

# Normal faciolingual inclination of tooth crowns for Iraqi adolescent in Mosul City

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## ABSTRACT

The purposes of this study are to determine the faciolingual inclinations of tooth crowns in Class I normal occlusion of Iraqi adolescent in Mosul City, investigate the possible significant differences between genders, and determine the correlation of the faciolingual inclination of teeth crown with each others.

The sample of this study consisted from 35 Iraqi adolescents (19 males and 16 females) aged 12–16 years selected according to certain criteria from Mosul City. Stone casts were taken for each subject, the faciolingual inclinations were made on the dental models of the subjects by using torque angle gauge.

The data were analyzed with the Statistical Package for Social Sciences program and it was found that each tooth distally to the central incisor had more lingual inclination than did its neighbor. The females had more labial inclination of upper lateral incisor and more lingual inclination of the lower canine, premolars and first molar as compared with the males. Most intraarch teeth torque correlation were positive and decreased with remoteness while most interarch teeth correlation showed weak negative correlation.

**Key Words:** Faciolingual inclination, torque, cast.

## الخلاصة

هدف هذه الدراسة هو تحديد الميلان الوجهي اللساني لتيجان الأسنان للمراهقين العراقيين في مدينة الموصل الذين يمتلكون إطباق طبيعي من الصنف الأول وبحث الفروقات الممكنة بين الجنسين وتعيين علاقة الميلان الوجهي اللساني لتيجان الأسنان مع بعضها.

أجريت الدراسة على عينة مكونة من ٣٥ مراهق عراقي (١٩ ذكر و ١٦ أنثى) تتراوح أعمارهم بين ١٢ – ١٦ سنة اختيروا حسب صفات معينة من مدينة الموصل. أخذ القالب الجبسي لكل شخص وقيس الميلان الوجهي اللساني على القالب السني باستعمال مقياس زاوية الميلان الوجهي اللساني.

تم تحليل البيانات باستخدام نظام الحقيبة الإحصائية للعلوم الاجتماعية ووجد أن ميلان الأسنان باتجاه اللسان يكون أكبر كلما ابتعدنا عن الفاطع الأول؛ كما وجد أن الإناث يمتلكون ميلان وجهي أكبر للقاطع العلوي الثاني وميلان لساني أكثر للنايب والضواحك والطاحن الأول في الفك السفلي مقارنة مع الذكور.

كانت معظم علاقات الميلان الوجهي اللساني للأسنان ضمن الفك الواحد موجبة وتقل مع بُعد الأسنان عن بعضها؛ بينما كانت معظم علاقات الميلان الوجهي اللساني للأسنان بين الفكين ضعيفة وسالبة.

## INTRODUCTION

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 inclination of all teeth at the end of active treatment.

Several studies on faciolingual inclination have been published,<sup>(1-8)</sup> but only few statistical investigations have been performed. These reports concluded that

there was a considerable variation in faciolingual inclinations in normal occlusions. Andrews<sup>(4)</sup> stated that “this variation was in the range of biologic limits”. Wheeler<sup>(9)</sup> similarly noted that the facial curvatures of teeth are as consistent as any anatomic detail. On the contrary, Dellinger<sup>(10)</sup> reported that this variation was so great that there was no basis to give specific values for crown torque in the straight wire appliance.

Faciolinguinal inclination of the dentition has been studied by employing different methods on untreated ideal occlusions, treated occlusions and tooth positioner setups,<sup>(10-12)</sup> as well as extracted teeth<sup>(13)</sup> by using study model, cephalometric roentgenography and photography.

In Iraq, there are no data available about the faciolinguinal inclination of crown teeth by using study cast that are useful for orthodontic diagnosis and treatment.

The purposes of this study are to determine the faciolinguinal inclinations of tooth crowns in Class I normal occlusion of Iraqi adolescents aged 12–16 years in Mosul City, to investigate the possible differences in faciolinguinal inclination between the genders, and to determine the correlation of the faciolinguinal inclination of teeth crown with each other for males, females and total sample.

## **MATERIALS AND METHODS**

The sample consisted of 35 Iraqi adolescents (19 males and 16 females) aged 12–16 years old, selected from intermediate school children from different areas in Mosul City.

Each of these subjects was selected on the following criteria:

- 1) All children were Iraqi and borne in Mosul City.
- 2) No previous orthodontic treatment.
- 3) Normal anatomic occlusion.
- 4) Angle Class I molar relationship.
- 5) All the teeth were in occlusion, no rotation and diastema present.
- 6) Normal overbite and overjet (2–4 mm).
- 7) Minimum attrition.
- 8) No artificial crown present.
- 9) No restorations replacing the incisal edges of anterior teeth or buccal cusps of posterior teeth.

Measurements were made on the dental models of the subjects. All impressions were taken with Cavex alginate impression material (Cavex Holland BV, Keur and Sneltjcs Dental Mfg Co, Haarlen, Holland). All models were poured in MEHECO dental stone (Shanghai Dental Material Factory, China).

The torque angle to be measured was

formed by the intersection of a line perpendicular to the occlusal plane (occlusal plane is an imaginary surface that passes through the occlusion of the teeth) and a line tangent to the middle of the labial or buccal long axis of the clinical crown (LA point).<sup>(11, 14)</sup> A special instrument (locally made, Figure) was designed for the torque measurement. The torque angle gauge was used similar to that used by Vardimon and Lambertz.<sup>(12)</sup> This gauge was constructed out of a geometric triangle, a plum line emerging from the vertex of the protector, and a thin flat rectangular metal piece. The extended metal piece was attached to the right-angled triangle with one side parallel to the ordinate and the other aligned with the abscissa. The torque angle of a given tooth was calculated by subtracting 45° from the measured angle. A reading was taken when the ordinate of the rectangular metal made a single contact with the LA point, with the plumb line touching the triangular abscissa without breaking its planar integrity. The occlusal plane was established by setting an isosceles triangle on its points of definition. By means of surveyor's parallelometer, the base of the lower plaster model was scribed with a line parallel to the occlusal plane. The lower model was then trimmed with respect to this line. Therefore, the base of the upper model was oriented and trimmed parallel to the lower one.

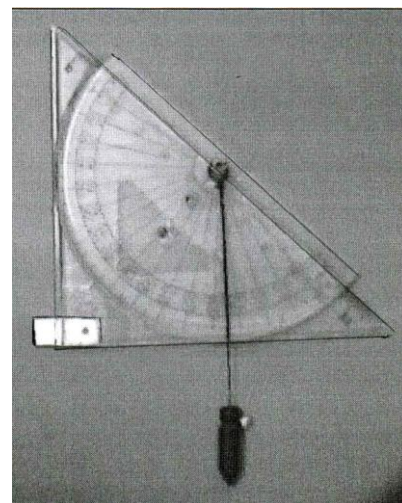


Figure: Torque angle gauge

Crown inclination is expressed in plus or minus degrees. A plus reading represented labial buccal crown torque and a minus

reading represented a lingual crown torque.

The data were analyzed with the Statistical Package for Social Sciences (SPSS) program which included mean, standard deviation, minimum and maximum values computed for each variable using t-test made comparison of the Iraqi males and females.

As the student's t-test at  $p \leq 0.05$  showed no significant differences between torque values of the right and left tooth crown for all teeth in the upper and lower arches for males, females and total sample; therefore, two segments were combined for better statistical evaluation.

To test the reliability of the method, two casts chosen at random were measured on a separate occasion. No statistically significant difference was found between the two measurements (paired t-test,  $p > 0.05$ ).

Also, the intraarch and interarch teeth torque correlation were done for males and females separately, for more precision in estimating the degree of significance of our "r" in hand, the value of probability for our "r" in correspondence with our sample size was established and hence we can say whether our "r" is significant at

0.05 level or highly significant at 0.01 level.

## RESULTS

Table (1) shows the descriptive statistics of faciolingual inclinations (torque) for Iraqi adolescent with Class I normal occlusion in the upper and lower arches. With the exception of lower lateral incisor in female group, the upper and lower incisors had a positive torque value, while the mean torque values from canine to first molar in the upper and lower arches were negative progressive increase toward the posterior teeth.

Table (2) illustrates the comparison of the mean torque data of upper and lower teeth in males group with the females group. It was found that females had more labial inclination of upper lateral incisor and more lingual inclination of the lower canine, first and second premolars and first molar than those in males.

Tables (3) and (4) contain the intraarch upper and lower teeth torque correlation respectively, while Table (5) explains the interarch upper and lower teeth torque correlation for males, females and total groups.

Table (1): Descriptive statistics of faciolingual inclination for Iraqi adolescent

Tooth	Upper			Lower		
	Min(°)	Max(°)	Mean(°) $\pm$ SD	Min(°)	Max(°)	Mean(°) $\pm$ SD
Central	-8.00	16.00	7.26 $\pm$ 5.40	-14.00	13.00	2.13 $\pm$ 6.90
Lateral	-7.00	21.00	4.93 $\pm$ 6.30	-15.00	12.00	0.94 $\pm$ 6.78
Canine	-15.00	7.00	-3.19 $\pm$ 4.54	-20.00	5.00	-7.87 $\pm$ 5.44
First Premolar	-17.00	1.00	-7.24 $\pm$ 4.68	-27.00	-2.00	-15.87 $\pm$ 5.09
Second Premolar	-17.00	4.00	-7.57 $\pm$ 5.56	-35.00	-11.00	-22.03 $\pm$ 5.65
First Molar	-25.00	-1.00	-12.96 $\pm$ 5.58	-42.00	-11.00	-32.24 $\pm$ 6.65

Min.: Minimum values; Max.: Maximum values; SD: Standard deviation.

## DISCUSSION

Generally, in the upper and lower arches beginning with the central incisor, each tooth distally had more lingual crown torque than did its neighbor and this is in accordance with other studies.<sup>(4, 10, 12, 15-17)</sup>

The relatively high values of standard deviations in this study show the considerable dispersion around the mean torque measurements in all teeth. This is in agree-

ment with previous studies.<sup>(4, 5, 12)</sup> The cause of scattered distribution of torque data may be related to: 1) Tooth posture and facial contour as a major etiologic factors, and 2) the occlusal plane as a secondary influential component.<sup>(12)</sup>

The greater mean lingual inclination of the mandibular teeth as compared with the maxillary teeth particularly the poster-

ior teeth permitting proper occlusion especially of the posterior crowns.

Table (2): Comparison of faciolingual inclination between females and males groups

Tooth	Female	Male	t-value	Significance
	Mean(°) ± SD	Mean(°) ± SD		
Upper				
Central	8.12 ± 3.62	6.56 ± 6.45	1.05	NS
Lateral	7.87 ± 5.88	2.56 ± 5.66	3.36	S
Canine	-2.83 ± 4.27	-3.46 ± 4.80	0.51	NS
First Premolar	-7.20 ± 4.07	-7.26 ± 5.18	0.04	NS
Second Premolar	-8.08 ± 5.65	-7.16 ± 5.54	-0.59	NS
First Molar	-12.71 ± 5.93	-13.16 ± 5.39	0.29	NS
Lower				
Central	2.06 ± 7.61	3.91 ± 6.16	-1.40	NS
Lateral	-3.33 ± 6.90	1.9 ± 6.64	-1.24	NS
Canine	-10.16 ± 4.69	-6.03 ± 5.37	-2.97	S
First Premolar	-17.37 ± 5.00	-14.6 ± 4.92	-3.01	S
Second Premolar	-24.41 ± 5.67	-20.1 ± 4.94	-1.99	S
First Molar	-35.83 ± 4.42	-29 ± 6.78	-2.96	S

SD: Standard deviation; NS: Not significant; S: Significant.

Table (3): Intraarch upper teeth torque correlation

Tooth	Sex	Upper Central	Upper Lateral	Upper Canine	Upper 1 <sup>st</sup> Premolar	Upper 2 <sup>nd</sup> Premolar
Upper Central	Male					
	Female					
	Total					
Upper Lateral	Male	-0.102				
	Female	0.297				
	Total	0.534**				
Upper Canine	Male	0.666*	0.114			
	Female	0.477*	0.835**			
	Total	0.320*	0.607**			
Upper 1 <sup>st</sup> Premolar	Male	-0.045	0.929**	0.103		
	Female	0.179	0.294	0.384		
	Total	0.209	0.106	0.362**		
Upper 2 <sup>nd</sup> Premolar	Male	0.259	-0.330	0.498**	-0.346	
	Female	0.296	0.069	0.231	0.671**	
	Total	0.125	-0.107	0.227	0.719**	
Upper 1 <sup>st</sup> Molar	Male	-0.291	0.760**	0.156	0.692**	-0.023
	Female	0.211	0.147	0.304	0.663**	0.673**
	Total	0.132	-0.034	0.145	0.611**	0.734**

\*:Significant difference at 0.05 level; \*\*: Highly significant difference at 0.01 level.

Table (4): Intraarch lower teeth torque correlation

Tooth	Sex	Lower Central	Lower Lateral	Lower Canine	Lower 1 <sup>st</sup> Premolar	Lower 2 <sup>nd</sup> Premolar
Lower Central	Male					
	Female					
	Total					
Lower Lateral	Male	-0.025				
	Female	0.904**				
	Total	0.916**				
Lower Canine	Male	0.764**	0.020			
	Female	0.724**	0.823**			
	Total	0.738**	0.743**			
Lower 1 <sup>st</sup> Premolar	Male	-0.042	0.710**	-0.099		
	Female	0.592**	0.656**	0.709**		
	Total	0.498**	0.512**	0.603**		
Lower 2 <sup>nd</sup> Premolar	Male	0.591**	0.093	0.802**	-0.011	
	Female	0.353	0.489*	0.536**	0.698**	
	Total	0.018	0.339*	0.447**	0.728**	
Lower 1 <sup>st</sup> Molar	Male	0.222	0.552**	0.052	0.703**	0.077
	Female	0.380	0.556**	0.364	0.447*	0.514*
	Total	0.413**	0.431**	0.450**	0.555**	0.678**

\*:Significant difference at 0.05 level; \*\*: Highly significant difference at 0.01 level.

Table (5): Interarch upper and lower teeth torque correlation

Tooth	Sex	Lower Central	Lower Lateral	Lower Canine	Lower 1 <sup>st</sup> Premolar	Lower 2 <sup>nd</sup> Premolar	Lower 1 <sup>st</sup> Molar
Upper Central	Male	0.224	-0.615**	0.075	-0.370*	0.097	-0.312
	Female	-0.054	-0.052	0.099	-0.062	0.115	0.184
	Total	-0.104	-0.069	-0.219	-0.446**	-0.233	-0.244
Upper Lateral	Male	-0.188	0.357	-0.401*	0.187	-0.354	0.399*
	Female	0.084	0.094	0.418*	0.235	0.209	-0.160
	Total	0.007	0.017	0.061	-0.259	-0.192	-0.419**
Upper Canine	Male	-0.001	-0.504*	-0.204	-0.272	-0.241	-0.339
	Female	-0.187	-0.066	0.221	0.032	0.195	-0.055
	Total	-0.268	-0.235	0.038	-0.196	-0.093	-0.339*
Upper 1 <sup>st</sup> Premolar	Male	-0.190	0.354	-0.323	0.123	-0.212	0.338
	Female	-0.032	0.013	0.046	0.154	0.131	0.012
	Total	-0.116	-0.108	-0.054	0.041	0.025	0.137
Upper 2 <sup>nd</sup> Premolar	Male	0.351	0.341	0.237	-0.289	0.020	-0.491**
	Female	0.126	0.105	-0.010	0.143	0.048	0.341
	Total	-0.118	-0.111	-0.132	0.095	0.005	0.170
Upper 1 <sup>st</sup> Molar	Male	-0.112	0.463*	-0.296	0.215	-0.373*	0.314
	Female	0.075	0.174	0.183	0.256	0.305	0.272
	Total	-0.137	-0.035	-0.137	0.152	0.120	0.105

\*:Significant difference at 0.05 level; \*\*: Highly significant difference at 0.01 level.

### Torque Data of Iraqi Adolescent

Controversial claims have been made concerning the faciolingual inclinations of tooth positions. Various methods have been used in different torque studies; so it has been difficult to make direct comparisons.<sup>(4, 5, 10, 12, 17)</sup>

The comparison of the torque data in this study with the other studies (Tables 6 and 7) indicated that the upper and lower anterior teeth had more labial crown inclination than those reported by many investigators.<sup>(10, 12, 15, 16)</sup> On contrast, the upper and lower anterior teeth had less labial inclination than other investigators.<sup>(5, 17-19)</sup> However, the upper incisors had similar torque data to that of Andrews.<sup>(4)</sup>

Continuing with the anterior teeth, the upper and lower canine had more labial inclination than those of many studies.<sup>(4,9,10,15,16,18)</sup> However, they had a very similar torque data to that of Alexander.<sup>(17)</sup>

The mean faciolingual inclination of the upper first premolar was generally similar with those of many investigators.<sup>(4, 7, 17-19)</sup> While the lower first premolar had approximately similar torque data with those of Creekmore,<sup>(7)</sup> Vardimon and Lambertz,<sup>(12)</sup> Morrow<sup>(16)</sup> and Roth.<sup>(19)</sup> Also the lower second premolar had similar torque data to those of many studies.<sup>(4, 10, 12, 18, 19)</sup> On the other hand, the upper and lower premolars had more lingual inclination than those of Rickett<sup>(5)</sup> and less lingual inclination than that of Uğur and Yukay.<sup>(15)</sup>

Continuing with the posterior teeth, the upper and lower first molar had approximately similar torque data to those of Andrews<sup>(4)</sup> and Roth<sup>(19)</sup> but it showed variations with other investigators.<sup>(5, 16, 17)</sup>

It was concluded that these differences from other studies can be a feature of our group that was taken into consideration.

Table (6): Comparison of faciolingual inclination of Iraqi adolescent with other studies (upper teeth)

Author	Central Mean(°) ± SD	Lateral Mean(°) ± SD	Canine Mean(°) ± SD	First Premolar Mean(°) ± SD	Second Premolar Mean(°) ± SD	First Molar Mean(°) ± SD
Current Study	7.26 ± 5.40	4.93 ± 6.30	-3.19 ± 4.54	-7.24 ± 4.68	-7.57 ± 5.56	-12.96 ± 5.60
Uğur and Yukay <sup>(15)</sup>	-3.77 ± 5.77	-2.62 ± 4.59	-10.27 ± 5.53	-13.70 ± 3.89	-15.87 ± 4.27	-20.92 ± 5.89
Andrews <sup>(4)</sup>	6.11 ± 3.97	4.11 ± 4.38	-7.25 ± 4.21	-8.47 ± 4.02	-8.78 ± 4.13	-11.53 ± 3.91
Vardimon and Lambertz <sup>(12)</sup>	3.32 ± 4.89	-1.90 ± 4.82	-9.15 ± 4.18	-9.90 ± 5.60	-8.53 ± 4.61	-11.55 ± 5.18
Morrow <sup>(16)</sup>	3.76 ± 5.32	1.16 ± 6.57	-6.53 ± 6.17	-6.86 ± 6.73	-5.14 ± 6.67	-6.86 ± 7.66
Dellinger <sup>(10)</sup>	2.27 ± 4.84	0.06 ± 5.16	-8.40 ± 5.02	-5.77 ± 5.44	-10.02 ± 5.20	-16.15 ± 6.80
Alexander <sup>(17)</sup>	14	7	-3	-7	-7	-10
Creekmore <sup>(7)</sup>	7	3	-7	-7	-7	-10
Hilgers <sup>(18)</sup>	22	14	7	-7	-7	-10
Ricketts <sup>(5)</sup>	22	14	7	0	0	0
Roth <sup>(19)</sup>	12	8	-2	-7	-7	-14

SD: Standard deviation

Table (7): Comparison of faciolingual inclination of Iraqi adolescent with other studies (lower teeth)

Author	Central Mean(°) ± SD	Lateral Mean(°) ± SD	Canine Mean(°) ± SD	First Premolar Mean(°) ± SD	Second Premolar Mean(°) ± SD	First Molar Mean(°) ± SD
<b>Current Study</b>	2.13 ± 6.90	0.94 ± 6.78	-7.87 ± 5.44	-15.87 ± 5.09	-22.03 ± 5.65	-32.24 ± 6.65
<b>Uğur and Yukay<sup>(15)</sup></b>	0.92 ± 6.01	-3.05 ± 5.23	-11.35 ± 5.02	-20.32 ± 5.52	-26.50 ± 5.12	-34.15 ± 3.79
<b>Andrews<sup>(4)</sup></b>	-1.71 ± 5.79	-3.24 ± 5.37	-12.73 ± 4.65	-18.95 ± 4.96	-23.63 ± 5.58	-30.67 ± 5.90
<b>Vardimon and Lambertz<sup>(12)</sup></b>	1.26 ± 5.41	-1.35 ± 5.10	-9.00 ± 3.77	-15.90 ± 4.36	-21.16 ± 5.15	-26.00 ± 4.60
<b>Morrow<sup>(16)</sup></b>	0.15 ± 7.03	-2.54 ± 5.84	-10.85 ± 6.11	-15.49 ± 6.98	-18.81 ± 7.12	-25.73 ± 7.12
<b>Dellinger<sup>(10)</sup></b>	-0.80 ± 4.32	-2.80 ± 5.01	-12.70 ± 4.51	-18.60 ± 6.55	-22.48 ± 5.17	-29.60 ± 6.82
<b>Alexander<sup>(17)</sup></b>	-5	-5	-7	-11	-17	-22
<b>Creekmore<sup>(7)</sup></b>	0	0	-7	-15	-15	-25
<b>Hilgers<sup>(18)</sup></b>	-1	-1	7	-11	-22	-27
<b>Ricketts<sup>(5)</sup></b>	0	0	7	0	-14	-22
<b>Roth<sup>(19)</sup></b>	-1	-1	-11	-17	-22	-30

SD: Standard deviation.

### Comparison of the Torque Values between Iraqi Males and Females

As shown in Table (2), in the upper arch only the lateral incisor had significantly more labial inclination in the females than that in the males; while in the lower arch, the females had more lingual inclinations of the canine, first and second premolars and first molar than those in males. This may be attributed to a steeper occlusal plane in males.<sup>(20, 21)</sup> Also, the possible cause of these differences is the stronger and heavier muscle mass in males than females.<sup>(22)</sup> This support the findings of Kasai and Kawamura<sup>(23)</sup> who suggest that the molar orientation is more buccal in people with strong masticatory function and also may be attributed to that the females had a tendency toward a dolichofacial pattern, while the males had tendency toward a brachifacial pattern and this confirm the results of Masumoto *et al.*<sup>(24)</sup>

who found the teeth of long-faced subjects and the cortical bone thickness was thicker in short-faced subjects than in long-faced subjects.

### Intraarch and Interarch Teeth Torque Correlation

As shown in Tables (3) and (4), the intraarch relationships indicated that most tooth-to-tooth correlation were positive and the torque correlation decreased with remoteness. Neighboring teeth always showed the highest correlation values in each tooth rank in the upper and lower arch for males, females and total samples.

The results for tooth-to-tooth interarch torque showed a very weak and negative correlation coefficient for most teeth as illustrated in Table (5). The results of intraarch and interarch torque correlation are in accordance with Vardimon and Lambertz.<sup>(12)</sup>

## CONCLUSIONS

Generally, in the upper and lower arch, each tooth distally to the central incisor had more lingual inclination than did its neighbor.

Greater lingual inclination of lower teeth particularly the posterior teeth as compared to the maxillary teeth.

The relatively high values of standard deviations in this study show a considerable dispersion around the mean torque measurements in all teeth.

The females had more labial inclination of upper lateral incisor and more lingual inclination of the lower canine, premolar and first molar as compared with the males group.

Most tooth-to-tooth intraarch torque correlations were positive and decreased with remoteness, while most tooth-to-tooth interarch correlation showed negative weak correlation.

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