Research Article

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Evaluation of 3D Hard Tissue Changes in Adult Patients Undergoing Orthodontic Treatment with Premolar Extractions

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ABSTRACT

Background: Orthodontists primarily have always diagnosed and planned treatment keeping hard tissues in mind. The foundation of the soft tissue is determined by the skeletal and dental relationships. Objective evaluation of the soft tissues of the face is integral to effective treatment planning, postoperative assessment, and describing patterns of craniofacial growth and variation. The bony and dental framework supports the soft tissues of the face, which provides subtle and sometimes glaring information concerning the positioning of the framework. Improvement of the soft-tissue profile depends on many variables related to the anatomy of the face, including lip thickness, facial muscle activity, and ethnicity. The relationship between dentoalveolar movement and soft-tissue change is complex and contingent on soft-tissue relationships in all 3 planes of space. **Aim of the study:** To evaluate the 3D hard tissue changes in adult patients undergoing orthodontic treatment with premolar extractions and its correlation with soft tissue facial changes.

Materials and methods: The present study was conducted in the Outpatient Department of Orthodontics and Dentofacial Orthopedics, I.T.S Dental college, Hospital and Research Centre, Greater Noida. 20 consecutive patients, requiring extraction of all first premolars for orthodontic purposes, reporting to I.T.S Dental college, Hospital and Research Centre, Greater Noida, were selected for the study. Pre-treatment CBCT of all the patient was taken with 10 x 10 FOV in Carestream (CS-9300). All the landmarks were identified on patient pretreatment photographs & CBCT, then calibration was done using software for CBCT.

Results: We observed that improvement in dental measurements were statistically significant from 1st day to after 3 months, however, skeletal measurements were not statistically significant.

Conclusion: Within the limitations of the present study, it can be concluded that this CBCT study found positive results in patients who required first bicuspids extraction, with a significant change in their hard tissues and soft tissue profile and facial esthetics.

Keywords: CBCT, orthodontic extraction, hard tissue changes.

INTRODUCTION

Orthodontists primarily have always diagnosed and planned treatment keeping hard tissues in mind. The foundation of the soft tissue is determined by the skeletal and dental relationships. However, a foundation that is harmonious does not mean the overlying tissues of the face will be esthetic. [1, 2, 3] Objective evaluation of the soft tissues of the face is integral to effective treatment planning, postoperative assessment, and describing patterns of craniofacial growth and variation. The bony and dental framework supports the soft tissues of the face, which provides subtle and sometimes glaring information concerning the positioning of the framework. Facial analysis [4, 5] has rapidly become the determinant of many orthodontic treatment choices. Although there are many limitations to

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what clinicians can do to change the soft tissues with orthodontic treatment, the soft tissues ultimately direct the treatment decisions. Assessing the intricate details of a patient's facial anatomy in 3 dimensions has traditionally been limited to evaluating the patient clinically. New technology has been introduced to evaluate the patient's 3-dimensional (3D) anatomic relationships. [6] Improvement of the soft-tissue profile depends on many variables related to the anatomy of the face, including lip thickness, facial muscle activity, and ethnicity. The relationship between dentoalveolar movement and soft-tissue change is complex and contingent on soft-tissue relationships in all 3 planes of space. Previous studies [7] have focused on lip changes only in the midsagittal plane, using superimposed lateral cephalograms and facial photos. This study was designed to evaluate the 3D hard tissue changes in adult patients undergoing orthodontic treatment with premolar extractions and its correlation with soft tissue facial changes.

MATERIALS AND METHODS

The present study was conducted in the Outpatient Department of Orthodontics and Dentofacial Orthopedics, I.T.S Dental college, Hospital and Research centre, Greater Noida. The ethical clearance for the study was approved from the ethical committee of the hospital prior to starting the study. 20 consecutive patients, requiring extraction of all first premolars for orthodontic purposes, reporting to I.T.S Dental college, Hospital and Research Centre, Greater Noida, were selected for the study.

SIZE OF SAMPLE -20

AGE- 16-25 YEARS

Inclusion Criteria

- No history of previous orthodontic treatment.
- All teeth present till permanent 2nd molar.
- Cases requiring orthodontic extraction of all four first premolars.

EXCLUSION CRITERIA:

- Extreme skeletal class II overjet greater than 10mm, indicated for orthognathic surgery.
- Periapical or periradicular pathologies or radiolucencies of either periodontal or endodontic origin.
- Significant medical or dental history(eg.use of bisphosphonate or bone altering medication or diseases).
- Periodontally compromised dentition.
- Congenital anomalies
- Significant facial asymmetry.
- Congenitally missing teeth.

Pre-treatment CBCT of all the patient was taken with 10 x 10 FOV in carestream (CS-9300).All the landmarks were identified on patient pr-etreatment photographs & CBCT,than calibration were done using software for CBCT.

The statistical analysis of the data was done using SPSS version 11.0 for windows. Chi-square and Student's t-test were used for checking the significance of the data. A p-value of 0.05 and lesser was defined to be statistical significant.

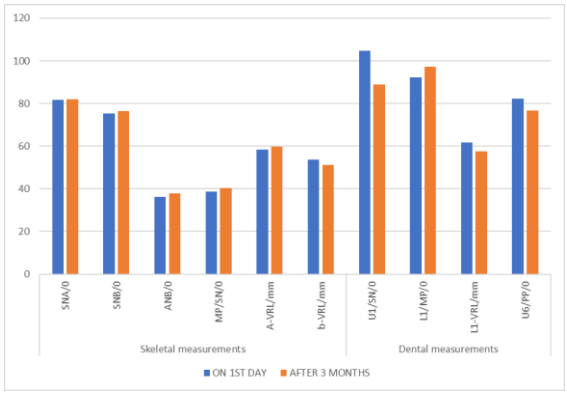
RESULTS

Table 1 shows changes in hard tissues after orthodontic extraction and treatment. We observed that improvement in dental measurements were statistically significant from 1st day to after 3 months, however, skeletal measurements were not statistically significant. (Fig 1)

Table 1: Changes in hard tissues after orthodontic extraction and treatment.

		ON 1ST DAY	AFTER 3 MONTHS	P-VALUE
Skeletal measurements	SNA/⁰	81.65	82.0	0.23
	SNB/⁰	75.36	76.31	0.11
	ANB/⁰	36.25	37.95	0.5
	MP/SN/⁰	38.65	40.26	0.68
	A-VRL/mm	58.36	59.68	0.65
	b-VRL/mm	53.69	51.32	0.63
Dental measurements	U1/SN/⁰	104.69	88.98	0.05
	L1/MP/⁰	92.34	97.36	0.05
	L1-VRL/mm	61.65	57.69	0.05
	U6/PP/⁰	82.36	76.65	0.65

Fig 1: Skeletal and dental measurements after orthodontic extraction and treatment.



DISCUSSION

Radiographs are an indispensible tool in the evaluation of the bony structures of the head and neck in orthodontic diagnosis and treatment planning. These radiographic techniques provide 2-dimensional information about the maxillomandibular relationship, soft tissuess, dentoalveolar relationship. Sir Godsfrey N.Hounsfield, beholder of noble prize, invented the Cone Beam Computed Tomography (CBCT) machine. This machine represents the 3 dimensional representation of any object and is more accurate than conventional radiographs.[8] CBCT has several advantages over conventional 2 dimensional imaging. The reliability and stability of landmarks are more precise. The radiation dose as compared to conventional radiographs is remarkably less. [9] With the advent of cone-beam computed tomography (CBCT), it became possible to evaluate the hard and soft tissuess of the maxillofacial region in 3 dimensions, and in high spatial detail. Additionally, visualization of the craniofacial complex in 3 dimensions became possible with surface reconstruction views. For the purpose of facial examination, soft tissue face can be produced by gathering all HU values in the range of skin and increasing opacity value, so that face looks solid. All the diagnostic parameters which is applied to static facial examination and recording can be applied here, like facial type, profile, morphological examination of lips including lip prominence. Morphological examination of nose, nostrils, chin, nasolabial angle, mento labial sulcus, facial dimensions, midline symmetry, eye width, nose width, mouth width, soft tissues landmarks, and various linear & angular measurements can be measured. Such information has the potential to improve orthodontic diagnosis and treatment planning.

The present study was conducted to evaluate the changes in hard tissues in cases requiring first bicuspid extractions. 20 patients were selected. CBCT of all 20 patients was taken pre treatment and after space closure . The appliance of choice was the MBT. 022 slot brackets (3M Unitek, Monrovia, Calif.) and en masse retraction of teeth was done on 19× 25 Stainless Steel working archwires using active tie backs. With the shift of paradigm from hard tissues to soft tissues, the emphasis is more to treat the esthetics of the patients, followed by the underlying dentoalveolar malocclusion. In the present study, orthodontic treatment lead to the increase in the Lower facial height, which is again a linear measurement from soft tissue point Subnasale to Menton. In CBCT, there was an increase in Lower Facial height. There has been controversy regarding the relation between extraction and change in vertical dimension. Changes in lower anterior vertical height have been documented in literature. In our study the alteration of the LAFH was compared between the T1 and T2 in relation to the concept that mesial movements of the molars will rotate the mandible in an anticlockwise direction leading to reduction of the LAFH thus creating a “wedging effect”. Precautions were taken not to extrude the buccal teeth during space closure by avoiding class II elastics and extra oral anchorages. Though these precautions were taken, post treatment results indicate that there was some amount of extrusion of both the upper and lower molars, that resulted in an increase in LAFH in almost all the cases.

Retraction of the upper and lower incisors after extraction demonstrates significant effect on the lower lip, that diminishes the commissures, which is in proportion to the degree of retraction. In the present study, four sagittal planes were taken and landmarks were placed at the most anterior point of upper and lower lips. A significant reduction in the intercommissure distance was observed. A similar study was conducted by RC solem [13] in 2015 on three dimensional evaluation of the

intercommissure distance. The author stated that Orthodontic retraction in this study produced lower lip changes that diminished toward the commissures in proportion to the degree of retraction.

A similar study conducted by Tan [14] on the Chinese population, he found out that treating cases with first premolar extractions, helps in achieving favorable soft and hard tissues which was in accordance to the results of our study.

The present study demonstrate significant changes in upper and lower lip length. A similar contrasting study conducted by K Lew [15] on 32 patients aged between 18-26 years ,to assess the change in the soft tissues profile after first bicuspid extraction , the results of his study shows the upper lip and lower lip lengthened by 1.9 mm and 1.2 mm, respectively, which is in accordance with the results of our study.

Our study indicates a non significant correlation of the change in linear dimensions of Interalar width & Bizygomatic width, in CBCT, after the space closure. In our study, commissure width is also assessed, pre treatment and after closure of the space and it was found that there was significant increase of the commissure width, which was due to the retraction of anterior teeth, that resulted in the transformation of a Convex profile into a Flat one & increased the Commissure width.

The advantage of the present study conducted, is that the evaluation of all the landmarks is done by cone beam computed tomography technique, & results were compared with Photometric changes, in which the reliability, stability and accuracy of the landmark was more precisely done. The evaluation of the landmarks is done in all the three planes, in CBCT of all the patients were standardized since the beginning of the study. CBCT with a radiation exposure of 35 µSv provides information in any crossection and plane, whereas the radiation exposure in conventional two-dimensional radiographs is approximately 75 µSv, which in turn provides very limited findings.

CONCLUSION

Within the limitations of the present study, it can be concluded that this CBCT study found positive results in patients who required first bicuspids extraction, with a significant change in their hard tissues and soft tissue profile and facial esthetics.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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