the tooth with less bone support. The awareness about thickness of labial cortex prevents the incidence of perforation, fenestration, and dehiscence during orthodontic treatment. It also gives an idea to the orthodontist about the type of movement to be undertaken during orthodontic retraction.

Materials & methods

HYPOTHESIS

There is change in anterior labial bone thickness after orthodontic retraction using sliding mechanics in bimaxillary protrusion cases

NULL-HYPOTHESIS

There is no change in labial bone thickness after retraction correction in patients with bimaxillary protrusion cases.

STUDY DESIGN

Cross sectional study

10 Male & 10 Female patients

SRUDY SETTING

This study was conducted on patients reporting to Department of Orthodontics & Dentofacial Orthopedics, St.Gregorios Dental College,Chelad, Kothamangalam

SAMPLE SIZE CALCULATION

Tests - Means: Difference between two dependent means (matched pairs)
Analysis: A priori: Compute required sample size

Input: Tail(s) = One

Effect size dz = 0.6

α err prob = 0.05

Power (1-β err prob) = 0.80

Output: Non centrality parameter δ = 2.6153394

Critical t = 1.7340636

Df = 18

Total sample size = 19

Actual power = 0.8079091

The sample size was calculated using the G Power Software V.3.9.7. Considering the effect size to be measured at 0.6 for ‘t tests - Means: Difference between two dependent means (matched pairs)’ with one tail and, α err prob at 0.05. The total sample size was estimated at 19 with a power of 80%. The sample size was rounded of to 20.

Inclusion Criteria

1) Age: - 18-25 years
2) Bimaxillary protrusion cases which require extraction of 1st premolar tooth
3) Normal body mass index (18.5-24.5)
4) Patient with labial orthodontic appliance.
5) No significant medical history.

6) No history of trauma to the upper and lower anterior teeth.

Exclusion Criteria

1) Missing or unerupted permanent anteriors
2) Congenitally missing teeth other than third molar
3) Patient with previous history of orthodontic treatment or orthognathic surgery
4) A significant medical or dental history (e.g., use of bisphosphonates or bone altering medications Or diseases)
5) Poor image quality.
6) Craniofacial abnormality including cleft lip
7) Patient with abnormal tongue size
8) Patient with history of trauma induced fracture of jaw bones
9) Patient with antero posterior jaw discrepancies
10) Periapical or periradicular pathologies or radiolucencies of either periodontal or endodontic origin

MATERIALS

1) Planmeca Promax 3D plus CBCT Machine
2) Planmeca Romexis Viewer version 5.1.0.4
3) CBCT images of 20 patients before and after orthodontic correction
4) 0.022 straight wire brackets
5) 0.019 x0.025 rectangular SS wire
6) Laptop or computer supporting windows 7 or upgraded versions.

METHODOLOGY

The current study was conducted in the Department of Orthodontics and Dentofacial Orthopedics, St.Gregorios Dental College, Chelad, Kerala .20 Patients of both the sexes between age group of 18-25 years with class I bimaxillary protrusion,who need extraction of all first premolars as a part of treatment plan were selected , considering the above mentioned inclusion and exclusion criteria who desired to undergo orthodontic treatment with pre adjusted edgewise appliance. The retraction was carried out by using 0.019 × 0.025' stainless steel arch wire

The soft copies of the patient consent for all 20 patients which were already taken during their time of treatment from the subjects and/or their parents was used.

CBCT IMAGING

Pre-retraction and post-retraction CBCT images of patients which were taken using the same machine and with same exposing parameters were used for the study

The CBCT files was imported into Planmeca Romexis Viewer version 5.1.0.4 imaging software to obtain the linear measurements needed for the study.

CBCT images taken pre-retraction (T_0) and post-retraction (T_1) was evaluated to measure the change in the alveolar bone thickness. For evaluation of the changes in thickness of alveolar bone after post retraction phase the thickness between labial and palatal alveolar plates were measured for most anteriorly placed maxillary central incisor. The long axis of the maxillary incisor drawn in the imaging software and 11mm was measured from the incisal tip to the root along the principle axis of the respective tooth to form the first site/level(S), crestal level S1, further two more sites was made from S1 apically on to formS2 and S3 which are separated by 4mm respectively. (Figure 1)

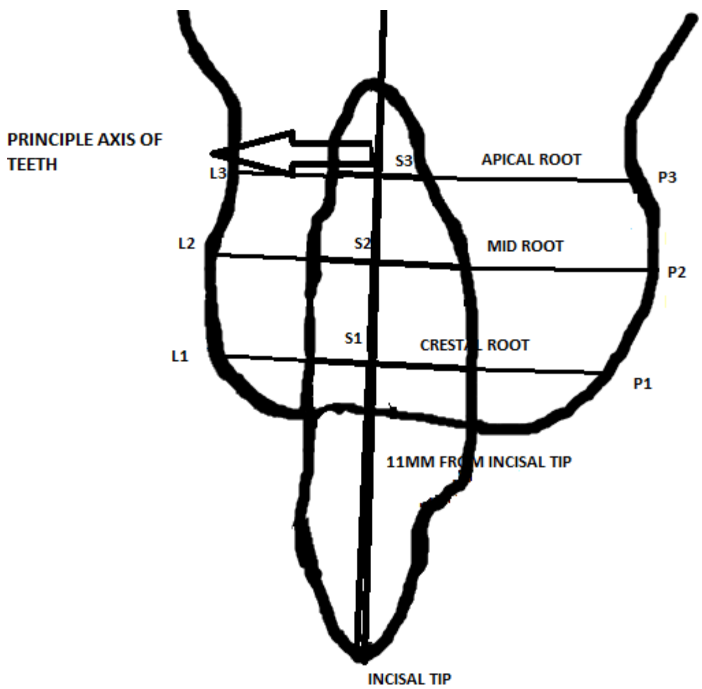


Figure: 1

Labial (L) and palatal (P) bone thicknesses was assessed at the crestal level (S1), midroot level (S2) and apical level (S3) to evaluate bone thickness changes during retraction. The distance from the anterior border of the labial cortical plate to the anterior border of the root of the tooth at each site (S1, S2 and S3) was measured to determine the labial (L) bone thickness of each tooth which was L1, L2 and L3 respectively.

The distance from the posterior border of the palatal cortical plate to the posterior border of the root of the tooth at each site(S1, S2 and S3) was measured to determine the palatal (P) bone thickness of each tooth which was P1, P2 and P3 respectively. The parametrical changes was evaluated from the pre-retraction (T_0) and post-retraction (T_1) images.

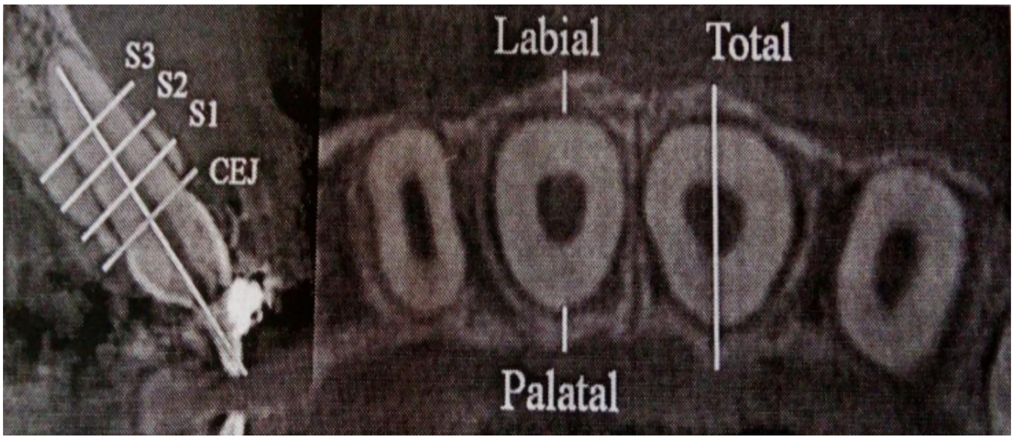


Figure: 2

INTRA ORAL PHOTOGRAPHS- PRE TREATMENT

Figure : 3

INTRA ORAL PHOTOGRAPHS- SLIDING MECHANICS

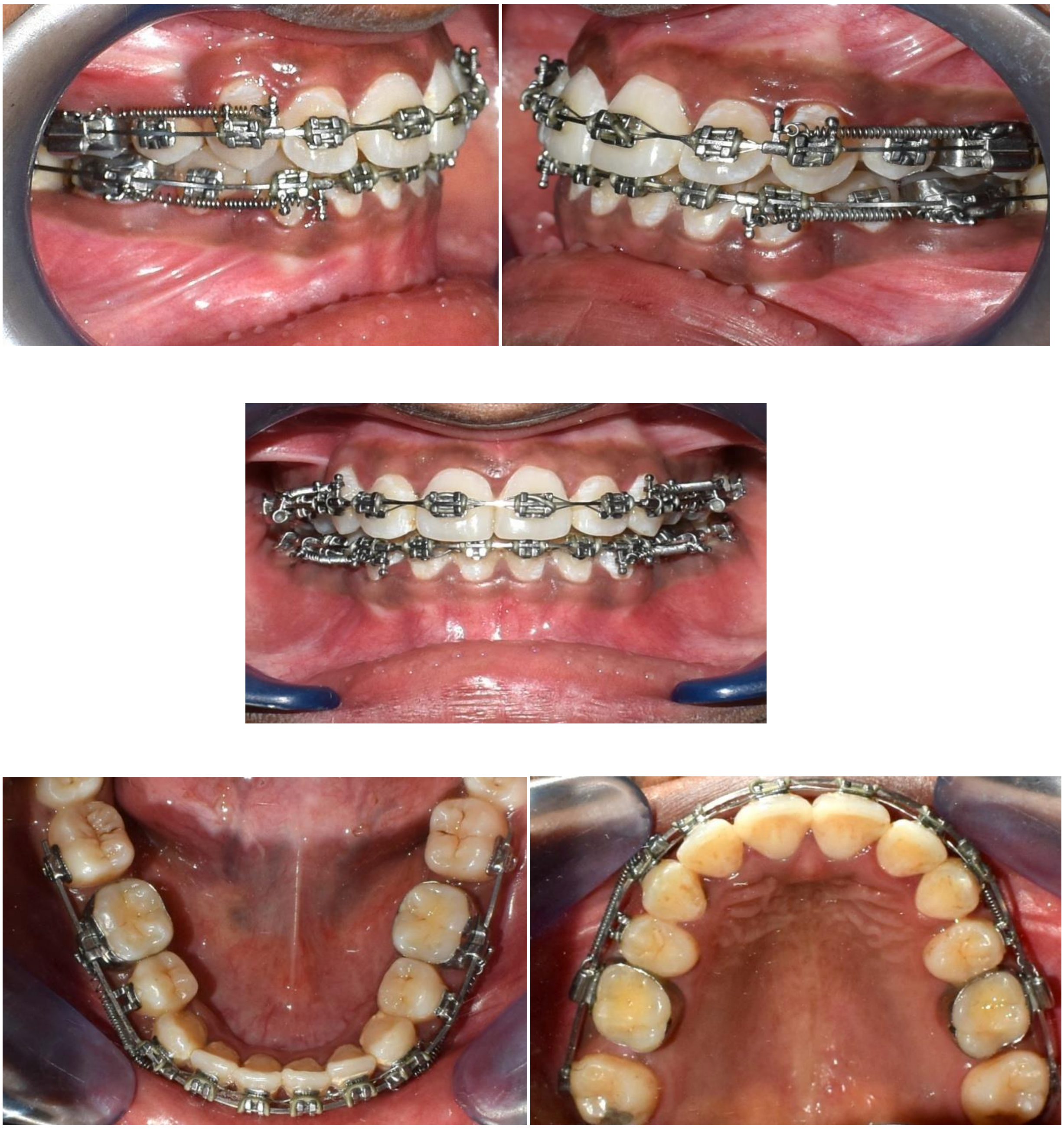


Figure : 4

Figure : 5. CBCT image showing labial bone and palatal bone thicknessmeasurements.

Figure 6 : Planmeca Promax 3D plus CBCT Machine

Fig.7: Planmeca Romexis Viewer version 5.1.0.4

ETHICAL CONSIDERATION

Informed consent was obtained from all participants. The study protocol was approved by the Institutional Ethical Committee

Results

RESULTS

The present study evaluated the linear changes before and after en-masse retraction of the maxillary central incisor. Data was collected from the Cone Beam Computed Tomography records in the Department of Orthodontics and Dentofacial Orthopaedics, St.Gregorious Dental College, Kothamangalam. Cone Beam Computed Tomography records of patients with bimaxillary dentoalveolar protrusion who were treated with all 4 first pre-molar extractions using PEA mechanotherapy using 0.022 MBT bracket prescription was used for the study.

For the evaluation of the changes in the labial and lingual alveolar bone thickness of the upper central incisors, the long axis of the maxillary central incisors was drawn in the imaging software and 11mm was measured from the incisal tip to the root along principle axis of the respective tooth to form the first site/level(S), crestal level S1, further two more sites was made from S1 apically on to form S2 and S3 which are separated by 4mm respectively. Labial (L) and palatal (P) bone thicknesses was assessed at the crestal level (S1), midroot level (S2) and apical level (S3) to evaluate bone thickness changes during retraction.. Pre-retraction (T_0) and post-retraction (T_1) CBCT images were incorporated into Planmeca Romexis Viewer version 5.1.0.4 imaging software in which the change in the alveolar bone thickness of teeth were calculated.

ALVEOLAR BONE THICKNESS

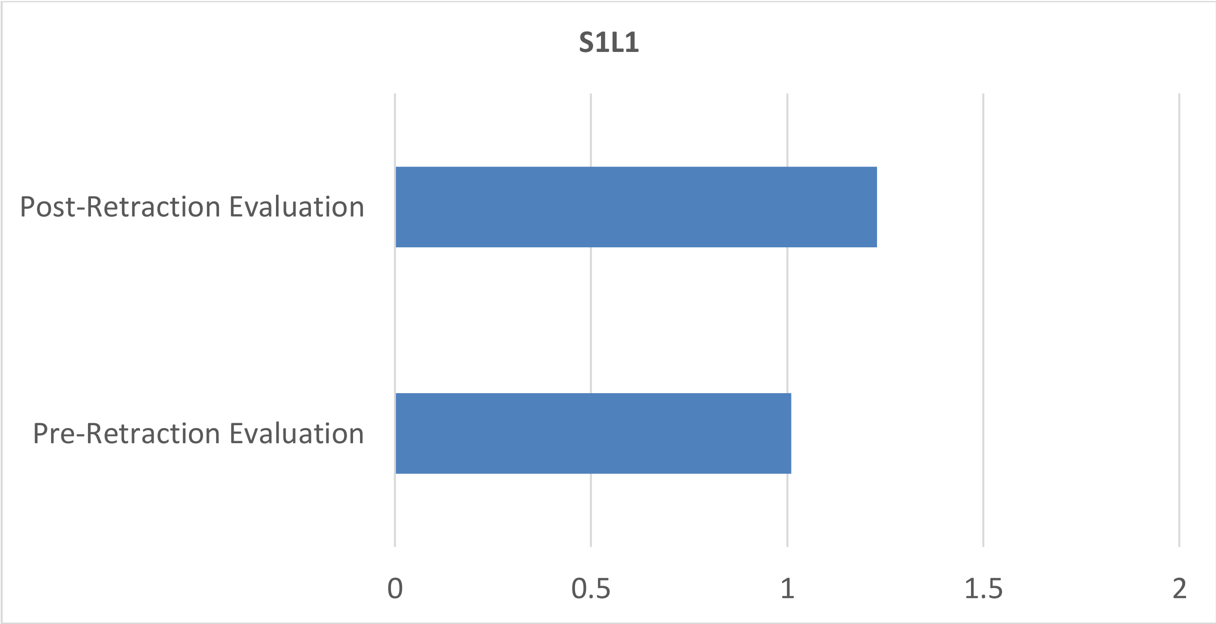
MAXILLAR CENTRAL INCISORS AT S1

Labial side

The changes in the alveolar bone thickness at S1 in pre retraction and post retraction phase of the maxillary central incisors labial side is shown in table 1. The labial side pre retraction alveolar bone thickness at S1was 1.01±0.3mm and post retraction was 1.23±0.12mm. On comparing the alveolar bone thickness in pre retraction and post retraction phase there was a mean difference of 0.22 mm which signifies increase in labial bone thickness and which was statistically significant with p value of 0.001.

	S1L1	
	Pre-Retraction Evaluation	Post-Retraction Evaluation
Observations	20	20
Mean	1.01	1.23
SD	0.115684	0.125368
Mean Difference	0.22	
P Value	0.001*	

Table: 1 Student t test *Statistically significant



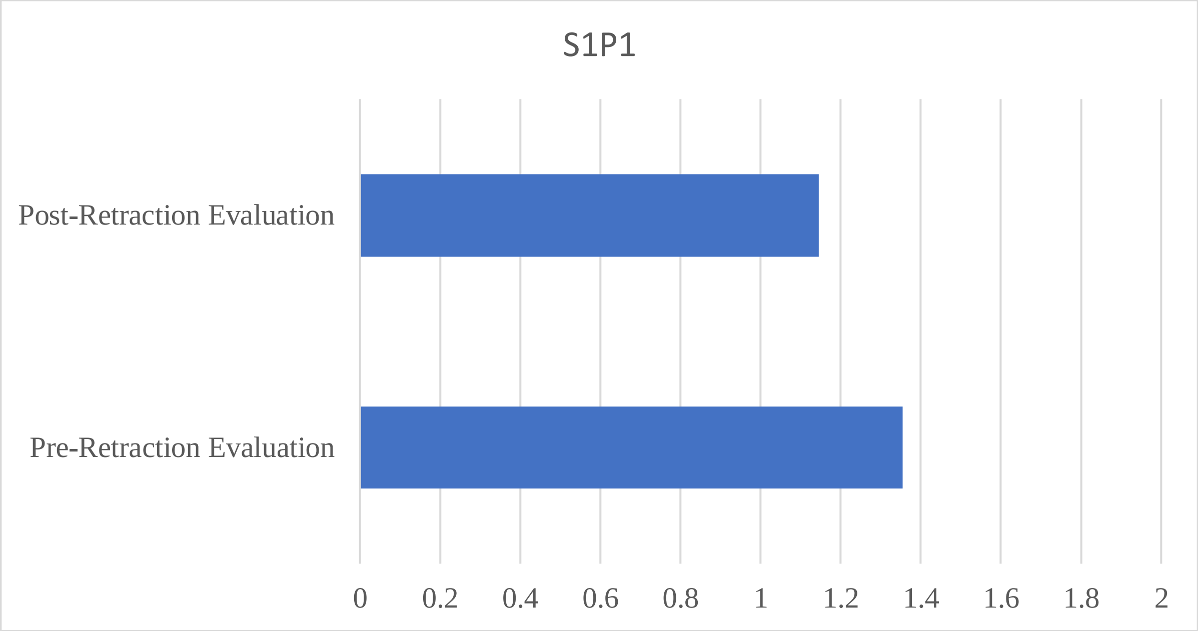
Graph 1

Palatal side

The changes in the alveolar bone thickness at S1 in pre retraction and post retraction phase of the maxillary central incisors palatal side is shown in table 2. The palatal side pre retraction alveolar bone thickness at S1 was 1.35±0.4 mm and post retraction was 1.14±0.7 mm. On comparing the alveolar bone thickness in pre retraction and post retraction phase there was a mean difference of – 0.21 mm which signifies decrease in palatal bone thickness and which was statistically significant with p value of 0.001.

	S1P1	
	Pre-Retraction Evaluation	Post-Retraction Evaluation
Observations	20	20
Mean	1.355	1.145
SD	0.041553	0.071026
Mean Difference	-0.21	
P Value	0.001*	

Table 2: Student t test *Statistically significant



Graph:2

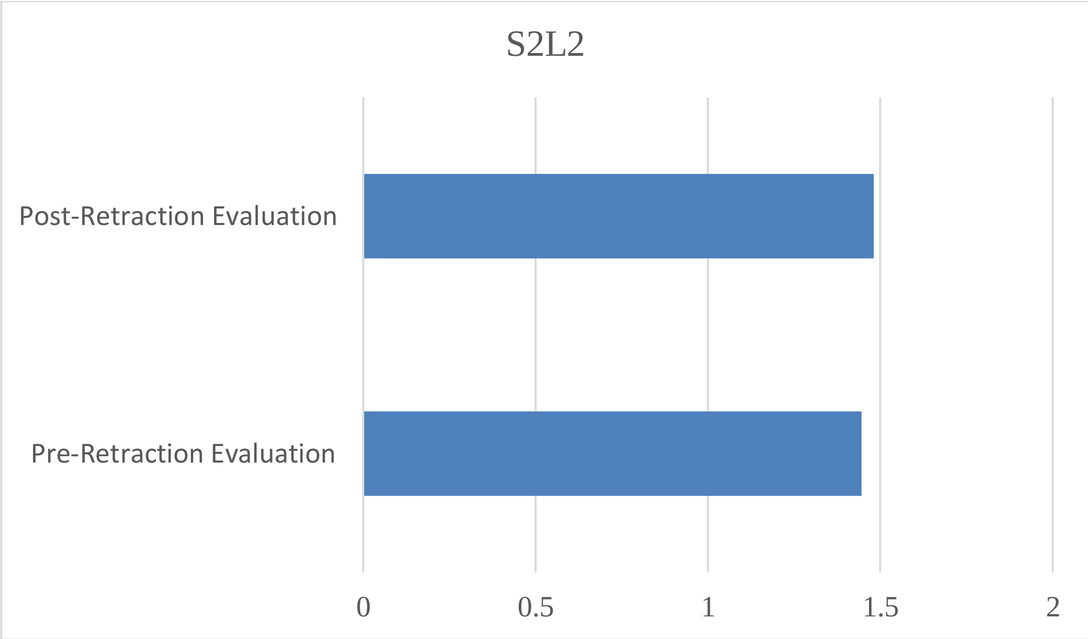
MAXILLARY CENTRAL INCISORS AT S2

Labial side

The changes in the alveolar bone thickness at S2 in pre retraction and post retraction phase of the maxillary central incisors labial side is shown in table 3. The labial side pre retraction alveolar bone thickness at S1was 1.44±0.13mm and post retraction was 1.48±0.13mm.
On comparing the alveolar bone thickness in pre retraction and post retraction phase there was a mean difference of 0.035mm with a p-value of .472 which showed a statistically insignificant and increase in labial alveolar bone thickness at S2.

	S2L2	
	Pre-Retraction Evaluation	Post-Retraction Evaluation
Observations	20	20
Mean	1.445	1.48
SD	0.134184211	0.137473684
Mean Difference	0.035	
P Value	0.472	

Table:3 Student t test



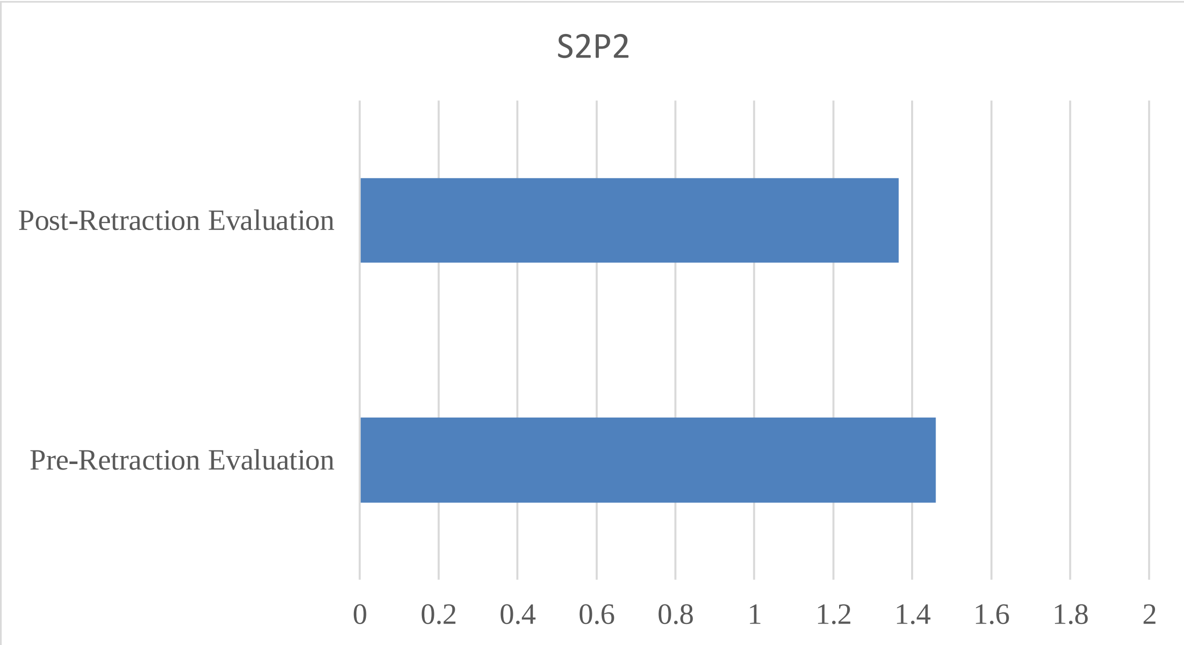
Graph:3

Palatal side

The changes in the alveolar bone thickness at S2 in pre retraction and post retraction phase of the maxillary central incisors palatal side is shown in table 4. The palatal side pre retraction alveolar bone thickness at S2 was 1.46±0.02 mm and post retraction was 1.36±0.03 mm. On comparing the alveolar bone thickness in pre retraction and post retraction phase there was a mean difference of -0.095mm with a p-value of .001 which showed a statistically significant decrease in palatal bone thickness at S2.

	S2P2	
	Pre-Retraction Evaluation	Post-Retraction Evaluation
Observations	20	20
Mean	1.46	1.365
SD	0.024632	0.038184
Mean Difference		-0.095
P Value		0.001*

Table:4 Student t test *Statistically significant



Graph:4

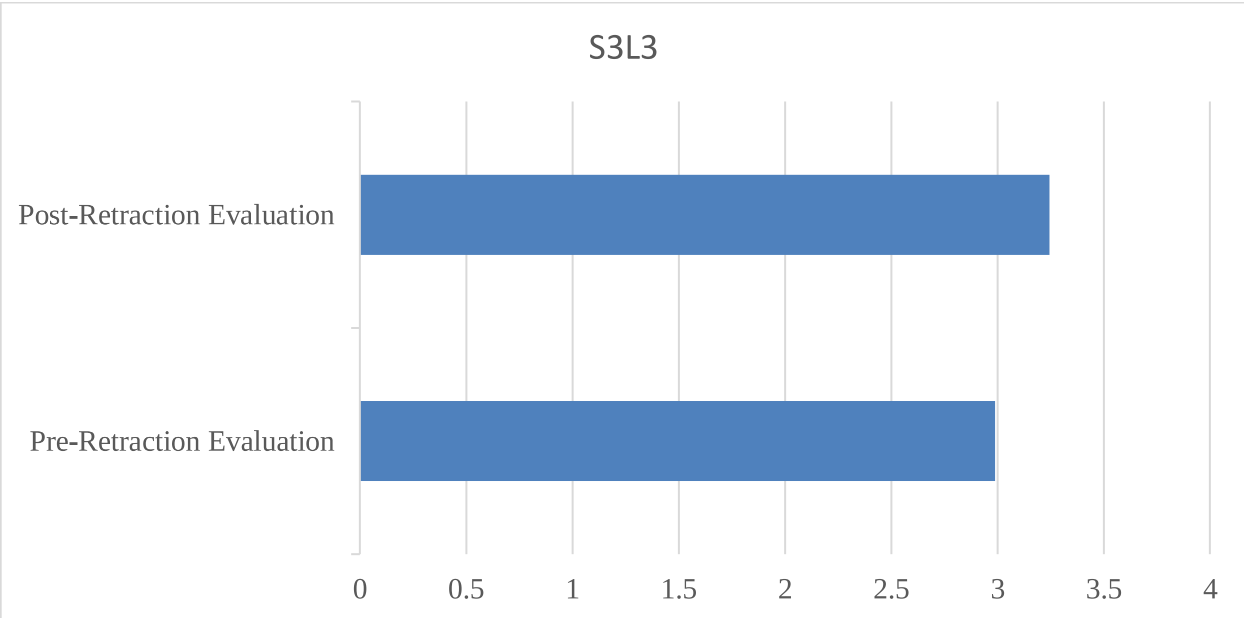
MAXILLARY CENTRAL INCISORS AT S3

Labial side

The changes in the alveolar bone thickness at S3 in pre retraction and post retraction phase of the maxillary central incisors labial side is shown in table 5. The labial side pre retraction alveolar bone thickness at S3 was 2.99±0.48 mm and post retraction was 3±0.46mm. On comparing the alveolar bone thickness in pre retraction and post retraction phase there was a mean difference of 0.25mm with a p-value of .003 which showed it is statistically significant and there was increase in labial bone thickness at S3.

	S3L3	
	Pre-Retraction Evaluation	Post-Retraction Evaluation
Observations	20	20
Mean	2.99	3.245
SD	0.483053	0.461553
Mean Difference		0.255
P Value		0.003*

Table 5 Student t test *Statistically significant



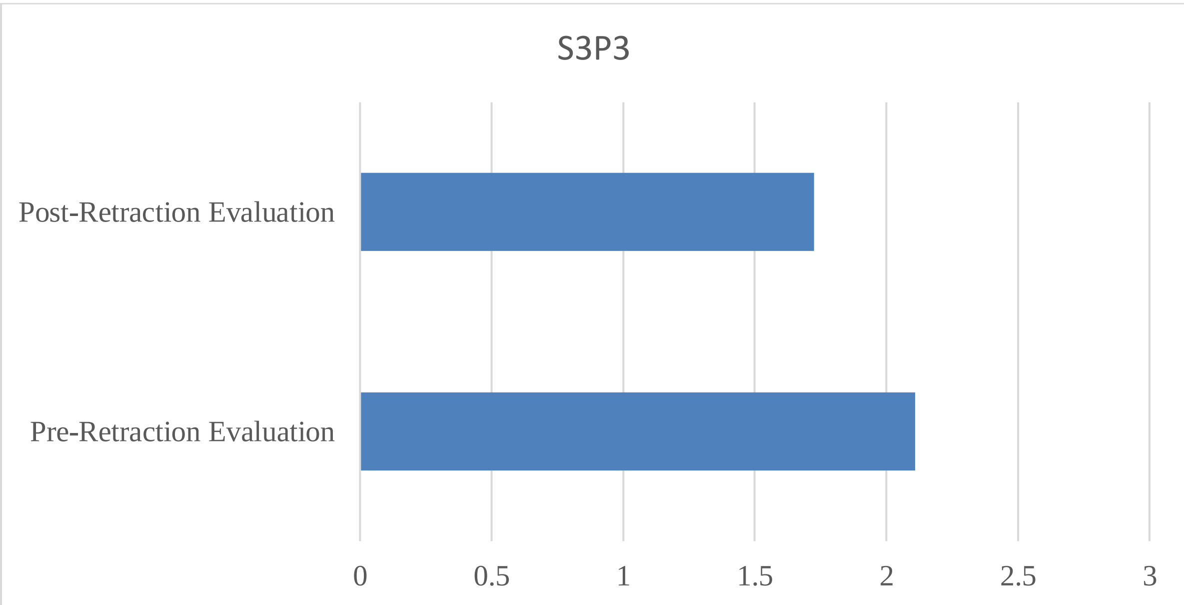
Graph:5

Palatal side (Table 6) (Chart 6)

The changes in the alveolar bone thickness at S3 in pre retraction and post retraction phase of the maxillary central incisors palatal side is shown in table 6. The palatal side pre retraction alveolar bone thickness at S3 palatal side was 2.1±0.3mm and post retraction was 1.70±0.3mm. On comparing the alveolar bone thickness in pre retraction and post retraction phase there was a mean difference of 0.39±0.09mm with a p-value of .000 which was statistically significant and there was decrease in the palatal bone thickness at S3.

	S3P3	
	Pre-Retraction Evaluation	Post-Retraction Evaluation
Observations	20	20
Mean	2.11	1.725
SD	0.102	0.140921
Mean Difference	-0.385	
P Value	0.001*	

Table: 6 Student t test *Statistically significant



Graph:6

Discussion

DISCUSSION

It is generally accepted that tooth movement can occur either with the bone or within the bone. But the question that is of significant interest and that always strikes an orthodontist is whether “bone traces tooth movement” or to be more specific, when an orthodontic tooth movement occurs, the bone surrounding the alveolar socket always remodels to an extent or not. Birte Melson in his study of biological reaction of alveolar bone to orthodontic tooth movement, discussed the tissue reaction related to tooth movement from an osteological point of view, as opposed to the traditional orthodontists point of view and stated that a direct resorption can be perceived as an activation of remodelling and the undermining resorption as a pair of trauma in which the apposition of bone can be taken as a reaction to bending of the alveolar wall. If the tooth were moved bodily in the alveolar process over a distance, the remodelling would take place and form new healthy bone.[13]

Patients with bimaxillary dentoalveolar protrusion generally have perfectly good occlusion and the orthodontic treatment is often solely sought to correct the protrusive profile and improve the facial esthetics. The most common therapy for this condition involves extracting the four 1st premolars and then retracting the incisors to acceptable inclinations. Handelman claims that a thin tooth alveolus or an inappropriate alveolar cavity for the amount of desirable tooth movement must be considered as a risk for the occurrence of unfavourable sequel to orthodontic movement, especially fenestration, bone dehiscence and root resorption.[14] According to him unlimited tooth movement was not possible during retraction of the incisors, especially the mandibular incisors. This is due to the restriction imposed by the symphyseal bone which consists of a dense cortical plate on the labial and lingual surfaces near the roots of the incisors. In fact, the incisors can be moved labially or lingually to only a very limited extent.[7]

In order to assess dentoalveolar morphology in both sagittal and vertical dimensions, orthodontists often use cephalometric tracings. However, this fails to assess the bone thickness. Conventional 2D lateral cephalograms have numerous drawbacks in terms of investigating the changes in the alveolar bone and roots, particularly in the anterior region, as a consequence of the midsagittal projection.[11] Cephalometric radiographs are midsagittal projections thus; the actual limit of the palate and the symphysis at the midline may be narrower than the traced image. CBCT is now used to qualitatively and quantitatively assess potential surgical procedures.[9] Fuhrmann et al recently showed that quantitative evaluation of alveolar bone plates is accurate to a minimum bone thickness of 0.5 mm. Conventional dental radiographs do not allow for evaluation of sites of dehiscence however, CBCT findings have proven to be statistically similar to histological measurements. The tridimensional analysis provided by computed tomography is of great importance for an accurate assessment of craniofacial morphology because through this examination, it is possible to obtain more reliable information on the dimensions and levels of facial bone tissues when compared to traditional bidimensional examinations.[10]

Pre and post retraction CBCT images of 20 patients were taken for the study. They were evaluated for the labial bone thickness and change in alveolar bone thickness since there is lack of scientific evidence in the literaturewhich elaborates the change in the alveolar bone thickness that may take place due to the retraction mechanics. Hence the study was taken up to evaluate the changes that occur in alveolar bone thickness of the maxillary anterior teeth after en-masse retraction in adult patients with bimaxillary dentoalveolar protrusion using Cone Beam Computed Tomography (CBCT).

ALVEOLAR BONE THICKNESS

Maxillary central incisors-

There was an increase in the alveolar bone thickness on the labial side and a decrease in the palatal side. There was an increase of 0.3mm of labial bone thickness and a decrease of 0.18mm of palatal bone thickness in the crestal region (S1). There was an increase of 0.02mm of labial bone thickness and a decrease of 0.11mm of palatal bone thickness in the mid-root region (S2). In the apical region (S3) there was an increase of 0.26mm of labial bone thickness and a decrease of 0.39mm of palatal bone thickness. From this finding it can be inferred that the maxillary anteriors move palatally within the alveolar process during retraction of the anteriors.

Resorption of the alveolus in the direction of the force is a necessary pre condition for tooth movement. Resorption of the alveolar walls was observed throughout the crestal, mid-root and the apical region of the teeth when there was an applied force toward the palatal or lingual cortical bone. This would indicate that resorption had started as a reaction to the force applied. The present study showed that the applied force system caused a pronounced formation of labial bone thickness in the tension side. This could be explained when the total reaction is considered in light of the sequence of remodelling which includes activation, resorption and apposition of cellular reaction as explained by Frost.

Sarikaya et al, Mimura et al and Lin et al in their studies have indicated a lag in bone remodelling in response to tooth movement and reported that as the upper incisors are retracted, labial bone thickness at the crestal level and apical level significantly increased.[2,16,27]

Krishna Nayak and co-workers in their study to evaluate the changes in bone thickness due to retraction of the maxillary and mandibular central and lateral incisors, concluded that the thickness of bone lingual to the anterior teeth was reduced in both scenarios, in fact a greater decrease of thickness was found in lateral incisors. A similar result was found in our study where a significant decrease in the alveolar bone thickness in the palatal and lingual cortical plate of both the maxillary and mandibular central incisors was observed.[17]

In this study, we observed a statistically significant decrease in palatal bone thickness after upper incisor retraction in contrast to the results of Sarikaya et al, Vardimon et al and Wehrbein et al.[2,18,19] The rate of tooth movement correlated strongly with changes in labial bone thickness at the crestal level (S1) and apical level (S3) respectively in the maxillary central incisor indicating that the rate of tooth movement is related to alveolar bone thickness changes at crestal and apical regions. Even though there were no significant changes in labial bone thickness in mid-root level, a mild amount of increase in bone thickness was seen in this region, in all the samples which emphasized on pure translatory or bodily movement of the maxillary central incisors on enmasse retraction of anteriors.

The results demonstrated that lingual movements of the maxillary incisors reduced the alveolar bone thickness in the palatal side of upper arch.This finding, disputes that of De Angelis, who presented the bending capacity of alveolar bone. According to De Angelis, mechanotherapy induces alveolar distortion and the distorted alveolus alters the electric environment, a process that is attributed to the piezoelectricity of bone. As a result the theory is that highly synchronized coordinated changes are triggered and with coordinated apposition and resorption, the alveolar bone retains its structuralcharacteristics and size as it moves. In the present study it was found that the alveolar bone thickness did not remain the same rather it decreased in the palatal side and increased in the labial side.[21]

This finding of reduced bone thickness in the direction of tooth movement agreed with the results of Wainwright, Ten Hoeve and Mullie, Vardimon et al, Wehrbein et al and Sarikaya et al.[2,3,22,20] The results demonstrated significant increase in the labial bone thickness at crestal level which was similar to the study of Bimstein et al, which reported that an increase in the amount of buccal alveolar bone may take place as a result of orthodontic treatment that involves lingual positioning of procumbent mandibular permanent central incisors.[23] Palatal bone thickness did not remain the same; rather, it decreased at the crestal level, mid-root level and the apical level and was statistically significant. This finding agreed with the results of Sarikaya et al, Ten Hoeve and Mulie, Wehrbein et al, Vardimon et al and Wainwright.[2,22,19] The hypothesis of this study was that if controlled forces are used with proper biomechanics it might be possible to achieve tooth movement without any possible damage such as bone dehiscence, fenestration or root resorption to the alveolar bone.

Limitations of the study

The limitations of this study should be considered.

Firstly, minute changes cannot be quantified accurately and are within the margins of error. Fuhrmann et al. also suggest that measurements are accurate only to the nearest 0.5 mm.
Secondly, the position of the anterior limit of labial cortical plate and posterior limit of lingual/palatal cortical plate was not measured.[36]
Finally, long-term changes in bone thickness after orthodontic treatment were not followed up. A longitudinal follow-up study would be beneficial to explain the long-term response of alveolar bone to various rates of tooth movement.

Conclusion

CONCLUSION

This study was undertaken to evaluate the changes in labial and lingual alveolar bone thickness on retraction of anterior teeth using cone beam computed tomography..

After evaluating and analysing the data, following conclusions were made:

1) **There was significant increase in the labial bone thickness and decrease in the palatal/lingual bone thickness indicating that the anteriors moved palatally/lingually within the alveolar process during the enmasse retraction.**

Summary

SUMMARY

This study was conducted on a sample of 20 patients selected from the out patients to the Department of Orthodontics and Dentofacial Orthopedics, St.Gregorious Dental college college,Kothamanglam It's a non-randomized comparative study using quantitative data on an interval scale.

It's a CBCT study to evaluate the changes in alveolar bone thickness during upper incisor retraction in Class I Bimaxillary protrusion cases. Patients ofboth the sexes between age group of 18-25 years were selected who desired toundergo orthodontic treatment with preadjusted edgewise appliance. The retraction was carried out using 0.019 × 0.025' stainless steel wire. Changes in alveolar bone thickness in the retracted area were assessed using pretreatment (T0) and postretraction (T1) on cone-beam computed tomography images. Labial bone thickness & palatal bone thickness were assessed at the crestal, midroot, and apical levels of the retracted incisors.Statistical analyses were done using student paired 't' tests to determine the significance of the findings.

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ANNEXURES

Annexure 1 : Informed Consent (Malayalam)

സമ്മതപത്രം

സെന്റ് ഗ്രീഗോറിയോസ് ഡെന്റൽ കോളേജിലെ ഓർത്തോഡോണ്ടിക്സ് വിഭാഗം നടത്തുന്ന ഇവാലുവേഷൻ ഓഫ് ലേബിയൽ ആൽവിയോളർ ബോൺ തിക്ക്നെസ് ഇൻ ബൈമാക്സിലറി പ്രൊട്രൂഷൻ കേസസ് പ്രീ ആൻഡ് പോസ്റ്റ് ഓർത്തോഡോണ്ടിക് റിട്രാക്ഷൻ യൂസിങ് സ്ലൈഡിങ് മെക്കാനിക്ക്സ് : എ സി.ബി.സി.ടി സ്റ്റഡിയിൽ എന്റെ മകൾ / മകൻ.......... പങ്കെടുക്കുവാൻ എനിക്ക് സമ്മതമാണ്.
പഠനത്തെക്കുറിച്ചുള്ള എല്ലാ വിവരങ്ങളും എനിക്ക് അറിയാവുന്ന ഭാഷയിൽ എന്നോട് വിവരിച്ചിട്ടുണ്ട്. ഏത് നിമിഷവും, പഠനത്തിൽ നിന്നും പിൻമാറാം എന്നും, ഇത് തുടർന്നുള്ള എന്റെ മകളുടെ/ മകന്റെ ചികിത്സയെ ബാധിക്കില്ല എന്നും, ചികിത്സാ വിവരങ്ങളുടെ സ്വകാര്യത നഷ്ടപ്പെടുത്താതെ സൂക്ഷിക്കുമെന്നും ഉറപ്പ് നൽകിയിട്ടുണ്ട്. ഇതിന്റെ ഭാഗമായി സി.ബി.സി.ടി എടുക്കുന്നതിനും, പ്രസിദ്ധീകരണങ്ങളിൽ പബ്ലിഷ് ചെയ്യുന്നതിനും എനിക്ക് സമ്മതമാണ്.

പേര്

ഒപ്പ്/വിരലടയാളം

രക്ഷകർത്താവിന്റെ പേര്

ഒപ്പ്/ വിരലടയാളം

തീയതി

പരിശോധകന്റെ പേര് ഒപ്പ്

അഡ്രസ്സ്

സാക്ഷിയുടെ പേര്

ഒപ്പ്/വിരലടയാളം

ഡോക്ടർ.......

പി.ജി. സ്റ്റുഡന്റ്

ഡോക്ടർ.......

പ്രൊഫസ്സർ/ഗൈഡ്.

Annexure 2 : Informed Consent (English)

Consent which allow to take and use CBCT images from the patient for the study
"Evaluation of labial alveolar bone thickness in bimaxillary protrusion cases before and after orthodontic retraction using sliding mechanics" : A CBCT study

Name :
Age :
Address :

I am giving permission to take and use CBCT images for the study related to the "evaluation of labial alveolar bone thickness in bimaxillary protrusion cases before and after orthodontic retraction using sliding mechanics". The department head has ensured me that the existing records will not be used for purposes other than above mentioned study.

Name :

Signature :

Place :
Date :

Witnesses :
Signature

Annexure 3: Ethical clearance certificate

ST. GREGORIOS DENTAL COLLEGE

UNDER THE MANAGEMENT OF MJSCE TRUST, PUTHENCRUZ

CHELAD, KOTHAMANGALAM, ERNAKULAM DIST, KERALA - 686681

ETHICAL CLEARANCE CERTIFICATE

SGDC/ISA/2021/4016 17/02/2021

To,

Dr. Sreenath U.P
St. Gregorios Dental College
Chelad, Kothamangalam

Dear Dr. Sreenath U.P

Subject: Ethics Committee Clearance-reg

Protocol: Evaluation of labial alveolar bone thickness in bimaxillary protrusion cases before and after orthodontic retraction using sliding mechanics : A CBCT study

At the Institutional Ethics Committee (IEC) held on 15th of January 2021, this study was examined and discussed. After consideration, the committee has decided to approve and grant clearance for the aforementioned study.

The members who attended the meeting at which the protocol was discussed were:

1) Dr .C.K.K Nair - Former BARC Scientist
2) Dr.Cinu Thomas A - Scientist, Vice Principal, Caritas College of Pharmacy
3) Dr. Lissy Jose – Former member of Women's welfare Association.
4) Adv. Jose Aranjani – Advocate.
5) Dr. Sauganth Paul – Reader, Department of Biochemistry, St. Gregorios Dental College.
6) Dr. Eapen Cherian – Secretary, Professor, St. Gregorios Dental College
7) Dr. Jain Mathew – Principal and Head of the Department, Department of Conservative Dentistry and Endodontics.
8) Dr. George Francis – Head of the Department, Department of Prosthodontics and Crown and Bridge.
9) Dr. Binoy Kurian – Head of the Department, Department of Orthodontics and Dentofacial Orthopaedics.

Dr. C.K.K Nair
Chairman Institutional Ethics Committee
St.Gregorios Dental College, Chelad.

Dr. Eapen Cherian
Secretary

St. Gregorios Dental College, Chelad - 686681

Phone : 0485-2572529, 530, 531, 2571429, Fax : 0485-2572530,
Email : sgdc@rediffmail.com, Web : sgdc.ac.in

Annexure 4: MASTER CHART

PRE RETRACTION MEASUREMENTS

SAMPLE NO	ALVEOLAR BONE THICKNESS					
	S1L1	**S2L2**	**S3L3**	**S1P1**	**S2P2**	**S3P3**
1	0.2mm	1.6mm	1.4mm	1.4mm	1.2mm	1.6mm
2	1.0mm	1.3mm	1.3mm	1.3mm	1.5mm	1.8mm
3	1.7mm	2.7mm	3.2mm	1.2mm	1.3mm	1.9mm
4	0.8mm	1.8mm	2.8mm	1.3mm	1.4mm	2.0mm
5	1.0mm	1.6mm	3.4mm	1.4mm	1.6mm	2.2mm
6	0.9mm	1.1mm	2.6mm	1.2mm	1.6mm	1.9mm
7	0.7mm	1.2mm	2.5mm	1.1mm	1.4mm	1.8mm
8	1.2mm	1.4mm	3.7mm	1.4mm	1.2mm	2.3mm

9	1.0mm	1.6mm	3.6mm	1.4mm	1.6mm	2.4mm
10	1.3mm	1.1mm	2.8mm	1.1mm	1.7mm	2.2mm
11	0.8mm	1.4mm	2.9mm	1.3mm	1.4mm	1.9mm
12	0.8mm	1mm	3.8mm	1.7mm	1.6mm	1.9mm
13	1.4mm	1.3mm	3.7mm	1.8mm	1.5mm	2.6mm
14	0.8mm	1.4mm	2.8mm	1.1mm	1.4mm	2.3mm
15	1.5mm	1.6mm	2.9mm	1.2mm	1.2mm	2.7mm

16	1.2mm	1.5mm	3.4mm	1.5mm	1.7mm	2.4mm
17	1.3mm	1.2mm	2.8mm	1.1mm	1.4mm	2.3mm
18	0.7mm	1.4mm	3 mm	1.5mm	1.4mm	1.8mm
19	0.8mm	1.6mm	3.4mm	1.6mm	1.5mm	1.7mm
20	1.1mm	1.1mm	3.8mm	1.5mm	1.6mm	2.5mm

Annexure 5 : MASTER CHART

POST RETRACTION EVALUATION

SAMPLE NO	ALVEOLAR BONE THICKNESS					
	S1L1	S2L2	S3L3	S1P1	S2P2	S3P3
1	0.4mm	1.5mm	1.6mm	1.3mm	1.1mm	1.3mm
2	1.2mm	1.4mm	1.7mm	1.2mm	1.4mm	1.4mm
3	2.1mm	2.7mm	3.4mm	1.0mm	1.2mm	1.5mm
4	1.1mm	1.9mm	2.9mm	1.2mm	1.3mm	1.6mm
5	1.3mm	1.6mm	3.6mm	1.2mm	1.5mm	1.8mm
6	1.4mm	1.1mm	2.8mm	0.9mm	1.4mm	1.4mm

7	0.9mm	1.2mm	2.9mm	1.0mm	1.1mm	1.2mm
8	1.6mm	1.4mm	3.9mm	1.1mm	1.0mm	2.0mm
9	1.3mm	1.8mm	3.7mm	1.2mm	1.5mm	2.1mm
10	1.5mm	1.3mm	3.1mm	0.8mm	1.6mm	1.7mm
11	0.9mm	1.4mm	3.3mm	1.1mm	1.3mm	1.4mm
12	1.1mm	1.6mm	3.9mm	1.6mm	1.6mm	1.6mm
13	1.5mm	1.1mm	4.1mm	1.7mm	1.5mm	2.2mm
14	1.0mm	1.3mm	3.2mm	1.0mm	1.3mm	2.0mm
15	1.5mm	1.5mm	3.3mm	0.9mm	1.1mm	2.4mm
16	1.4mm	1.4mm	3mm	0.7mm	1.7mm	1.6mm

17	0.8mm	1.5mm	3.4mm	1mm	1.4mm	1.3mm
18	1.3mm	1.7mm	3.9mm	1.5mm	1.6mm	1.5mm
19	1.2mm	1.2mm	4.1mm	1.5mm	1.4mm	2.4mm
20	1.1mm	1.mm	3.1mm	1.0mm	1.3mm	2.1mm

-

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Dr. SREENATH