

Method to measure faciolingual teeth inclination

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Abstract:

This research evaluates the faciolingual inclination of people in Mosul city as a base data for bracket design for straight wire arch technique (SWA) 50 study models (25 males, 25 females) used aged 12-15 years, they concomitant with six keys of normal occlusion that suggested by Andrews.

The data then subjected to statistical evaluation at $p < 0.05$, description of the data (mean, SD., minimum, maximum) also the correlation of all the teeth and comparison for both sexes.

The result show a higher record in lower central and lateral incisors in males (17.0) whereas a lowest record found in lower first molar in males (-30.0). A high correlation can be seen among anterior teeth and among posterior teeth with each other.

Key word:

Normal occlusion , faciolingual, inclination.

Introduction:

In the last 20 years, 3 relevant genres of experiments have emerged that progressively enhance our understanding of sliding mechanics⁽¹⁻⁴⁾.

Normal facio-lingual crown inclinations of anterior and posterior teeth are one of essential keys of occlusion. The facio-lingual crown inclinations of anterior teeth are essential to resist over-eruption of anterior teeth and to allow proper distal positioning of the contact points of the upper teeth in their relation to the lower teeth permitting proper occlusion of the posterior crown, upper posterior teeth (canines through molars) are similar from canine through premolars, and was slightly more pronounce in the molars,

while lower posterior (canines through molars) crown inclination are progressively increased from the canines through the second molars⁽⁵⁾.

Facio-lingual crown inclination is expressed in plus or minus degrees representing the angle formed by a line which bear 90 degrees to the occlusal plane and a line that is tangent to the middle of the facial long axis of the clinical crown. A plus reading is giving if the gingival position of the tangent line is lingual to the occlusal portion, a minus reading is recorded the gingival of the tangent line is labial to the occlusal portion⁽⁶⁾.

The ratio is approximately 4:1 for lingual crown torque ; there is 1 degree of mesial tip of crown, if the gingival portion of the central and lateral crowns

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have lingually torque 20° degrees ; in the area of the central incisors there would be a resultant -5° mesial tipping, in that the average distal tip of central incisors is $+5$, it would be necessary to place $+10$ degree to accomplish a $+5$ degree distal tip of crown^(5,7).

In straight wire technique orthodontic treatment is pre adjusted within brackets construction such as Andrew⁽⁶⁾, Roth⁽⁸⁾, and Ricketts⁽⁹⁾ systems.

Vardimon & Lambertz⁽¹⁰⁾ stated the torque concept of S.W.A is based on the consumption of ideal occlusion tooth posture, facial tooth crown contour and the occlusal plane invariable relation. Andrews stated that; normalizing the occlusion involves many factors that include normalizing the mesio-dstal angulation and labio-lingual inclination of the teeth. These arrangement are crucial in closing and considering the interdental spaces and obtaining an ideal over-bite and over-jet relations⁽¹¹⁾.

Facial contour of that individual teeth vary within only a very limited range.

German et al⁽⁷⁾ stated that the facial curvatures of teeth are as consistent as any anatomic details.

Author's researches work's have elucidated torque from statistical point of view's Dellinger⁽¹²⁾ measured third order bend angulations from positioner set-up and Morrow⁽¹³⁾ studied crown inclination changer facial surface of treated and untreated cases as well as extracted teeth-both investigators come to some conclusion in ideal occlusion, facial tooth angulation show large standard deviation in measurement.

Nowadays the orthodontists in Iraq correct the facio-lingual inclination and mesiodistal angulations according to the other population crowns inclination and

angulations, so it is preferable establish Iraqi norm crown's inclination and angulations to correct orthodont cases according to our stander.

Mesio-distal angulations of Iraqi population in Mosul city was studied by Al-Dewachi⁽¹⁴⁾. He found the normal mesio-distal inclination of the upper and lower which was numerically less than the Brazilian's population which were evaluated by Uris et al⁽¹⁵⁾. This study was designed to determine the facio-lingual crown inclination, to establish basic information for normal occlusion in finishing Iraqi orthodontic class.

Material and methods:

The sample consisted of (50) study model (25 males, 25 females) aged (12-15) years, which were selected in condition, that should have normal occlusion, concomitant with the six keys of normal occlusion, that suggested by Andrews⁽⁵⁾ and Paul et al⁽¹⁶⁾. The sample was collected from intermediate school in Mosul city.

The criteria of the sample selection:

1. Full-complement of permanent dentition (except 3rd molar)
2. All children are Iraqi origin born in Mosul city.
3. Class I molar (Angle classification) and canine when teeth in centric occlusion^(17,18,19). Ligament of maxillary and mandibular teeth without crowding, spacing, rotation, tipping and flat or slight curved occlusal plane.
4. Normal overbite and over jet (3-4 mm)⁽²⁰⁾.
5. No history of previous orthodontic treatment.

The facio-lingual inclination measurement as defined by Andrew was measured by the intersection of a line perpendicular to the occlusal plane and a

line tangent to the middle of the labial or buccal long axis of clinical crown.

A geometric device (movable protractor) which is highly precise angular device used for measurement of inclination. The occlusal plane placed on a surveyor parallelometer.

The measurement of facio-lingual crown inclination done by placing the occlusal plane of the model on the surveyor after adjusting the surveyor parallel to the horizontal plane then one movable arm of the Geometric protractor adjusted to the base of the surveyor in situation parallel to the surveyor, the other movable arm of the device moved toward the facial contour of the crown till one of the projection of the movable arm be touching (tangent) of the contour of the facial surface of the crown. The tangent line of the projection is passing within the center of the protractor device.

The appeared degree on the protractor will express as (+ve) or (-ve)

degree angle. The same procedure done on all the casts (upper & lower) and recording data. The data was analyzed using Minitab statistical program, this include :

1. Descriptive static (mean, standard deviation, minimum, & maximum)
2. Correlation of all the teeth among them.
3. t-test used to differentiate between right & left, males and females.

Results:

Description of the mean angles produced by the intersection of facial surface tangent with the occlusal plane shown in tables :

Table (1) Description of torque angles for upper dental arch were SD for all teeth ranging (2-3) except for the 1st molar range between (4-5).

Figure (1, 2) shows the mean value of males & females facio-lingual inclination of upper dental arch.

Table (1):Description of faciolingual inclination of upper dental arches.

	Sex	Mean*	SD	Min.	Max.
1	M.	5.19	3.85	0.00	12.0
	F.	4.11	2.84	0.00	7.00
	T.	4.83	3.53	0.00	12.0
2	M.	4.89	3.69	0.00	11.0
	F.	5.56	2.96	2.00	10.0
	T.	5.11	3.42	0.00	11.0
3	M.	0.56	3.48	-6.00	6.00
	F.	-1.89	2.52	-7.00	2.00
	T.	-1.00	3.21	-7.00	6.00
4	M.	-2.61	2.89	-8.00	3.00
	F.	-3.11	2.47	-6.00	1.00
	T.	-2.78	2.72	-8.00	3.00
5	M.	-2.83	2.89	-8.00	2.00
	F.	-3.33	2.74	-8.00	1.00
	T.	-3.00	2.81	-8.00	2.00
6	M.	-3.67	4.74	14.0	4.00
	F.	-4.22	5.52	12.0	3.00
	T.	-3.85	4.91	14.0	4.00

* Measurement in degree

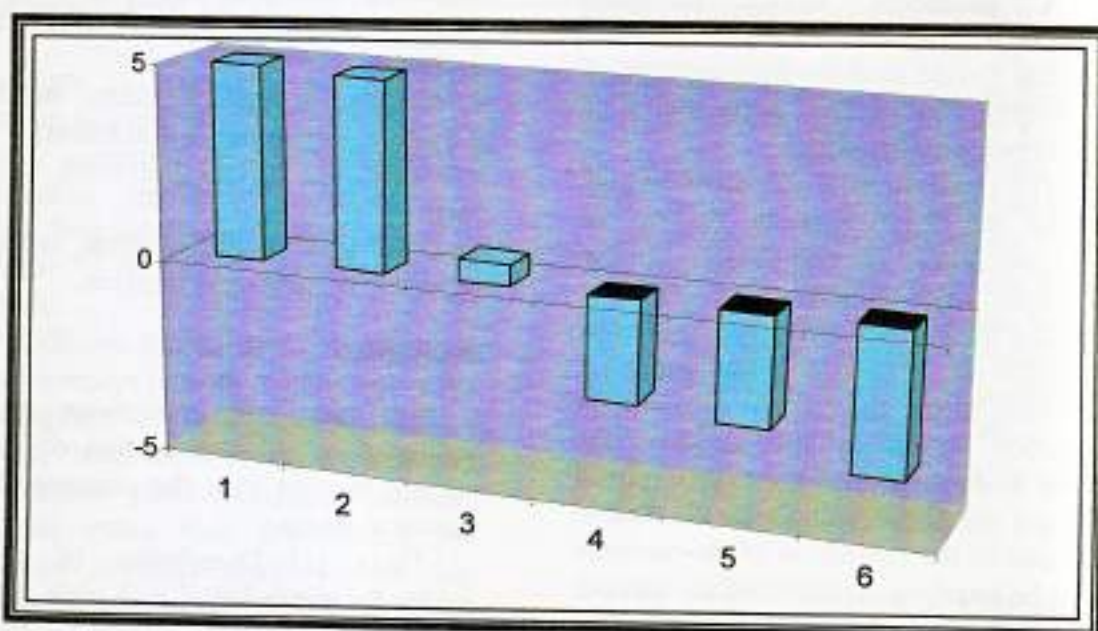


Figure (1): The mean (faciolingual inclination) of males upper arch.

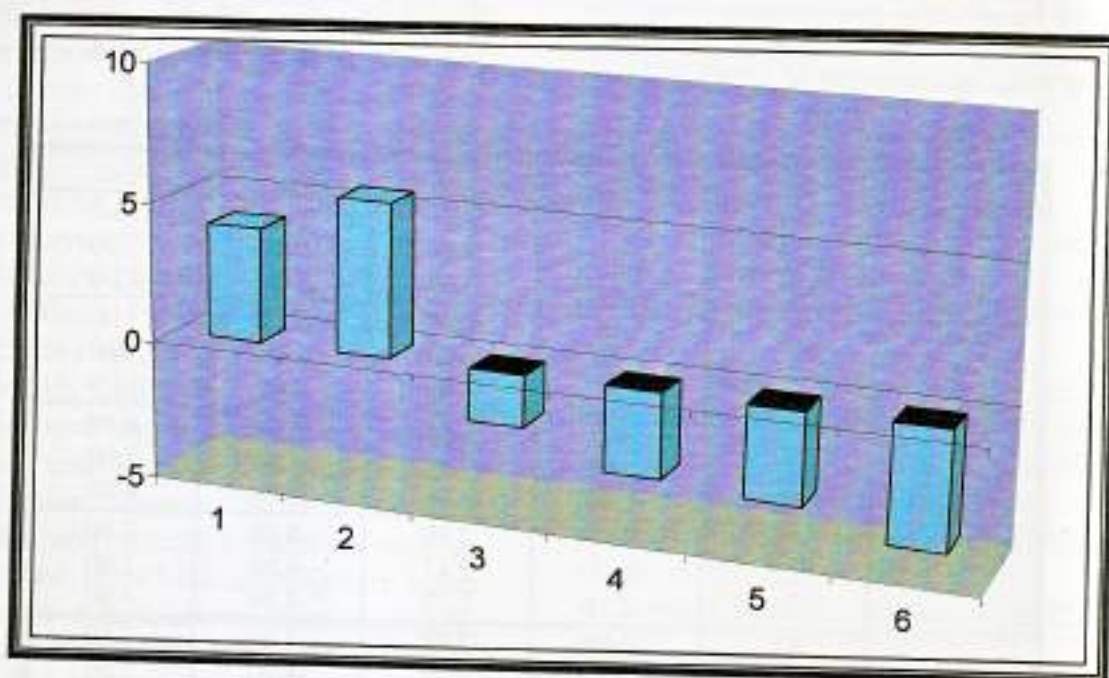


Figure (2): The mean (faciolingual inclination) of females upper arch.

Table (2) Description for lower dental arch also SD of anterior teeth and first premolar range (3-5), while for second premolar and first molar (5-7).

Figure (3, 4) shows the mean value of males & females facio-lingual inclination of lower dental arch.

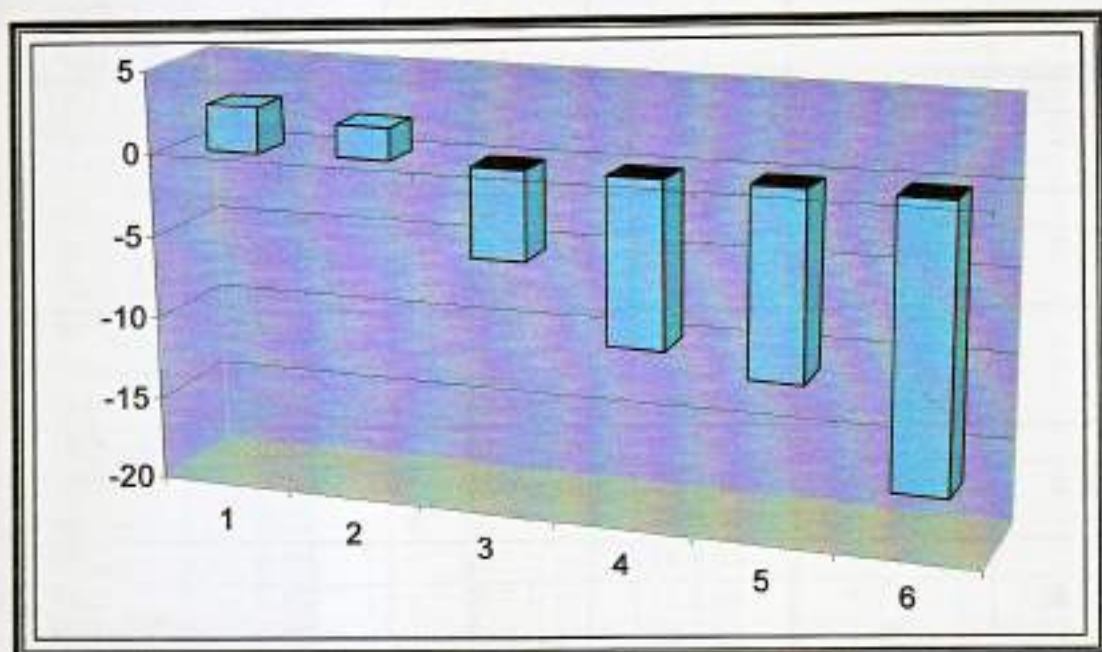


Figure (3): The mean (faciolingual inclination) of males lower arch.

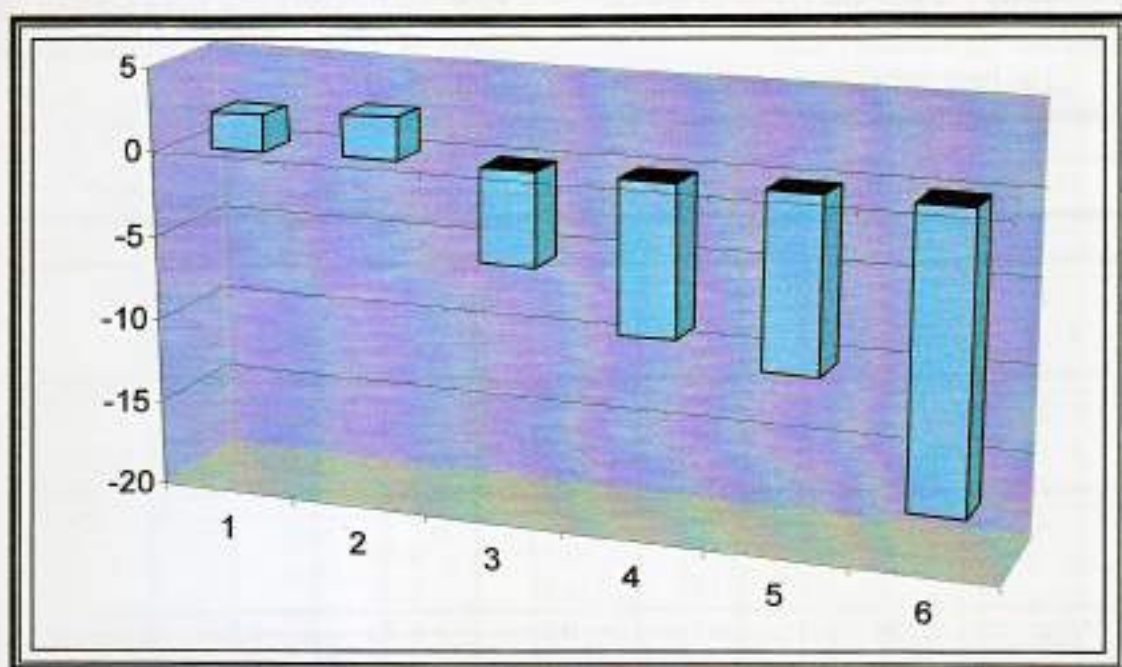


Figure (4): The mean (faciolingual inclination) of females lower arch.

Table (2):Description of faciolingual inclination of lower dental arches.

	Sex	Mean*	SD	Min.	Max.
1	M.	2.69	5.48	-5.00	17.00
	F.	2.11	3.26	-5.00	5.00
	T.	1.76	4.89	-5.00	17.0
2	M.	2.03	5.36	-5.00	17.00
	F.	2.56	3.81	-7.00	5.00
	T.	2.10	4.94	-7.00	17.0
3	M.	-5.38	5.16	-10.00	6.00
	F.	-5.44	3.91	-10.00	0.00
	T.	-5.40	4.66	-10.00	6.00
4	M.	-10.00	4.58	-20.00	-2.00
	F.	-8.89	5.04	-15.00	0.00
	T.	-9.60	4.67	-20.00	0.00
5	M.	-11.19	5.04	-22.0	-4.00
	F.	-10.22	6.02	-18.0	0.00
	T.	-10.84	5.30	-22.0	0.00
6	M.	-16.94	5.89	-30.0	-6.00
	F.	-17.33	7.92	-24.0	1.00
	T.	-17.80	6.63	-30.0	1.00

* Measurement in degree

Table (3) the correlation of torque angle among maxillary teeth.

The high correlation can be seen in posterior teeth between (4-5),(5-6),(3-5),

(4-6), and for anterior teeth within (1-2) teeth. A moderate correlation between (2-3), (2-4).

Table (3): Correlation of faciolingual inclination of upper dental arches.

	Sex	1	2	3	4	5
2	M.	0.81				
	F.	0.64				
	T.	0.72				
3	M.	0.31	0.46			
	F.	0.07	0.34			
	T.	0.28	0.41			
4	M.	0.48	0.57	0.69		
	F.	-0.09	-0.43	0.56		
	T.	0.18	0.32	0.60		
5	M.	0.45	0.5	0.70	0.95	
	F.	-0.08	-0.42	0.58	0.95	
	T.	0.15	0.25	0.62	0.95	
6	M.	0.17	0.17	0.32	0.65	0.69
	F.	-0.08	-0.37	0.14	0.58	0.52
	T.	-0.09	-0.0	0.26	0.62	0.64

Table (4) the correlation of torque angle among lower dental arch teeth a high correlation seen between (1-2), (4-

5), (4-6), (5-6). A moderate correlation between (1,3), (2,3), (3,4).

Table (4): Correlation of faciolingual inclination of lower dental arches.

	Sex	1	2	3	4	5
2	M.	0.95				
	F.	0.98				
	T.	0.95				
3	M.	0.48	0.42			
	F.	0.87	0.85			
	T.	0.50	0.5			
4	M.	0.38	0.28	0.57		
	F.	0.59	0.67	0.59		
	T.	0.37	0.34	0.65		
5	M.	0.42	0.30	0.39	0.93	
	F.	0.54	0.63	0.59	0.96	
	T.	0.39	0.36	0.44	0.94	
6	M.	0.28	0.19	0.28	0.74	0.90
	F.	0.49	0.48	0.64	0.70	0.72
	T.	0.35	0.31	0.39	0.68	0.78

Table (5) a combined correlation between maxillary and mandibular teeth,

shows only moderate correlation between upper and lower incisor.

Table (5): Correlation of faciolingual inclination of upper & lower dental arches.

	Sex	1	2	3	4	5	6
1	M.	0.26	-0.03	-0.4	-0.2	-0.22	-0.01
	F.	0.31	0.27	0.3	-0.45	-0.4	0.17
	T.	0.3	0.03	-0.18	-0.19	-0.2	0.08
2	M.	0.13	-0.13	-0.35	-0.17	-0.4	-0.01
	F.	0.26	0.16	0.16	-0.46	-0.43	0.18
	T.	0.2	-0.07	-0.16	-0.18	-0.19	0.1
3	M.	0.15	0.16	-0.32	-0.09	-0.1	-0.24
	F.	0.04	0.04	0.56	-0.06	0.02	0.34
	T.	0.12	0.13	-0.12	-0.07	-0.05	-0.01
4	M.	0.04	0.11	-0.3	0.05	-0.03	0.03
	F.	-0.32	-0.5	-0.2	0.02	-0.02	0.56
	T.	-0.1	-0.81	-0.28	0.02	-0.04	0.24
5	M.	0.18	0.2	-0.24	0.17	0.01	0.05
	F.	-0.44	-0.5	-0.19	0.13	0.1	0.67
	T.	-0.04	-0.2	-0.23	0.13	0.03	0.32
6	M.	0.09	0.1	-0.2	0.12	-0.07	-0.03
	F.	-0.46	-0.18	0.3	0.41	0.44	0.54
	T.	-0.06	-0.01	0.0	0.26	0.16	0.29

Table (6) comparison of inclination of males upper and lower combined right-left sides (faciolingual) dental arch.

Table (6): Comparison of combined right-left sides (faciolingual) inclination of males upper and lower dental arches

	Side	Mean	SD.	t-value	Mean	SD.	t-value
		Upper			Lower		
1	R.	5.01	3.58	0.08	2.71	5.50	0.53
	L.	4.87	3.04	NS	2.66	5.46	NS
2	R.	4.91	3.83	0.23	2.03	5.35	0.53
	L.	4.87	4.21	NS	2.03	5.37	NS
3	R.	0.59	3.38	0.33	-5.40	4.58	-0.11
	L.	0.55	3.38	NS	-5.36	4.57	NS
4	R.	-2.63	2.91	0.25	-10.00	5.16	-0.07
	L.	-2.60	2.87	NS	-10.00	5.16	NS
5	R.	-2.83	2.91	0.23	-11.20	5.04	-0.39
	L.	-2.82	2.87	NS	-11.20	5.04	NS
6	R.	-3.69	4.75	0.02	-14.94	5.89	-0.27
	L.	-3.65	2.74	NS	-14.93	5.89	NS

*Tabulated t = 1.68 p.<0.05

Table (7) comparison of combined inclination of females upper and lower dental arch. right-left sides (faciolingual)

Table (7): Comparison of combined right-left sides (faciolingual) inclination of females upper and lower dental arches

	Side	Mean	SD.	t-value	Mean	SD.	t-value
		Upper			Lower		
1	R.	4.10	2.83	0.23	0.11	3.26	0.43
	L.	4.11	2.84	NS.	0.10	3.12	NS.
2	R.	5.59	2.96	0.23	-0.54	3.81	-0.32
	L.	5.56	2.95	NS.	-0.57	3.79	NS.
3	R.	-1.91	2.50	-0.02	-5.46	3.90	-0.22
	L.	-1.87	2.52	NS.	-5.43	3.91	NS.
4	R.	-3.11	2.49	-0.79	-8.87	5.03	-0.21
	L.	-3.90	2.45	NS.	-8.87	5.05	NS.
5	R.	-3.30	2.75	-0.74	-10.22	6.02	-0.12
	L.	-3.36	2.80	NS.	-10.22	6.00	NS.
6	R.	-4.22	5.52	-0.56	-17.30	7.92	-0.13
	L.	-4.18	5.50	NS.	-17.35	7.91	NS.

Table (8) comparison of faciolingual inclination of males-females upper dental arches.

Table (8): Comparison (faciolingual) inclination of males and females upper dental arches

	Sex	Mean*	SD	t-value	significance
1	M.	5.19	3.85	1.10	0.27
	F.	4.11	2.84		NS.
2	M.	4.89	3.69	0.04	0.97
	F.	5.56	2.96		NS.
3	M.	0.56	3.48	2.75	0.008
	F.	-1.89	2.52		S.
4	M.	-2.61	2.89	3.33	0.001
	F.	-3.11	2.47		S.
5	M.	-2.83	2.89	2.01	0.05
	F.	-3.33	2.74		S.
6	M.	-3.67	4.74	2.54	0.01
	F.	-4.22	5.52		S.

*tabulated t = 1.68 P<0.05

Table (9) comparison of faciolingual inclination of males-females lower dental arches.

Table (9): Comparison (faciolingual) inclination of males and females lower dental arches

	Sex	Mean*	SD	t-value	significance
1	M.	2.69	5.48	0.66	0.1
	F.	2.11	3.26		NS.
2	M.	2.03	5.36	0.61	0.11
	F.	2.56	3.81		NS.
3	M.	-5.38	5.16	0.30	0.2
	F.	-5.44	3.91		NS.
4	M.	-10.00	4.58	0.89	0.33
	F.	-9.89	5.04		NS.
5	M.	-11.19	5.04	0.99	0.35
	F.	-10.22	6.02		NS.
6	M.	-16.94	5.89	0.28	0.78
	F.	-17.33	7.92		NS.

*tabulated t = 1.68 P<0.05

Discussion:

The (+ve) angle means labially inclined tooth, the inclination in

accordance to the vertical line, and a (-ve)angle means lingually or palatally inclined tooth.

In Table (1, 2) we see that upper central and lateral are proclined (4.83,

5.11) were as more uprighting for lower central and lateral incisors (1.76, 1.1). Upper canine seems to be more upright than central and lateral, but the lower canine inclined lingually, then increases in the (-ve) torque angle for all posterior teeth, however more lingually inclined for lower buccal teeth than upper. This explanation depend on the fact that the upper dental arch cover the lower dental arch when closed in centric occlusion, that is why more vertical upper teeth than lower, the maximum record seen in lower & lateral incisors (17.0°), the highest (-ve) record noted in lower 1st molar (-30.0°).

As a general a high correlation can be seen among the anterior teeth with them, and among posterior with each other also can see a high correlation between upper and lower anterior teeth, as they depended on each, in that if the lower teeth proclined this will lead to proclination of upper anterior teeth and vice versa, or if the lower upright also the upper will be uprighted.

In table (6, 7) we note a non significant differences between right and left sides for males and females for all teeth when compare the resultant t-value of each tooth and tabulated t-value (1.68).

In Table (8) we note a significant differences between right and left sides for males and females for upper teeth (canine, premolars & molars) when comparing the resultant t-value of each tooth and tabulated t-value (1.68), a higher record in males than for females means more vertical teeth for males.

In Table (9) a non significant differences between males and females for lower dental arches.

In Table (10) the comparison of the present research with the previous researches, we note the differences in the mean values among them, the large difference found with (Alexander⁽²¹⁾, , Greekmore⁽²²⁾, Burston⁽²³⁾). This is because the different means of measuring the torque angle either on extracted teeth or sectioning the cast.

Table (10): Comparison of the present research & previous researches

	Tooth	present research	Varidon & Lambertz ¹⁰	Alexander ²¹	Burston ²³	Greekmore ²²	Hilgers ²³
Upper	1	4.83	0.32	14	7	7	22
	2	5.11	-1.9	7	3	3	14
	3	-1.0	-9.15	-3	-7	-7	7
	4	-2.78	-9.9	-7	-7	-7	-7
	5	-3.0	-8.53				
	6	-3.85	-11.6	-10	-10	-10	-10
Lower	1	1.76	1.26	-5	-1	0	-1
	2	1.1	-1.35				
	3	-5.4	-9.0	-7	-11	-7	7
	4	-9.6	-15.9	-11	-17	-15	-11
	5	-10.84	-21.2	-17	-22	-15	-22
	6	-15.8	-26.0	-22	-27	-25	-27

Although we can see an increase in the negative value from anterior to posterior teeth progressively for both arch and for all researches.

Only Varidom and Lambertz⁽¹⁰⁾ research seem to be close to this research in the same method of measuring the torque angle that is used a special device different for the device used in this study, but it depended on the occlusal plane by the surveyor and the vertical line on the occlusal plane.

The benefit of this study is that a direct measurement of the torque angle from the study model, unlike Varidom and Lambertz⁽¹⁰⁾ in that they subtract 45° from their measurement from the cast in order to evaluate the torque angle.

Table (11) comparison of faciolingual brackets design, we see that Andrews⁽⁶⁾ bracket design similar to Burston⁽²³⁾ record of upper teeth inclination, Ricketts⁽⁹⁾ bracket design nearly similar to Hilgers⁽²³⁾ record of upper dental arch.

Table (11): Comparison of faciolingual brackets design

	Tooth	Andrews ⁶	Ricketts ⁹	Roth ⁸
Upper	1	7	22	12
	2	3	14	8
	3	-7	7	-2
	4	-7	0	-7
	5	-7	0	-7
Lower	1	-1	-1	-1
	2	-1	-1	-1
	3	-11	7	-11
	4	-17	0	-17
	5	-22	0	-22

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