



The Form of Upper Dental Arch for Mousli Adults (A Computerized Study)

ABSTRACT

Aims: To find out the most frequent dental arch form in Mosuli adults. Establishment of the normative values of the upper dental arch dimensions. **Materials and Methods:** The sample of this study involved students from Mosul University, 95 students (58 females, 37 males) were selected. The age of the sample ranged between 18–25 years old. They were normal healthy individuals of Mosul origin. Full complement of permanent dentition, bilateral Class I molar and canine occlusion. The data recorded in this research were subjected to computerized statistical analysis using SPSS programs, including descriptive statistics (mean, standard deviation, minimum, maximum), Student's t-test was applied to test the significant differences between the genders. **Results:** There were highly significant differences between males and females of the vertical measurements, that males had larger arch length than females. Also, males had larger arch width with a highly significant difference at $p \leq 0.01$ in all width dimensions in maxillary arches. It could be noticed that the most prevalent arch form among the sample was the Mid form followed by the Narrow and Wide then flat & pointed forms. **Conclusions:** The mid arch form is the most frequent arch form followed by other types. All the measured dimensions (width and length) have significantly greater mean value in males than in females with significant difference for linear measurements. no significant difference in ratio between genders.

Asst Prof Ne'am F Al-Obaidi (BDS, MSc); Prof Dr Khidhair A Al-Jumaili (BDS, CES, DSO)

Department of Pedodontics, Orthodontics and Preventive Dentistry, Dentistry College, Mosul University

Key words: The form of upper dental arch.

Long term retention studies support the view that post-treatment changes are greater when the arch form is altered than being maintained. So it is not a goal for orthodontic treatment to produce dental arch of a single ideal size and shape for everyone. It is also important to keep in mind during using preformed arch wires in orthodontic treatment that their shapes should be considered the starting point for that adjustments necessary for proper individualization. That's why establishment of the most frequent dental arch form will be useful in both diagnosis and construction or choosing the most appropriate ready-made arch wires.⁽¹⁾

The human dental arch form is of prime importance to the dentists as well as to the anthropologist,⁽¹⁾ it is useful in prosthodontics and orthodontics procedures and for describing evolutionary changes in dentition and their variation.⁽²⁾

Graber⁽³⁾ gave the dental arch three forms:

1. Broad (Square).
2. Long and Narrow (Tapered).
3. Parabolic or Average (Ovoid).

Dental arch forms range from arches that are relatively short and square to others that are relatively long and tapered.⁽⁴⁾

The achievement of stable, functional and esthetic arch form has long been one of the prime objectives of orthodontic. The dental arch form can be defined as the position and relationship the teeth have to each other.⁽⁵⁾

With present-day knowledge, the study cast analysis as a whole is often considered to have a limited diagnostic value. A new method of computer imaging and measurements on a dental stone cast is everywhere tool in dentistry and helps to record precise information. Currier compared the arch form of 25 dental casts with parabolic and the elliptic curves. By computerized analysis, he discovered that the curve of the incisal edge of the incisors and canines, together with the buccal cusps of premolars and molars, could be expressed as an ellipse in both arches. Brader, on the other hand, maintained that the teeth were arranged in formation as in the constricted end of a trifocal ellipse.⁽⁶⁾

Many geometric forms and mathematical functions have been proposed as models of the human dental arch. However, it has become clear that the models defined by 1 parameter cannot describe the dental arch form accurately.⁽⁷⁾

Furthermore, these forms vary in their dimensions in two different areas:⁽⁸⁾

- The anterior curvature and intercanine width.
- The posterior curvature and intermolar width.

The harmony in size and relation of the dental arches are important in maintaining normal occlusion of teeth beside the influence of the orofacial musculature labially, buccally and lingually.⁽⁹⁾

The size and form of the dental arches vary among individuals according to the tooth size, tooth position, pattern of craniofacial growth and by several genetic and environmental factors. The form range from arches that are relatively short and square to other that are relatively long and tapered.^(10, 11)

The size and shape of the arches have considerable implications in orthodontic diagnosis and treatment planning, affecting the space available, dental esthetics, and stability of the dentition.⁽¹²⁾

Aims of the Study:

1. To find out the most frequent dental arch form in Mosuli adults.
2. Establishment of the normative values of the upper dental arch dimensions represented by the dental arch width and length measurements in a sample of Mosuli people for both genders.

MATERIALS AND METHODS

The sample of this study involved students from Mosul University; 95 individuals (58 females, 37 males) were selected. Five were excluded due to problem in cephalometric and cast production. The age of the sample ranged between 18–25 years old. They were normal healthy individuals of Mosul origin.

Criteria for Sample:

1. Full complement of permanent dentition (excluding the third molars).
2. Bilateral Class I molar and canine occlusion (Angle, 1889).
3. Normal overjet and overbite (3–4 mm).
4. There are no:⁽²⁾

- a. History of previous orthodontic treatment.
- b. History of bad oral habits.
- c. Facial disharmony (deformation).

Digitizing Equipments:

Lap top (hp) (Pentium IV), compact disc, computer scanner (hp), software Planmeca Dimaxis program.

The Landmarks:

1. **Inter-incisal Point:** The contact point between the two central incisors.⁽¹³⁾
2. **Canine Point:** The most anterior point of the labial surface of right and left permanent canines.
3. **First Premolar Point:** The most anterior point of the buccal surface of right and left first premolars.⁽¹⁴⁾
4. **First Molars Point:** The central fossa of the right and left permanent first molars.^(6, 15)
5. **Second Molars Point:** The central fossa of the right and left second permanent molars.⁽²⁾

Dental Arch Dimensions:

Linear distances were measured on the copy of the study models for the maxillary dental arches to determine the dental arch width and length in Figure (1).

1. **Inter Canine Distance:** The linear distance between right and left permanent canines.
2. **Inter First premolar Distance:** The linear distance between the most anterior point of the buccal surface of right and left first premolars.⁽¹⁴⁾
3. **Inter First Molar Distance:** The linear distance between the right and left permanent first molars.
4. **Inter Second Molar Distance:** the linear distance between the right and left permanent second molars.
5. **Anterior Arch Length:** The vertical distance from the inter incisal point perpendicular to the inter canine distance and inter first premolar distance.
6. **Posterior Arch Length:** The vertical distance from the inter incisal point perpendicular to the inter molar distance of permanent first molars.
7. **Total Arch Length:** The vertical distance from the inter incisal point to the line joining the second permanent molars.

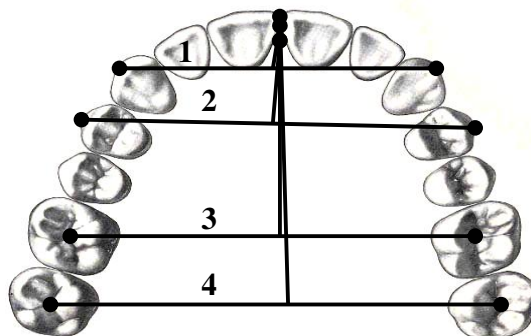


Figure (1): Measurements of the distance.

Statistical Analysis:

The data recorded in this research were subjected to computerized statistical analysis using SPSS (Statistical Package for Social Sciences) programs, including descriptive statistics (mean, standard deviation, minimum, maximum), Student's t-test was applied to test the significant differences between the genders. Euclidian clustering analysis for determination the form of the arch. Standardized number of arch ratios (from study models).

Dental Ach Form:

For determination of dental arch form, the method used by Rabin *et al.*⁽²⁾ was utilized which depends on the Euclidian clustering method of analysis to calculate five independent ratios which are :

- Anterior ach length (canine vertical distance)/inter canine distance.
- Molar vertical distance /inter first molar distance.
- Total arch length/inter second molar distance.
- Inter canine distance/inter first molar distance.
- Molar vertical distance /total arch length .

Euclidian distance between the five ratios of each subject with the different centroid of clusters were calculated. Each subject was allocated according to the nearest centroid, and as a result, five arch forms will developed for upper arch.

For each ratio, the average was calculated for the dental arch in both sexes, then each of the five ratios correspond to the average that give the base for classification as follow:

Form (1) Narrow: Sagittal distances/transverse ratios= positive; i.e., greater than the mean.

Form (2) Wide: Sagittal distances/transverse ratios= negative; i.e., lesser than the mean.

Form (3) Mid: Non of the ratios significantly deviated from the average.

Form (4) Pointed: Only the anterior arch length (canine vertical dimension)/inter canine distance ratio has value noticeably higher than the average.

Form (5) Flat: Only the anterior arch length (canine vertical dimension)/inter canine distance ratio has value noticeably below the average.

Raberin *et al.*⁽²⁾ used Euclidian clustering to determine five arch forms (Narrow, Mid, Wide, Flat and Pointed).

RESULTS

Descriptive statistics that include mean, standard deviation, minimum and maximum value of the arch width & length for total sample are listed in Tables (1, 2) respectively. The Findings of this study showed larger mean value of the second molar followed by first molar then premolar and canine for widths and lengths.

Table (1): Description of maxillary arch width for the total sample.

	Mean	± SD	Minimum	Maximum
Inter Canine Distance	34.92	2.07	30.9	41.18
Inter Premolar Distance	46.90	2.79	38.71	54.04
Inter First Molar Distance	54.11	2.92	47.62	61.7
Inter Second Molar Distance	57.94	3.12	52.34	64.78

Table (2): Description of maxillary arch length for the total sample.

	Mean	± SD	Minimum	Maximum
Canine Vertical Distance	8.50	0.89	6.56	10.68
Premolar Vertical Distance	22.6	0.92	18.45	25.31
First Molar Vertical Distance	33.13	1.81	28.34	37.85
Second Molar Vertical Distance	43.34	2.23	37.53	48.75

Table (3) displays the comparison of arch width between males and females groups. It can be observed that males have higher values than females in all the distances with a high significant difference at $p \leq 0.01$. Table (4) displays the comparison of arch length between males and females groups, also can be observed that males have higher values than females in all the vertical distances with a high significant difference at $p \leq 0.01$. Table (5) shows the average ratios used for determination of arch form for males and females. We see that a nearly equal results obtained for both genders.

Table (3): Comparison of maxillary dental arch width for both genders.

	Sex	Mean	± SD	t-value	Significance
Inter Canine Distance	Male	36.19	1.92	5.45	HS
	Female	34.11	1.74		
Inter Premolar Distance	Male	48.71	2.58	5.87	HS
	Female	45.75	2.28		
Inter First Molar Distance	Male	55.96	2.83	5.66	HS
	Female	52.93	2.31		
Inter Second Molar Distance	Male	60.07	2.74	6.29	HS
	Female	56.58	2.55		

HS: High significant at $p \leq 0.01$.

Table (4): Comparison of maxillary dental arch length for both genders.

	Sex	Mean	± SD	t-value	Significance
Inter Canine Distance	Male	8.81	0.89	2.79	HS
	Female	8.31	0.83		
Inter Premolar Distance	Male	22.8	0.56	2.93	HS
	Female	18.7	0.39		
Inter First Molar Distance	Male	34.09	1.56	4.56	HS
	Female	32.51	1.69		
Inter Second Molar Distance	Male	44.86	1.97	6.27	HS
	Female	42.37	1.83		

HS: High significant at $p \leq 0.01$.

Table (6) distribution of the five maxillary arch form according to genders, we can note that the mid arch form is the major type in our population, then the narrow, wide flat and pointed form. Figure (2) shows the different arch forms.

Table (5): The five ratios of dental arch form for both genders.

	Males	Females
Canine Vertical Distance/Inter Canine Distance	0.244	0.243
First Molar Vertical Distance/Inter First Molar Distance	0.610	0.614
Second Molar Vertical Distance/Inter Second Molar Distance	0.747	0.749
Inter Canine Distance/Inter First Molar Distance	0.647	0.645
First Molar Vertical Distance/Inter Second Molar Distance	0.760	0.767

The difference is not significant between the genders

Table (6): Distribution of the five maxillary arch form according to genders.

Arch Type	Males		Females		Total	
	No.	%	No.	%	No.	%
Narrow	7	18.91	12	20.68	19	20
Wide	7	18.91	10	17.24	17	17.89
Mid	17	45.94	29	50	46	48.42
Pointed	4	10.81	4	6.89	8	8.42
Flat	2	5.40	3	5.17	5	5.26
Total	37	100	58	100	95	100



Figure (2): The different arch forms.

DISCUSSION

The study confirms the view that male dental arches are larger than that of female ones this can be noticed from Tables (3) and (4) since all of the mean values for liner measurements, are larger in male subjects than females. This may be attributed to:

- The smaller and smoother bony ridge and alveolar process of females.
- The average weakness of musculature in females that plays an important role in facial breadth measurements, width and height of the dental arch

- The later growth period in males than females. This is mainly because males have longer growth period than females.^(16, 17) These come in accordance with other researchers,^(18, 19) who stated that there are important sexual differences in overall craniofacial growth – boys grow more and over a longer time. Also, the study of Cassidy⁽²⁰⁾ analyzed the size and shape of the maxillary and mandibular dental arches of 320 adolescents. Arch dimensions were significantly larger in boys than in girls, both mediolaterally and anteroposteriorly.

Upper inter canine width (male 38.01, female 36.19), inter molar width (male 50.11, female 47.62) for Mexican people.⁽¹⁴⁾ Also, Bishara⁽¹³⁾ found that inter canine width (male 36.2, female 33.2), inter molar width (male 54.7, female 50.2). These studies give picture about the differences within the genders for inter canine and inter molar width, respectively; the same as in this study.

The study confirmed that the ideal dental arch form was not a universal form, but there were different forms in untreated adults with normal occlusions. This was supported by Felton⁽¹⁰⁾, and Raberin⁽²⁾ who found that untreated normal sample did not show any particular ideal arch form. Unlike Angle, and other researchers who tried to determine a single ideal arch form that could ensure the stability of the therapeutic results.

Rai⁽²¹⁾ found that flat and pointed arch form had an association with anterior crowding, so in this study a few number of these types of arch form obtained, as the sample had specific criteria of good alignment of teeth.

Table (6) showed the percentage of maxillary dental arch forms within the sample, one can notice that the most frequent maxillary dental arch form in both genders was the Mid type, and then there was a drop in the frequency of other arch types as follows: Narrow, Wide, Pointed and the Flat form, in which the inter canine and inter premolar distances play an important role in determining the type of the arch.

The most common type of dental arch form for Saudian was the average or ovoid (76.1%), followed by the square or broad (14.4%) and, finally, the narrow or peaked (9.5%).⁽²²⁾

These findings agreed with Borgan,⁽²³⁾ who found that the most frequent Jordanian maxillary arch form was the Mid form, and Salem,⁽²⁴⁾ who found that the most frequent Palestinians maxillary arch form was the Mid form, also Haralabakis⁽²⁵⁾ found that the most frequent maxillary arch form was the Mid form. On the other hand, the present study disagreed with Ramadan,⁽²⁶⁾ who found that the most frequent Jordanian arch was the Flat followed by the Narrow, Wide, Mid, and Pointed one; and Al-Zubier,⁽²⁷⁾ who found that the most frequent Yemeni arch was the Narrow. Also, Al-Hadithy⁽¹¹⁾ found that the most frequent arch was the Narrow. This could be related to ethnic, habitual, environmental and geographic variations.

African-Americans population had significantly larger arch lengths and widths. The arch in Caucasians was disproportionately narrow in the canine-first premolar area, and defined a more rounded arch form. In contrast, the straighter and less convergent buccal tooth rows in African-Americans defined a more squared arch form.⁽¹¹⁾

Also the findings of this study showed significant differences in sex for all dimensions, while no arch form variability where there was a balance between males and females subjects this agreed with the study findings of Hassan and Najim.⁽²⁸⁾

CONCLUSIONS

1. The mid arch form is the most frequent arch form followed by other types.
2. All of the measured upper dental arch dimensions (width and length) have significantly greater mean value in males than in females with significant difference for linear measurements.
3. No significant difference in ratio between genders.

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