

Dental arch asymmetry

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ABSTRACT

Objective: This study was conducted to assess the dental arch asymmetry in a Yemeni sample aged (18-25) years. **Materials and Methods:** The investigation involved clinical examination of 1479 adults; only 253 (129 females, 124 males) out of the total sample were selected to fulfill the criteria for the study sample. Study models were constructed and evaluated to measure mandibular arch dimensions. Three linear distances were utilized on each side on the dental arch: Incisal-canine distance, canine-molar distance and incisal-molar distance, which represent the dental arch segmental measurements. **Results:** When applying “*t*-test” at $P < 0.05$, no significant differences were found between the right and left canine-molar, incisal-canine and incisal-molar distances in both dental arches for both sexes. The greater variation (0.30 mm) was observed between right and left canine-molar distance in the maxillary dental arch in male and the smaller (0.04 mm) in the mandibular dental arch between the right and left canine-molar distance in females. **Conclusion:** The findings of the present study revealed a symmetrical pattern of dental arches, since the right and left sides showed no statistically significant difference. In general, it can be observed that the measurements related to the central incisors and canines have the widest range of reading and give the impression that the location of central incisor and canines to each other and to other teeth is the strongest factor in determining the dental arch asymmetry.

Key words: Dental arch asymmetry, dental cast analysis, Yemen

INTRODUCTION

Just as beauty is in the eye of the beholder, asymmetry depends on the beholder's view point.^[1] Although each person shares with the rest of the population a great many characteristics, there are enough differences to make each human being a unique individual. Variations in the size, shape and relationship of the dental, skeletal and soft tissue facial structures are important in providing each individual with his or her own identity.^[2]

Dental arch morphology is an important consideration in orthodontic treatment of dento-facial deformities. For over one century, dental arch morphology has been studied in hopes of defining proper goals for tooth position, esthetics, function and long-term stability.^[3-6]

Dental arch asymmetry can be caused by a combination of genetic and environmental factors, with skeletal, dental or functional repercussions.^[2,7]

Dental arch asymmetry is a common finding in normal (orthodontically untreated) children, and congenital malformations, finger-sucking, extractions, interproximal caries, and other extrinsic factors can increase dental arch asymmetry.^[2] But during the mixed dentition, environmental factors may account better for asymmetry, because growth and developmental changes are accelerated after the relatively stable period of the deciduous dentition.^[8,9]

Some authors have observed skeletal asymmetries both in normal occlusion and malocclusion groups with pre-orthodontic treatment patients showing more symmetrical arches.^[10,11]

Conversely, other authors revealed a tendency for posterior crossbite in individuals with malocclusion,^[12] and a greater tendency toward dental arch asymmetries in individuals with Angle Class II and/or Class III malocclusions.^[13,14]

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Other studies showed asymmetries in the dental arches of individuals with normal occlusion, in the passage from adolescence to adult age, further questioning the possibility of achieving post-treatment stability.^[8]

Accordingly, the purpose of this study was to describe the degree and distribution of dental arch asymmetry in a sample of Yemeni adults.

MATERIALS AND METHODS

Ethical approval was obtained from both the Ethics Committee of Sana'a University and the Faculty of Dentistry at the University of Sana'a. A brief outline of the study was explained to all participants and consent was obtained prior to participation.

The sample consists of 253 adults aged between 18 and 25 years, among whom 124 were males and 129 females.

The following criteria were used for the sample selection: (1) full complement of permanent dentition (excluding third molars); (2) class I molar occlusion and class I canine occlusion; (3) class I skeletal relationship, decided visually by using the two-finger technique; (4) free of local factors that disturb the integrity of the dental arches (congenital missing teeth; retained deciduous; supernumerary teeth); (5) normal vertical and horizontal dental relationships (normal overjet and normal overbite); (6) no heavy fillings that may affect the dental arch size and form; (7) no previous orthodontic, orthopedic, or facial surgical treatments; (8) well-aligned arches with less than 2 mm of spacing or crowding in either arch.

All the individuals examined under natural light with interchangeable plane mouth mirrors. During this examination, each individual was seated on an ordinary chair with his head being positioned so that the Frankfort horizontal plane is parallel to the floor.

The selected individuals were subjected to a thorough clinical examination to reassure the fulfillment of the required sample specifications.

Certain selected tooth-related points visible in an occlusal view were marked bilaterally with a sharp pencil in the mandibular study casts.

Great care was taken to ensure that the landmarks were accurately located on the study casts.

Measurements were taken from 506 dental casts (upper and lower), which were made of dental stone, with the base, made of plaster of Paris. Dental arch dimensions measurements were carried out using the modified sliding calipers gauge, which is accurate up to 0.02 mm.

Dental arch segmental measurements

- Incisal-canine distance (INCD): The linear distance from the incisal point to the canine cusp tip [Figure 1]
- Canine-molar distance (CMD): The linear distance from the canine cusp tip to the distobuccal cusp tip of the first permanent molar [Figure 1]
- Incisal-molar distance (INMD): The linear distance from the incisal point to the distobuccal cusp tip of the first permanent molar [Figure 1].

Statistical analysis

All statistical analyses were performed using SPSS 13.0. Descriptive statistics were performed for the calculation of the mean, standard deviation, minimum, maximum, range and coefficient of variation.

The "t-test" was applied to test the level of significance between the mean for males and females and right and left side of the dental arches. Statistical significance was pre-determined at the 95% level at $P < 0.05$.

RESULTS

The means and standard deviations ($M \pm SD$) of the maxillary and mandibular dental arch segmental measurements are shown in Table 1. The minimum and maximum values were recorded and expressed by the range.

Tables 2 and 3 depict the maxillary and mandibular segmental measurements according to gender.

The male group displayed greater mean values than the female group in incisal-canine distance, with the greater differences (1.023 and 0.877 mm) existing in

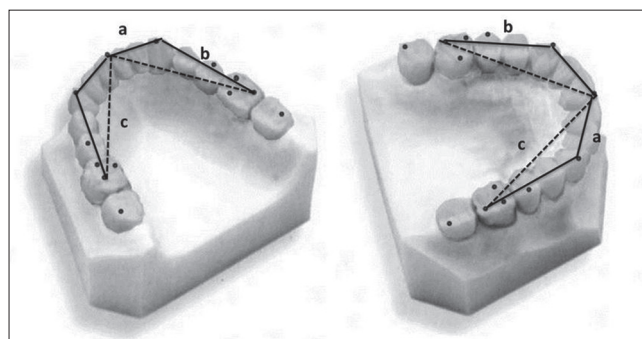


Figure 1: Dental arch segmental measurements; (a) incisal-canine distance, (b) canine-molar distance, (c) incisal-molar distance

the maxillary dental arch for the right and left sides, respectively, and incisal-molar distance, with the greater differences (1.211 and 1.015 mm) existing in the maxillary dental arch for both left and right

sides, respectively; this difference was considered statistically significant.

However, the female group displayed greater mean values of canine-molar distance than the male group, but the difference was considered statistically insignificant.

Table 1: Maxillary and mandibular dental arch segmental measurements for the study sample

Dental arch	Statistics	Side					
		INCD		CMD		INMD	
		L	R	L	R	L	R
Maxillary	Mean	19.13	19.07	25.62	25.38	41.68	41.48
	SD	1.24	1.15	1.24	1.12	1.94	1.88
	Min.	16.00	16.00	21.70	21.70	36.40	37.60
	Max.	21.44	21.44	27.90	27.75	45.20	45.40
	Range	5.44	5.44	6.20	6.05	8.80	7.80
Mandibular	Mean	13.69	13.71	24.85	24.89	35.93	36.05
	SD	0.97	1.03	1.23	1.22	1.88	1.83
	Min.	10.50	11.30	20.80	20.70	32.00	32.00
	Max.	15.40	15.54	27.50	27.20	40.60	39.40
	Range	4.90	4.24	6.70	6.50	8.60	7.40
Interarch difference		5.44	5.36	0.77	0.49	5.75	5.43

INCD: Incisal-canine distance, CMD: Canine-molar distance, INMD: Incisal-molar distance, SD: Standard deviation

Table 2: Maxillary segmental measurements according to gender

Sex	Statistics	Side					
		INCD		CMD		INMD	
		L	R	L	R	L	R
Male	Mean	19.62	19.49	25.63	25.33	42.27	41.98
	SD	1.23	1.17	1.38	1.24	1.74	1.81
	C.V	6.16	6.01	5.35	4.91	4.12	4.33
Female	Mean	18.60	18.61	25.71	25.44	41.00	40.96
	SD	1.25	1.15	1.07	0.97	1.96	1.81
	C.V	6.71	6.18	4.19	3.81	4.79	4.41
	T value	5.83*	5.35*	0.16	0.68	4.22*	3.62*

*Highly significant at $P < 0.01$, INCD: Incisal-canine distance, CMD: Canine-molar distance, INMD: Incisal-molar distance, SD: Standard deviation, C.V: Coefficient of variation

Table 3: Mandibular segmental measurements according to gender

Sex	Statistics	Side					
		INCD		CMD		INMD	
		L	R	L	R	L	R
Male	Mean	13.99	13.89	24.84	24.88	36.50	36.58
	SD	1.01	0.99	1.38	1.34	1.67	1.62
	C.V	7.21	7.12	5.54	5.38	4.56	4.43
Female	Mean	13.72	13.51	24.86	24.89	35.31	35.48
	SD	1.08	1.04	1.06	1.08	1.92	1.88
	C.V	8.09	7.71	4.26	4.34	5.42	5.28
	T value	4.37*	4.47*	0.10	0.06	4.28*	4.04*

*Highly significant at $P < 0.01$, INCD: Incisal-canine distance, CMD: Canine-molar distance, INMD: Incisal-molar distance, SD: Standard deviation, C.V: Coefficient of variation

Right and left side comparison

When applying the “t-test” at $P < 0.05$ significant level, no significant differences were found between the right and left canine-molar, incisal-canine and incisal-molar distances in both dental arches for both sexes [Table 4].

The greater variation (0.30 mm) was observed between right and left canine-molar distance the maxillary dental arch in male and the smaller (0.04 mm) in the mandibular dental arch between the right and left canine-molar distance in females; also, these differences are statistically not significant and clinically neglected.

Correlation coefficient

High correlations were observed between right and left sides of maxillary and mandibular segmental measurements. The strongest correlation was observed between the right and left incisal-molar distances in male (0.91, $P < 0.01$) in both dental arches, while

Table 4: Comparison and correlation coefficient between the left and right side of the study sample

Dimensions	Left side		Right side		T value	r value
	Mean	SD	Mean	SD		
Male						
Maxillary dental arch						
INCD	19.62	1.01	19.49	0.97	0.87	0.82**
CMD	25.63	1.38	25.33	1.25	1.53	0.84**
INMD	42.27	1.74	41.97	1.81	1.08	0.91**
Mandibular dental arch						
INCD	13.99	0.73	13.89	0.99	0.72	0.78**
CMD	24.84	1.38	24.88	1.34	0.21	0.82**
INMD	36.50	1.67	36.58	1.62	0.32	0.91**
Female						
Maxillary dental arch						
INCD	18.60	1.25	18.61	1.15	0.07	0.88**
CMD	25.60	1.07	25.44	0.97	0.97	0.88**
INMD	41.06	1.96	40.96	1.81	0.33	0.87**
Mandibular dental arch						
INCD	13.37	1.08	13.51	1.04	0.82	0.91**
CMD	24.86	1.05	24.90	1.08	0.21	0.80**
INMD	35.31	1.92	35.49	1.88	0.58	0.87**

**Statistically significant at $P < 0.01$. INCD: Incisal-canine distance, CMD: Canine-molar distance, INMD: Incisal-molar distance, SD: Standard deviation

in female the strongest correlation was observed between the right and left incisal-canine distance in mandibular dental arch [Table 4].

DISCUSSION

Proper diagnosis of asymmetries whether skeletal, dental, or a combination of both is extremely important in order to address the origin of the problem during treatment.

Study and determination of criterion for different ethnic groups is essential to promote accurate diagnosis and planning for orthodontic treatment. Each ethnic group has certain characteristics that should not be taken as standards for other areas with the different developmental and ecological foundation.

In this study, we selected fixed reproducible control point, which we called the “print” of our arch form. Any finger has its unique print, also each arch form has its unique print, the print of the arch form will be presented by the buccal cusp tips and the incisal edges of anterior teeth; in addition, using tooth-related points are less subjected to error when measured more than the alveolar points, which may be affected by the distortion of the gingiva owing to the fit or position of the impression trays. Besides, measurements that taken from a definite cusp tips to a corresponding definite cusp tip are very reliable.^[15,16]

It is obvious that the mean values of all measurements taken for the dental arch confirm the accepted view that the maxillary dental arch is larger in all dimensions than that in the mandibular counterpart. This is consistent with the principle that the maxillary dental arch overlaps the mandibular dental arch.^[15,17-19]

Female and male comparison

In this study, the measurements taken of the dimensions of the dental arch confirm the accepted view that male dental arches are greater than that of females ones. In most studies, the arch dimensions depended on the gender of the subjects, with smaller values in females. Generally, the dental arches in males grow larger and for longer than in females during both the preadolescent and adolescent periods.^[20,21]

However, differences between females and males were shown not to be systematic across all studies.^[15,22,23]

A direct comparison was not conducted since a different methodology was utilized, may be attributed

to different mesiodistal teeth dimensions, inclination of teeth and different sizes and shapes of dental arches.

Dental arch asymmetry

The findings of the present study revealed a symmetrical pattern of maxillary and mandibular dental arches, since the right and left sides of the dental arch show no statistically significant differences when the mean value of incisal-canine, canine-molar and incisal-molar distances are compared.

The greater variation between right and left incisal-canine distances (0.137 mm) was in the mandibular dental arch in females and the smaller (0.014 mm) in the maxillary dental arch in females; these differences are statistically not significant and clinically neglected. This result coincides with previous studies^[20,24] and contradicts with others.^[25]

In the present study, the maxillary right canine-molar distance was greater than left maxillary canine-molar distance by 0.30 mm in male, but these differences are statistically not significant and clinically neglected, Sawiris^[26] measured the buccal segment from canine cusp tip to the distobuccal cusp tip of second molar of 50 British subjects with class I occlusion and reported that the right side was larger by 0.24 mm.

Correlation between right and left side of dental arch

It can be noted that there are high values of correlation coefficient of the relationship between all right and left segmental measurements in both maxillary and mandibular dental arches. Whatever, these results give an impression that the dental arches, despite their forms are proportioned in this plane. These proportioned measurements might be attributed to the fact that the teeth are positioned within the alveolar bone which is affected by the dental base, which it rests on.^[27]

The mandibular dental arch is one of the main references for orthodontic treatment planning; many studies have strived to define its ideal size and morphology.^[28]

Studying the descriptive analysis for the dental arch revealed that the mandibular and maxillary incisal-canine distances showing the highest coefficient of variation (CV) than the others segmental measurements in both gender. The incisal-canine distance is responsible for the different arch forms reliving that this distance is responsible for the correct position of teeth and reflects the presence or absence of dental arch asymmetry.

It can be noted that the second highest CV reported for incisal-molar distance in female, giving the impression that incisal point responsible for arch asymmetry in female, while the second highest CV was reported for canine-molar distance in male, giving the impression that canine point responsible for arch asymmetry in male.

In general, it can be observed that the measurements related to the central incisors and canines have the widest range of reading and give the impression that the location of central incisor and canines to each other and to other teeth is the strongest factor in determining the dental arch symmetry.

CONCLUSIONS

- There were no differences between right and left sides confirming the presence of symmetry between the two sides.
- The measurements related to the central incisors and canines, have the widest range of reading and give the impression that the location of central incisor and canines to each other and to other teeth is the strongest factor in determining the dental arch asymmetry.

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