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Measurement of Mesiodistal Axial Angulation of the Teeth in Class I Malocclusion in Adults

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Abstract

This study aimed to provide a description of the mesiodistal axial angulation of the maxillary and mandibular teeth in cases of class I malocclusion.

The values of the mesiodistal axial angulation of the teeth were measured for 20 subjects (10 males and 10 females) from orthopantomograph using computer program and comparisons were made between the right and left sides and between males and females.

The mean values of the mesiodistal axial angulation of the teeth were higher in males than in females, and higher on the right side in upper and lower arches than on the left side for males, females and total sample, however; there was no statistically significant difference between the groups. This study provided a good description of the mesiodistal axial angulation of the maxillary and mandibular teeth in cases of class I malocclusion.

Keywords: mesiodistal axial angulations, class I malocclusion, orthopantomograph.

Introduction

The study of the axial inclination of the individual teeth to each other is the most important step in the process of case study for the purpose of classification and also points out to the successful manner of treatment, and any method of case analysis that omits the study of the axial inclination of the teeth is a faulty one¹. The study of teeth position specifically their mesiodistal axial angulation is a vital subject, since proper axial angulation is considered one of the keys for normally positioned teeth and proper axial angulation is necessary for distribution of occlusal forces with closed contact points². Teeth are presented with varying degrees of mesial inclination which is very important for proper distribution of

occlusal forces and stability, however ; the teeth tend to display abnormal inclination in cases of malocclusion and the analysis of axial inclination of certain key teeth can serve greatly in the clinical diagnosis of dental irregularities^{3,4}. Axial curvatures are also essential for adapting teeth to the curved occlusal planes of the dental arches which is normally a convex plane in the maxilla and concave in the mandible, this fascinating pattern of arrangement provides proper space between the roots which ensures adequate blood and nerve supply which helps to confine tooth roots in their location in the jaw bones⁵. Radiographs are very important tools for evaluating mesiodistal axial inclination of the teeth and one of them

is the orthopantomograph (OPG), where all the maxillary and mandibular teeth can be surveyed from a single film⁶. This technique was utilized to evaluate the inclination of the teeth in relation to each other and to the adjacent structures⁷⁻⁹. Panoramic radiography is useful in studying growth and development, resorption and eruption patterns, the TMJ, the sinuses, mandibular morphology and fractures, various pathological conditions and also applicable in serial extraction and monitoring progress during the therapy¹⁰. Orthopantomograph is recommended as a mean for determining the angulation development of the molar teeth^{7,11-13}. Many authors believed that the OPG could be used for assessment of mesiodistal axial angulation of the teeth, and it is capable of detecting any change in the axial inclination of the teeth^{7,8,12-15}.

The purpose of the this study is to establish a base line data about the mesiodistal axial angulation of the maxillary and mandibular teeth in cases of class I malocclusion in both genders .

Materials and Methods

The sample: consisted of 20 Iraqi adult subjects (10 males and 10 females) with age range of (18-25) years.

Criteria of the sample:

- 1-Bilateral class I Angle's classification molar relation with an overjet of 2-4 mm¹⁶.
- 2-Full set of permanent teeth excluding the third molars.
- 3-No history of bad habits, no proximal restorations or carious lesions, no history of orthodontic treatment or maxillofacial surgery, trauma, or facial asymmetry.
- 4-Minor crowding and spacing was accepted.

5-Skeletal class I relationship was assessed clinically by two fingers method¹⁷.

Examination instruments: include dental mirrors and vernier.

The OPG machine:

PLANMICA PROMAX with DIMAX 3 Digital X-Ray Unit System Machine (FIN-00880, Helsinki, Finland). All the radiographs were taken the orthodontic department at the college of dentistry, University of Baghdad.

Method

Each subject was examined clinically using the dental mirror and vernier to determine the Angle's relation and the overjet, then the skeletal relation was determined by the two fingers method. Then each subject was positioned in the OPG machine and instructed to place the incisal edges of the maxillary and mandibular incisors in the notch of the bite block. The subject's head was positioned so that the midsagittal plane coincides with the midsagittal plane light beam of the machine and the Frankfort's plane coincides with the Horizontal plane light beam of the machine, the layer light beam of the machine was placed between the lateral incisor and the canine tooth¹⁸⁻²⁰.

The exposure values were selected according to gender and general weight of the subject (small or large)²¹.

After taking the radiographs each image was analyzed using the computer (Pentium IV) using AutoCAD 2008 program to calculate the angular measurements required for the study.

The tracing procedure:

The measurement of mesiodistal axial angulation of the teeth was done directly on each OPG image using the computer program by identifying certain landmarks.

Definition of landmarks:

The long axis of each tooth was determined according to certain landmarks according to Alwash 1994²²:

Cusp tip: used as a reference point for the canines and premolars.

Root end: represented by the root apex, used as a reference point for all the single rooted teeth.

Crown width point: indicate the centre of the greatest mesiodistal crown width, used as a reference point for all the teeth except the canines and premolars.

Bifurcation and trifurcation: represent the root bifurcation or trifurcation, used as a reference point for all the molars.

Reference lines: represented by two horizontal lines, the upper one passing through the most inferior points of the right and left orbits, and the lower one passing through the centre of the right and left mental foramina. After determining the long axis of all the teeth and determining the upper and lower horizontal lines using the computer program for each image, then the angle formed between the long axis of each maxillary tooth and upper horizontal line toward the midline and the angle formed between the long axis of each mandibular tooth and lower horizontal line toward the midline is measured to determine the value of mesiodistal axial angulation for each tooth⁸ (Figure 1).

The statistical analysis was carried out using SPSS program version 15 in which the descriptive statistics included mean and standard deviation, and inferential statistics by sample t-test. P values smaller than 0.05 were regarded as statistically significant.

Results

Descriptive statistics for male, female and total class I subjects are shown in table (1). The results showed

that the mean values of the degrees of mesiodistal axial angulations of the teeth are somewhat higher on the right side than those of the same teeth on the left side for all the maxillary and mandibular teeth in male, female subjects and total sample (Table 1), however; there was no statistically significant difference between the right and left sides except between lower right and left second premolars in male subjects, and between right and left canine, first and second premolars in the total sample that showed statistically significant difference (Table 1).

For the maxillary teeth there was a gradual increase in the mean value of the degree of mesiodistal axial angulation of the teeth starting from the central incisor towards the second molar on both sides in male and female subjects and in the total sample, while for the mandibular teeth there was a gradual decrease in the mean value of the degree of mesiodistal axial angulation of the teeth starting from the central incisor towards the second molar except for the lateral incisor where the value of the degree of mesiodistal axial angulation is greater than that of the central incisor on both sides in male, female and in the total sample (Table 1).

The mean values of the degrees of mesiodistal axial angulations of the teeth are higher in males than those of the same teeth of females on both right and left sides for all the maxillary teeth except for upper left first and second premolar where the values are higher in females than males, however, there was no statistically significant difference between males and females except between maxillary first permanent molar on both right and left sides that showed statistically significant difference (Table 2). For the mandibular teeth, the mean values of the degrees of mesiodistal axial

angulations of the teeth are higher in males than females for right central and lateral incisors, right and left canines, and first premolars, but the mean values of the degrees of mesiodistal axial angulations of the teeth are higher in females than that of males for the lower left central and lateral incisors and right and left second premolar and first and second molars, however; there was no statistically significant difference between males and females except between mandibular first permanent molars on both right and left sides and between left second premolars that showed statistically significant difference (Table 2).

Discussion

Direct comparison of the results of this study with the results of other studies may be difficult since it is different from other studies in methodology that dealt with mesiodistal axial angulations of the teeth, in fact this study dealt with subjects with class I skeletal relationship and class I Angle's relation while other previous studies mainly dealt with the accuracy of measurement of mesiodistal axial angulations of the teeth from OPG ^{7,12-14,23,24}, or dealt with comparison of OPG image distortion and its effect on mesiodistal angulation of the teeth produced by different machines ^{8,12,13}. Many authors stated that it is both possible and accurate to measure the mesiodistal axial angulations of the teeth from the OPG and that distortion that occurred did not affect on the angular measurements ^{8,12-15,22,23,25}, however some authors suggested that it is inaccurate to measure the mesiodistal axial angulations of the teeth from the OPG due to image distortion and that we should be careful

during the interpretation of the results ²⁶⁻²⁹.

The findings of this study showed that for all the maxillary and mandibular teeth in males, females and in total class I sample; the mean values of the degrees of mesiodistal axial angulations of the teeth are somewhat higher on the right side than those of the same teeth on the left side (Table 1). The results also showed that the mean values of the degrees of mesiodistal axial angulations of the teeth are higher in males than in females (Table 2) except for some teeth where the values of mesiodistal axial angulations are higher in females than males which could be due to some local factors like crowding, this may be related to the difference that could exist in muscles activity between males and females as the biting force is higher in males than females with class I malocclusion ^{30,31} which could affect on the position of the teeth within the arch, however; this requires further investigations.

Regarding the total sample, the maxillary central and lateral incisors, canines, first and second premolars are almost upright and as we move towards the first and second molars the long axis of these teeth tilt mesially with the crowns tilted distally. For the lower arch (on both sides), the central and lateral incisors are upright and starting from the lower canine towards the second molar there is a gradual increase of the tilt of the crowns of the teeth towards the mesial side and tilt of the roots distally, this general picture coincide with most other findings ^{8,32}, however; further studies are required to provide better description for other classes of malocclusion in order to provide bases for comparison.

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Table (1): Descriptive statistics of the mean values of mesiodistal axial angulations of the upper & lower teeth for males, females & for total sample.

Gender	Arch	Tooth	n	Right side		Left side		t-test			
				Mean	SD	Mean	SD	t	df	P. value	Sig.
Male	Upper	1	10	90.078	2.956	89.738	3.159	0.249	18	0.807	NS
		2	10	91.542	3.557	90.150	3.257	0.913	18	0.373	NS
		3	10	91.862	3.171	91.167	3.277	0.482	18	0.636	NS
		4	10	92.542	2.775	91.442	3.663	0.757	18	0.459	NS
		5	10	94.158	2.285	91.745	4.834	1.427	18	0.171	NS
		6	10	100.262	3.976	99.410	5.045	0.419	18	0.680	NS
		7	10	108.610	4.123	105.556	4.607	1.562	18	0.136	NS
	Lower	1	10	91.043	2.368	88.450	3.417	1.972	18	0.064	NS
		2	10	92.242	3.926	89.380	2.774	1.883	18	0.076	NS
		3	10	84.500	2.902	82.030	4.419	1.477	18	0.157	NS
		4	10	81.778	2.712	79.100	3.971	1.761	18	0.095	NS
		5	10	73.750	3.708	70.826	2.066	2.178	18	0.043	S
		6	10	68.178	3.257	65.342	4.380	1.643	18	0.118	NS
		7	10	64.778	3.731	62.170	6.651	1.081	18	0.294	NS
Female	Upper	1	10	89.067	3.039	87.390	2.658	1.313	18	0.206	NS
		2	10	90.056	3.151	88.267	1.952	1.526	18	0.144	NS
		3	10	89.600	3.618	88.550	2.212	0.783	18	0.444	NS
		4	10	91.933	3.067	91.780	4.274	0.092	18	0.928	NS
		5	10	93.210	3.519	92.843	2.735	0.260	18	0.798	NS
		6	10	93.756	4.581	93.410	3.076	0.198	18	0.845	NS
		7	10	104.350	5.044	103.662	4.149	0.333	18	0.743	NS
	Lower	1	10	90.240	2.673	89.711	2.642	0.445	18	0.662	NS
		2	10	90.562	2.390	90.000	3.158	0.449	18	0.659	NS
		3	10	83.680	3.758	81.700	1.835	1.497	18	0.152	NS
		4	10	81.658	2.036	78.972	5.048	1.560	18	0.136	NS
		5	10	76.370	3.934	74.428	3.519	1.163	18	0.260	NS
		6	10	74.811	4.007	72.672	2.702	1.400	18	0.179	NS
		7	10	67.960	3.520	65.849	3.202	1.403	18	0.178	NS
Total	Upper	1	20	89.573	2.964	88.564	3.086	1.054	38	0.299	NS
		2	20	90.799	3.358	89.209	2.786	1.630	38	0.111	NS
		3	20	90.731	3.509	89.859	3.034	0.841	38	0.406	NS
		4	20	92.238	2.864	91.611	3.878	0.581	38	0.565	NS
		5	20	93.684	2.928	92.294	3.864	1.282	38	0.208	NS
		6	20	97.009	5.345	96.410	5.100	0.363	38	0.719	NS
		7	20	106.480	4.988	104.609	4.377	1.261	38	0.215	NS
	Lower	1	20	90.642	2.492	89.081	3.042	1.775	38	0.084	NS
		2	20	91.402	3.279	89.690	2.910	1.746	38	0.089	NS
		3	20	84.090	3.295	81.865	3.298	2.135	38	0.039	S
		4	20	81.718	2.335	79.036	4.421	2.399	38	0.021	S
		5	20	75.060	3.956	72.627	3.362	2.096	38	0.043	S
		6	20	71.495	4.920	69.007	5.165	1.559	38	0.127	NS
		7	20	66.369	3.890	64.010	5.420	1.582	38	0.122	NS

NS = non significant, S = significant

Table (2): Comparison between the mean values of mesiodistal axial angulations of the upper & lower teeth for males, females.

Side	Tooth	Male (n=10)		Female (n=10)		t-test			
		Mean	SD	Mean	SD	t	df	P. value	Sig.
Upper left	7	105.556	4.607	103.662	4.149	0.966	18	0.347	NS
	6	99.410	5.045	93.410	3.076	3.211	18	0.005	S
	5	91.745	4.834	92.843	2.735	-0.625	18	0.540	NS
	4	91.442	3.663	91.780	4.274	-0.190	18	0.852	NS
	3	91.167	3.277	88.550	2.212	2.093	18	0.051	NS
	2	90.150	3.257	88.267	1.952	1.568	18	0.134	NS
	1	89.738	3.159	87.390	2.658	1.798	18	0.089	NS
Upper right	1	90.078	2.956	89.067	3.039	0.754	18	0.461	NS
	2	91.542	3.557	90.056	3.151	0.989	18	0.336	NS
	3	91.862	3.171	89.600	3.618	1.487	18	0.154	NS
	4	92.542	2.775	91.933	3.067	0.466	18	0.647	NS
	5	94.158	2.285	93.210	3.519	0.715	18	0.484	NS
	6	100.262	3.976	93.756	4.581	3.392	18	0.003	S
	7	108.610	4.123	104.350	5.044	2.068	18	0.053	NS
Lower left	7	62.170	6.651	65.849	3.202	-1.576	18	0.132	NS
	6	65.342	4.380	72.672	2.702	-4.505	18	0.000	HS
	5	70.826	2.066	74.428	3.519	-2.791	18	0.012	S
	4	79.100	3.971	78.972	5.048	0.063	18	0.950	NS
	3	82.030	4.419	81.700	1.835	0.218	18	0.830	NS
	2	89.380	2.774	90.000	3.158	-0.466	18	0.646	NS
	1	88.450	3.417	89.711	2.642	-0.923	18	0.368	NS
Lower right	1	91.043	2.368	90.240	2.673	0.711	18	0.486	NS
	2	92.242	3.926	90.562	2.390	1.156	18	0.263	NS
	3	84.500	2.902	83.680	3.758	0.546	18	0.592	NS
	4	81.778	2.712	81.658	2.036	0.112	18	0.912	NS
	5	73.750	3.708	76.370	3.934	-1.532	18	0.143	NS
	6	68.178	3.257	74.811	4.007	-4.062	18	0.001	S
	7	64.778	3.731	67.960	3.520	-1.961	18	0.065	NS

NS = non significant, S = significant, HS = highly significant

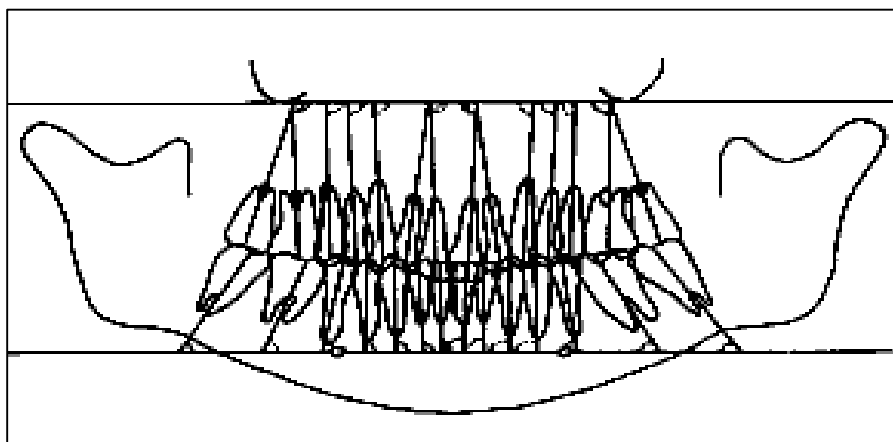


Figure (1): Angular measurements between long axes of teeth & upper & lower reference lines (Ursi et al 1990).