ORIGINAL ARTICLE

Assessment of Axial Angulations of the Mandibular Incisors in Various Classes of Dental Malocclusions: A Cross Sectional Study

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Abstract:

Objective: The main objective of this study was to assess the mesiodistal axial angulation of the mandibular incisors in various classes of dental malocclusion, Class-I / Class-II / Class-III, in patients presenting to Orthodontics Department of Rehman College of Dentistry.

Methods: A total of 55 panoramic radiographs of patients (age > 11 years) irrespective of gender were randomly selected from patient's records of department. Measurements were taken on a software IC Measures version 1.3. Root canals at their longest aspect of teeth were taken as long axis of teeth and their mesial angle recorded, with the horizontal reference line passing through right and left mental foramens. The main outcome measure was the "mesiodistal axial angulation" of the 4 lower incisors in all dental malocclusion classes.

Results: The relationship between the variables was assessed by one-way ANOVA test. The highest mean of mesiodistal angulation on right side was found in Class-III while on left side in Class-II group. The mean value of mesiodistal angulation of lateral incisors was greater than that of central incisors irrespective of side and gender. There was however no significant difference in mesiodistal angulation of all four mandibular incisors.

Conclusion: No significant difference in mesiodistal angulation of lower incisors was found among the malocclusion groups. Lateral incisors had more mesiodistal angulation than central incisors in both genders.

Key words: Axial angulation, Mandibular incisors, Orthopantomogram.

Introduction:

An important goal of orthodontic treatment is to obtain an esthetic, functional, and stable occlusion that depends on proper facio-lingual inclination and mesiodistal axial angulation of all teeth. According to Andrews, mesiodistal axial angulation of teeth is one of the key to normal occlusion.[1] This angulation helps in distribution of occlusal forces and stability of teeth.[2] In cases of malocclusion teeth tend to display abnormal angulations. Assessment of the axial inclinations of teeth can help in the clinical diagnosis of dental irregularities.[2]

Digital imaging plays an important role in evaluating "mesiodistal axial angulation" of the teeth in both arches.[3] Panoramic radiograph is a valuable tool used in dentistry.[4] In Orthodontics, it is commonly used due to its low radiation exposure, patient comfort and significant amount of diagnostic information obtained.[5] Most of the studies consider the panoramic radiograph as a valuable tool for the assessment of "mesiodistal axial angulation" of the teeth and also capable of identifying any variation in the axial angulation of the teeth.[6,8]

Ursi et.al radiographically measured normal mesiodistal axial angulation of teeth, using acetate sheets tracing, in non-orthodontic normal subjects.[7] Another study by Almeida et.al compared mesiodistal axial inclinations of maxillary anterior teeth in orthodontically treated patients with normal occlusion.[9] A study conducted on mesiodistal axial inclination of three maxillary teeth in children of age 8-12 years concluded that there is significant increase in mesiodistal axial inclination in second molar in male's while in females increase in angulation was observed for canines.[10]

Axial angulation of teeth should be included in the orthodontic treatment goals, as this is directly related to alignment of teeth and aesthetics.[11,12,13] Additionally, providing correct angulation is a contributing factor in the long-term stability of the treatment results.[14] Little data is available in our region about normal mesiodistal angulations of lower incisors in uncrowded cases.

The aim of this study was to assess the mesiodistal axial angulation of the mandibular incisors in different classes of dental malocclusion among patients visiting Orthodontic Department of Rehman College of Dentistry.

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Materials and Methods:

This cross-sectional analytical study was carried out at the Department of Orthodontics, Rehman College of Dentistry (RCD) from 1st July- 30th Sept 2018. Approval of ethical committee of RCD was sought for the study in the Ref No: 2021-06-069. 55 Dental casts and panoramic radiographs of patients (age >11 years) irrespective of gender were randomly selected from patient's records of department. Dental casts of the patients were categorized in to class I, II and III according to their dental malocclusions.

Inclusion criteria was panoramic radiographs of good quality and contrast, full set of permanent teeth anterior to first molars., Angle class I, II & III malocclusion and minimal crowding or spacing. While patients having crown/root pathologies of incisors, history of prior orthodontic treatment and history of trauma were excluded.

Data Collection Procedure:

The measurements were directly taken on panoramic radiographic images [Imaging machine CS900 using following parameters 70kv,10mA,14.3s],according to the method of Ursi et al.,[7] Root canals of the teeth at their longest aspect were used for determination of long axes of mandibular incisors, a horizontal line passing through right and left mental foramens was used as reference. The mesiodistal axial angulation of the mandibular incisors were measured from horizontal reference line, using software IC Measure version 1.3. [Figure 1].
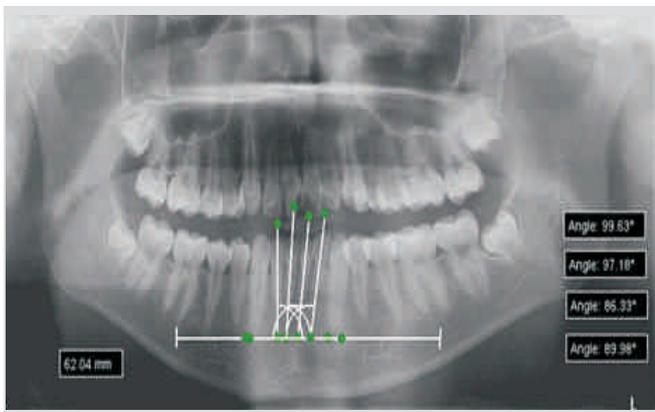

Figure 1: Angular measurements of long axes of mandibular incisors with horizontal reference line.

Statistical Analysis:

Data were analyzed by IBM SPSS Statistics software version 19.0. Means and standard deviations were calculated for all quantitative variables. Frequencies & percentages for categorical variables like class I, II, III were calculated. To calculate the relationship between axial angulations of lower incisors, one way ANOVA test was used.

Results:
Baseline data

Panoramic radiographs of 55 patients (36 females, 19 males) with Mean age 18 years (Range 11-35 years, SD 5.2 years) were included in this study. Class I included 22 patients (16 females, 6 males); class II included 27 patients (17 females, 10 males) while class III included 6 patients (3 females, 3 males).

Primary Outcomes:

Mean and standard deviation values of four angles calculated for all malocclusion group are shown in Table 1. The highest mean value of mesiodistal axial angulation for right central and lateral incisors was found in class III group and minimum in class I group. While on left side maximum angulation was found in class II group. The Mean values of the degree of axial angulation of lateral incisor was greater than that of the mean value of central incisor on each side, for both genders and in the total sample [Table 1 & Table 3].

Table 1: Mesiodistal axial angulation of mandibular incisors.

Angle	Class I		Class II		Class III		Total	
	Mean±SD	Range	Mean±SD	Range	Mean±SD	Range	Mean±SD	Range
LRt2	91.50±4.54	18.4	93.47±4.87	16.15	95.55±5.87	12.75	92.91±4.94	18.8
LRt1	88.98±5.02	17.75	89.82±4.44	17.54	92.92±5.78	15.18	89.82±4.89	20.4
LL1	89.29±7.41	24.94	90.63±4.96	21.86	89.26±6.24	19.33	89.95±6.11	28.11
LL2	91.33±7.26	27.65	95.17±5.22	20.72	93.35±6.81	19.48	93.43±6.42	27.65

Assessment of angulation in between groups

No significant differences were found between groups for mesiodistal axial angulation of mandibular incisors [Table 2].

Table 2: ANOVA results for mandibular incisor angulation between groups.

Angles	Sig.
Lower Right Lateral incisor	.147
Lower Right Central Incisor	.218
Lower Left Central Incisor	.723
L0wer Left Lateral Incisor	.113

($p < 0.05$)

Gender related difference:

The mean values of axial angulations were little higher in females (93.54) than males (91.7) on right side for lateral incisors however, no statistically significant difference was observed between males and females for all four lower incisors angle [Table 3].

Table 3. Mean values of axial angulations in male and female.

Angle	Male		Female	
	Mean±SD	Range	Mean±SD	Range
LRt2	91.71±5.38	18.09	93.54±4.64	18.80
LRt1	89.52±5.41	20.40	89.98±4.66	17.75
LL1	90.42±5.88	20.00	89.70±6.29	28.11
LL2	93.37±6.95	25.18	93.47±6.23	23.74

Discussion:

The mesiodistal axial angulation of the mandibular incisors in various dental malocclusion classes, in patients presenting to Orthodontics Department of Rehman College of Dentistry was observed. Assessment of axial inclinations of teeth has

significant importance in orthodontics. Faciolingual inclination and mesiodistal axial angulation of all teeth plays an important role in obtaining an esthetic, functional, and stable occlusion.[11] Establishing appropriate axial inclinations of the teeth with near parallel roots is an important goal of orthodontic treatment.[8]

Panoramic radiographs were used for this purpose since it is the most common radiograph in dentistry and routinely used radiograph in orthodontics. Like any other radiograph, panoramic radiograph has a tendency to magnifying the dimensions of structures.[15,16] Unlike linear measurements which are affected by projection factor, image distortion did not affect angular measurements, such as axial tooth angulation.[7,9,17]

In present study there were more females than males and the reason could be that females are more esthetically concerned about their appearance and seek orthodontic treatment in greater percentage.[15,19] There were more cases of class I and II patients in comparison with class III as the prevalence of latter malocclusion is low among our population.[16]

The outcomes of this study displayed that mean value of mesiodistal axial angulation of mandibular incisors for right side was slightly higher in class III group and minimum in class I group. While on left side higher values were found in class II group. However, no statistically significant differences were found among the groups for mesiodistal axial angulation of mandibular incisors.

This study revealed that the mean values of the mesiodistal axial angulations of lateral incisors were greater than that of the central incisor on both right and left sides in both genders and in the total samples, parallel with the results of previous study.[3]

The mean values of axial angulations for right lateral incisor were slightly higher in females than males but however, statistically insignificant. Some local factors like crowding and difference in muscle forces may be responsible for this phenomenon.[3]

The results of this study may not be directly compared with the outcomes of other studies since it is different from other studies in approach that dealt with mesiodistal axial angulations of all maxillary and mandibular teeth in subjects with class I malocclusion.[3,7] While this study dealt with cases with Angle class I, II and III relationship. The purpose of our study was to assess the mesiodistal axial angulation of the mandibular incisors in different classes of malocclusion while other studies assessed the correctness of OPG for measurement of mesiodistal axial angulations.[7,9]

Limitations:

Sample size can be increased in further studies for better description of mesiodistal axial angulation in order to provide bases for comparison. Assessment of angulation of all anterior and posterior teeth can be done.[3] dimensional radiographs like CBCT can be used to evaluate true long axis of teeth.

Conclusions:

No significant differences were found among the malocclusion groups for mesiodistal axial angulation of mandibular incisors. Lateral incisors had more axial angulation than central incisors in both genders. No significant differences in axial angulation were found between males and females.

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Author Contributions

1. Shahida Jehan- Creation of research idea, proposal writing, data collection, data analysis and referencing.
2. Rehana Fayyaz- Proposal writing and drafting.
3. Sohrab Shaheed- Data analysis, Interpretation and write up
4. Ayesha Iftikhar- Review and drafting