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Mesiodistal axial teeth angulations of permanent anterior teeth using postero–anterior cephalometric radiograph

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ABSTRACT

The present study aimed to determine the mesiodistal axial angulations of upper and lower permanent anterior teeth in young Iraqi adults having normal occlusion using postero–anterior cephalograph. Also to detect the sex difference in the mesiodistal axial angulations of such teeth.

The sample consisted of 33 young Iraqi adult students, 17 males and 16 females aged 20–23 years old who were having Class I normal occlusion. Postero–anterior cephalograph was taken for each subject and was traced to determine the mesiodistal axial angulation of upper and lower permanent anterior teeth.

The results revealed that the mean values of mesiodistal axial teeth angulations in both sexes showed very limited variation. No significant bilateral differences were found for right and left sides for both jaws (for males, females and total sample).

From the above results, it could be concluded that no significant bilateral differences in mesiodistal axial tooth angulations were found for both jaws, for total sample and for both sexes. Also, male–female comparison showed no significant difference in mesiodistal axial teeth angulations and for both jaws.

Key Words: Axial teeth angulations, frontal, radiographs.

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INTRODUCTION

Normally the crown portion of the teeth varies more than few degrees from the vertical in relation to the occlusal plane. The establishment of the mesiodistal axial angulations of permanent teeth is very important since normal occlusion depends upon proper axial angulations of the teeth.[1, 2]

Dewel[3] reported that it is characteristic for the teeth to have varying degrees of mesial angulations and also stated that the axes of teeth are not a straight lines, but curved lines and each one of them is represented by an arc passing distally from the occlusal plane to the root apex; i.e., teeth are presented with varying degrees of mesial angulations.

Wheeler[4] said that axial angulations are also essential for adapting teeth to the curved occlusal planes of the dental arch since incisal and occlusal surfaces of the upper teeth confirm to convex plane and those of lower teeth to concave plane. He also stated that the long axes of teeth are not at right angle to horizontal plane. Also angulations of teeth in orthodontics are important of "alignment of teeth".

Andrews[1] suggested that there are 6 keys to normal occlusion, which were established from the study of 120 non orthodontic normal models, the mesiodistal principle was the gingival portion of the long axes of all crowns is more distal than

incisal portion, crown angulation is expressed in degrees plus or minus, the angle formed between the long axis of the crown and the occlusal plane.

Andrews[2] stated in term of degrees the crown angulations; the angle formed by the long axes of the clinical crown as viewed from the labial or buccal perspective and align perpendicular to the occlusal plane found that in the non orthodontic normal models for the lower teeth were equal to 2 degrees with the exception of the lower canine were it equal to 5 degrees. He also measured crown angulation for the upper teeth which was found to be 5 degrees, 9 degrees, and 11 degrees for the upper central, lateral and canine, respectively.

Orthodontic treatment objectives can be stated as obtaining functional occlusion, esthetics and stability. One of the criteria for obtaining a functional occlusion is to have ideal axial angulations of all teeth at the end of active treatment.[5]

Holdaway[6] and Proffit *et al*.[7] stated that the use of an angulated bracket edgewise slot will help in obtaining parallel space closure and to achieve proper positioning of the roots of most teeth.

The assessment of the axial angulations of clinical crowns from the vertical in relation to the occlusal plane could be done either by: a) Clinical visual examination, craniometry: Direct assessment of the axial angulations of clinical crowns offers limited information for diagnosing dental irregularities.[3] Dempster *et al*.[8] studied the arrangement of the roots of the teeth qualitatively and quantitatively in eleven skulls with typical dentition; or b) study cast which can provide 3 dimensional reproduction of the dentition[2, 9]; or c) radiographs in which different types of radiographic techniques were utilized to determine the axial angulations of the teeth, whether intraorally[10] or extraorally in which several techniques as lateral oblique cephalograms at 60 degrees, 45 degrees[11] and orthopantomograph,[12–17] computerized tomography[18] and photographs.[19]

This study aimed to determine the mesiodistal axial angulations of upper and lower permanent anterior teeth in young Iraqi adults having normal occlusion using postero–anterior (PA) cephalogaph and to detect the sex difference in the mesiodistal axial angulations of such teeth.

MATERIALS AND METHODS

Thirty three students were randomly selected from the College of Dentistry, University of Mosul; 17 males and 16 females 20–23 years old according to the following criteria:

1. Full complement of permanent teeth in both jaws excluding third molars with bilateral Class I (normal occlusion) canine and molar relationships, no apparent dental discrepancy, over bite and over jet ranging from 2–4 mm.
2. No history of orthodontic treatment or maxillofacial surgery, extensive dentistry, facial trauma or temporomandibular joint pathosis.
3. No history of oral habit.
4. No apparent facial asymmetry and midline of the upper central incisors should be in the center and coincide with that of the lower incisors.
5. All subjects were Iraqis living in Mosul City.

The supplies used in this study included:

- Examination Equipment: Plane mouth mirror, kidney dish, disinfectant solution and cotton.
- Cephalometric Machine: SS White cephalometer with a Wehmer Cephalostate (Model–W–105A, USA) set at 90 kV and 15 mA power with 40–50 impulses.
- Double Emulsion Films: (8×10 inch) produced by AGFA Gevart NV Co, Belgium.
- The Cassette: One cassette of (8×10 inch) non–grid Whemer type (USA) with a pair of highly sensitive intensifying screen.
- Tracing Equipments: X–ray viewer, acetate matte tracing paper (19×24 cm) dimension and 0.003 inch in thickness, masking tape, lead pencil 0.5 mm thickness, writing pencil, eraser, transparent plastic ruler and protractor.

All subjects are clinically examined extra–orally and intra–orally to check their fulfillment of the required sample selection.

Postero–anterior cephalometric radiograph was taken for each subject with the teeth in the position of maximum interusp-ation and the lips were relaxed keeping Frankfort Horizontal Plane parallel to the floor.[20] After processing procedure for the films, tracing was done in dark room.

Cephalometric Landmarks (Figure):

The following landmarks were used in the study:

- Point UMT (upper molar tip): The tip of the mesiobuccal cusp of the upper first molar (left and right).
- Point LMT (lower molar tip): The tip of the mesiobuccal cusp of the lower first molar (left and right).

Cephalometric Planes (Figure):

Occlusal plane (OP): It is formed by a line joining the midpoint of the overlap of the mesiobuccal cusps of the upper and lower first molars bilaterally.[21]

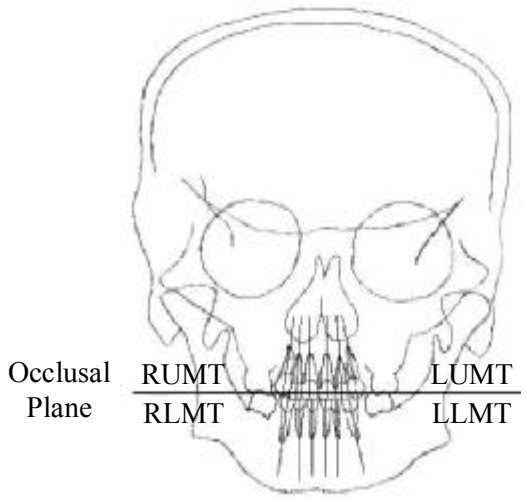

Figure: Mesiodistal axial angulations of upper and lower anterior permanent teeth made from the long axes of the anterior teeth to occlusal plane on postero–anterior view

RUMT: Right upper molar tip; RLMT: Right lower molar tip; LUMT: Left upper molar tip; LLMT: Left lower molar tip

For the measurements techniques (Figure), the cephalometric landmarks and planes were recorded from tracing of the radiographs to determine the mesiodistal axial angulations of upper and lower anterior teeth that were computed by measuring the angle formed by the long axes of the anterior teeth (represented by lines connecting the root apex to the mid point of the crown) to the occlusal plane. Angular measurements were recorded to the nearest half degree.

For assessment of the validity of the landmarks, planes and angular measurements, intra–examiner and inter–examiner calibrations were done by re–tracing and re–measuring seven randomly radiographs from the selected sample with lapse of two weeks between two examinations to exclude memory bias

The results indicated no significant differences between first and second readings for intra–examiner and inter–examiner calibration at the level of $p \leq 0.05$.

The data analyzed by using Statistical Package for Social Sciences (SPSS) system loaded on Pentium IV computer. Statistical analysis included: Descriptive statistics: Mean and standard deviation for all angular measurements; the significant differences of means between males and females were determined by using the Student's t–test at 0.05 level of significance; and pooled samples t–test were done for all the right and left angular measurements, for males, females and total sample to estimate the degree of difference between the right and left sides at 0.05 level of significance.

RESULTS

The summary of the results was presented in Tables (1) through (4). Table (1) showed the right–left side comparison in the mesiodistal axial angulation of upper and lower anterior permanent teeth for total sample. Table (2) represented comparison in the mesiodistal axial angulations of upper and lower anterior permanent teeth for males and females. Table (3) revealed the right–left side comparison in the mesiodistal axial angulations of upper and lower anterior permanent teeth for males, and Table (4) showed right–left side comparison in the mesiodistal axial angulations of upper and lower anterior permanent teeth for females.

Table (1): Right–left side comparison in the mesiodistal axial angulations of upper and lower anterior permanent teeth for total sample

Tooth	No.	Mean(°)	± SD	Side	No.	Mean(°)	± SD	t–value	Significance
U1	66	87.4243	0.1071	Right Left	33 33	87.3485 87.5000	1.6031 1.5207	0.209	NS
U2	66	86.0909	6.428	Right Left	33 33	86.0455 86.1364	1.6171 1.3421	0.658	NS
U3	66	85.2877	6.406	Right Left	33 33	85.2424 85.3333	1.969 1.6661	0.652	NS
L1	66	87.9292	7.156	Right Left	33 33	87.8788 87.9848	1.4309 1.4603	0.198	NS
L2	66	87.0985	5.360	Right Left	33 33	87.0606 87.1364	1.9029 2.0889	0.325	NS
L3	66	85.2803	0.2035	Right Left	33 33	85.4242 85.1364	1.4744 1.3537	0.108	NS

U: Upper; L: Lower; 1: Central incisor; 2: Lateral incisor; 3: Canine.
SD: Standard deviation
NS: Not significant ($p > 0.05$).

Table (2): Comparison in the mesiodistal axial angulations of upper and lower anterior permanent teeth for males and females

Tooth	No.	Mean(°)	± SD	Sex	Mean(°)	± SD	t–value	Significance
U1	66	87.4243	0.1071	Male Female	87.3225 87.5313	8.153 0.1326	0.001	NS
U2	66	86.0909	6.428	Male Female	86.2074 85.9675	8.111 0.2227	0.001	NS
U3	66	85.2877	6.406	Male Female	84.9100 85.6875	4.243 8.839	0.003	NS
L1	66	87.9292	7.156	Male Female	88.0730 87.7813	2.121 0.1326	0.001	NS
L2	66	87.0985	5.360	Male Female	87.3950 86.7813	6.364 4.419	0.002	NS
L3	66	85.2803	0.2035	Male Female	85.2490 85.3125	0.2277 0.1768	0.000	NS

U: Upper; L: Lower; 1: Central incisor; 2: Lateral incisor; 3: Canine.
SD: Standard deviation
NS: Not significant ($p > 0.05$).

Table (3): Right–left side comparison in the mesiodistal axial angulations of upper and lower anterior permanent teeth for males

Tooth	No.	Mean(°)	± SD	Side	No.	Mean(°)	± SD	t–value	Significance
U1	66	87.3225	8.153	Right Left	33 33	87.2647 87.3824	1.2262 1.3173	0.216	NS
U2	66	86.2074	8.111	Right Left	33 33	86.2647 86.1471	1.0476 1.2217	0.387	NS
U3	66	84.9100	4.243	Right Left	33 33	84.8824 84.9412	1.4527 1.4239	0.651	NS
L1	66	88.0730	2.121	Right Left	33 33	88.0588 88.0882	1.3906 1.2776	0.817	NS
L2	66	87.3950	6.364	Right Left	33 33	87.3529 87.4412	1.4116 1.7667	0.529	NS
L3	66	85.2490	0.2277	Right Left	33 33	85.4118 85.0882	1.3138 1.003	0.336	NS

U: Upper; L: Lower; 1: Central incisor; 2: Lateral incisor; 3: Canine.
SD: Standard deviation
NS: Not significant ($p > 0.05$).

Table (4): Right–left side comparison in the mesiodistal axial angulations of upper and lower anterior permanent teeth for females

Tooth	No.	Mean(°)	± SD	Side	No.	Mean(°)	± SD	t–value	Significance
U1	66	87.5313	0.1326	Right Left	33 33	87.4375 87.625	1.9653 1.7464	0.423	NS
U2	66	85.9675	0.2227	Right Left	33 33	85.8125 86.125	2.0726 1.5	0.441	NS
U3	66	85.6875	8.839	Right Left	33 33	85.625 85.75	2.3910 1.8439	0.757	NS
L1	66	87.7813	0.1326	Right Left	33 33	87.6875 87.875	1.493 1.6636	0.083	NS
L2	66	86.7813	4.419	Right Left	33 33	86.75 86.8125	2.3238 2.4005	0.333	NS
L3	66	85.3125	0.1768	Right Left	33 33	85.4375 85.1683	1.6721 1.273	0.041	NS

U: Upper; L: Lower; 1: Central incisor; 2: Lateral incisor; 3: Canine.
SD: Standard deviation
NS: Not significant ($p > 0.05$).

DISCUSSION

One of the characteristics of normal occlusion in the permanent dentition is the angulations of teeth buccolingually and mesiodistally.[22]

The occlusal plane was used to detect mesiodistal axial angulations of upper and lower anterior permanent teeth because it seems to be more reliable than the midsagittal plane in PA cephalometrics.[21]

The mean values, for total sample, of mesiodistal axial angulations were calculated for every upper and lower anterior permanent tooth. The mean value for upper canine approached that recorded by Proffit *et al.*;[7] while the mean value for upper ce-

ntral, lateral incisors is slightly larger than indicated to be built–in the brackets of such teeth.[7] The mean value for lower central, lateral incisors agreed with Andrews.[2] For lower canine, the mean value came in accordance with many investigators[2, 7] (Table 1).

The mean values, for total sample, regarding right–left sides comparison revealing no significant bilateral differences in mesiodistal axial tooth angulations and for both jaws (Table 1). Also, the mean values, for males and females, of mesiodistal axial angulations were calculated for every upper and lower anterior permanent teeth of right–left sides revealing no significant bilateral differences in mesiodistal axial tooth angulations and for both jaws for each sex (Tables 2 and 3). This bilateral symmetry in mesiodistal axial teeth angulations was also observed by Ursi *et al*.,[12] who found that mesiodistal axial tooth angulations become more dissimilar as one move posteriorly in the dental arch, and as cited by Bishara,[22] Vig and Hewitt, in their study of symmetry of various parts of the dentofacial complex, found that the dento–alveolar regions exhibited the greatest degree of symmetry.

Male–female differences showed no significant differences in mesiodistal axial tooth angulations and for both jaws reflecting very limited variations in these measurements (Table 4).

CONCLUSIONS

No significant bilateral differences in mesiodistal axial tooth angulations were found for both jaws, for total sample and for both sexes.

Male–female comparison showed no significant differences in mesiodistal axial tooth angulations and for both jaws.

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