Dental arches dimensions, forms and its association to facial types in a sample of Iraqi adults with skeletal and dental class II-division 1 and class III malocclusion (A cross sectional study)

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ABSTRACT

Background: The association between facial types and dental arches forms has considerable implications in orthodontic diagnosis and treatment planning. The aim was to establish the maxillary and mandibular dental arches width and length in skeletal and dental class II division 1 and class III malocclusion groups, find out the most frequent dental arch form and facial type and the association between them and to check the gender differences.

Materials and Methods: Frontal and lateral facial photographs and maxillary and mandibular occlussal photographs for 90 iraqi subjects with age 18-25 years old (45 males and 45 females) divided equally into three groups, the 1st group with class II division 1malocclusion (overjet more than 3mm but less than or equal to 6mm), the 2nd group with class II division 1malocclusion (overjet more than 6mm) while the 3rd group with class III malocclusion (edge to edge or reverse overjet).Six linear measurements for each maxillary and mandibular dental cast photographs and two liner measurements for frontal and profile facial photographs was analyzed with (AUTO CAD 2013), which simplified the analyzing process and reduced the time and effort spent on taking measurements directly from the records to facilitate work and to gain more accurate results.

Results: All the mean value of dental arches and facial measurements were higher in male than female, the most frequent maxillary and mandibular dental arch form in the three groups was the mid arch form follow by the narrow then the wide arch form except in the mandibular dental arch of the 3rd group it follow by the wide then the narrow arch form.The most frequent facial type in the 1st group is the Mesoprosopic one,followed by the Leptoprosopic then the Euryprosopic face type while in the 2nd and 3rd group the most frequent facial type is the Leptoprosopic, follow by the Mesoprosopic then the Euryprosopic facial type. An association was found between mid arch form and the Mesoprosopic face type in the 1st group, while no clear association was found between dental arch form and facial type in the 2nd and 3rd group for both genders.

Conclusions: It was concluded that there was an association between facial type and dental arch form in subject with class II division 1malocclusion (overjet not more than 6mm), while in subject with class II division 1malocclusion (overjet more than 6mm) or with class III malocclusion (edge to edge or reverse overjet) no clear association was found between dental arch form and facial type.

Key words: Facial types, dental arch forms, association, class II division 1malocclusion and class III malocclusion.
(J Bagh Coll Dentistry 2014; 26(2): 160-166).

INTRODUCTION

Knowledge of the standards for the dental arch dimensions in human population is of great value to clinicians in different fields of dentistry and they are of great interest to anthropologists in studying the dental arch growth and development in relation to different environmental, genetic and physical factors for different population [1,2]. In Orthodontics, it is important that the arch form is observed before the treatment is started as the post treatment occlusal stability depends on preservation of the original arch from[3].Facial harmony regard as one of the main characteristics of beauty [4]. It is the unity of diversity, characterized by good function and good form.

This harmony is primarily determined by the soft tissue integument, along with the underlying skeletal framework [5,6]. There is a sort of correlation between facial morphology and dental arch form, severe malocclusion is often accompanied by disproportion of the face and jaws, when this occurs, the problems are commonly referred to as dentofacial deformities, however, malocclusion should not be thought of as a pathologic condition but merely as human morphologic variation [7].

The aim was to establish the maxillary and mandibular dental arches width and length in skeletal and dental class II division 1 and class III malocclusion groups, find out the most frequent dental arch form and facial type and the association between them and to check the gender differences.

MATERIALS AND METHODS

Sample

The sample was selected from Baghdad University, college of Dentistry. In order to get our sample (90 subjects divided equally into males and females), a total of 334 Iraqi adult subjects were clinically examined (180 female, 154 male). The samplewas divided intothree equal groups:

(1) Master student. Department of Orthodontics, College of Dentistry, University of Baghdad.
(2) Assistant Professor, Department of Orthodontics, College of Dentistry, University of Baghdad.

The 1st Group included 30 subjects has skeletal class II and dental class II division 1 malocclusion (15 males and 15 females) with increased overjet (more than 3 but less than or equal to 6 mm) [8].
The 2nd Groupincluded 30 subjects has skeletal class II and dental class II division 1 malocclusion (15 males and 15 females) with extreme ovejet (more than 6 mm)[8].
The 3rd Group included 30 subjects has skeletal and dental class III malocclusion (15 males and 15 females) with 0 or –ve overjet [9].

The criteria of sample selection

General criteria:

All the sample was Iraqi subjects their age 18-25 years old have full permanent teeth excluding the third molars [10, 11]. Free of local factors that disturb the integrity of the dental arches (Congenital missing teeth; retained deciduous; supernumerary teeth). No crown and bridge prosthesis, large dental fillings or minor spacing or crowding were present [12].No history of bad oral habits. No posterior cross bite. No dental anomalies. No previous orthodontic, orthopedic, or facial surgical treatments.No anterior or posterior open bite.

Specific criteria for the 1st and 2nd groups [8]:

Skeletal class II, diagnosed clinically by using the two fingers technique [13], Bilateral dental Class II (molar and canine relationships)[14]with over jet more than (3 mm)[13].

Specific criteria for the 3rd group [9]

Skeletal class III relationship, diagnosed clinically by using the two fingers technique [13], Bilateral dental class III (molar and canine relationships) [14], with zero or reverse over jet [13].

Methods

Standardization of the facial photographs

The camera was fixed in position andadjusted in height to be at the level of subject 'eyes in the frontal photograph with a heightadjustable tripod. The distance from the digital camera (Sony Cyber Shot H 50, 9.1 Mega pixels, 15 X optical zoom, Sony Corporation, Nagoya, Japan) to the subject was fixed at a distance of about 101cm. measured from the lens of camera to the ear rodsthat were fit in the external auditory meatus inorder to avoid the forward, backward, and tiltingof the subject head (Cephalostate based headposition). The subject was asked to look to thecenter of the lens of the camera in the frontalphotograph and to look at a distant mirror whichis placed in front of his/her face in the lateral photograph with ear rods in the external auditorymeatus [16].

Facial landmarks: (figure 1)

1. nasion (n) The point in the midline of both the nasal root and the nasofrontal suture, always above the line that connects the two inner canthi, identical to bone nasion [17].
2. gnathion (gn): The soft tissue point corresponding to skeletal Gnathion [7] which is the most anterior and inferior point of the soft tissue chin [18].
3. zygoin (zyg): The most prominent point on the cheek area beneath the outer canthus and slightly medial the vertical line passing through it; different from bony zygoin [17].

Linear measurements

1. Inter-zygomatic distance (IzD): It is the transverse distance between soft tissue zygion on both sides [19].
2. Anterior facial height (n-gn): It is the distance between soft tissue nasion and soft tissue gnathion [20].

Facial types

Facial Form was determined using Farkas and Munro [21] method by calculating the ratio betweeninter-zygomatic distance and anterior facial height,and then the face type for each subject isclassified as follows:

- Euryprosopic facial type. The facial index(IzD/n-gn) is > 0.93.
- Mesoprosopic facial type. The facial index (IzD/n-gn) is ≤0.93 and ≥0.83.
- Leptoprosopic facial type. The facial index (IzD/n-gn) is<0.83.

Standardization of the Dental casts photographs:

After taking the proper impression for the maxillary and mandibular arches and preparing the casts, a photograph was taking to each dental cast using special apparatus [15].

Dental cast landmarks (figure.2)

1. Incisal point: The point in the midwaybetween the incisal edges of the two centralincisors [22].
2. Canine point: The cusp tip of the right and left permanent canines [23].
3. Mesiobuccal cusp tip of the first molars: themesiobuccal cusp tips of the right and left firstpermanent molars [24].
4. Distobuccal cusp tip of second molars: thedistobuccal cusp tips of the right and left second permanent molars [20].

Dental Arch Width:

1. The inter canine distance (ICD): The lineardistance from cusp tip of one canine to thecusp tip of the other [20].
2. Inter First Molar Distance (IMD): The linear distance from the mesiobuccal cusp tip of onefirst permanent molar, to the mesiobuccal cusptip of the other [25].
3. Inter-second molar distance (I2ndMD): The linear distance between the distobuccal cusptip of one second permanent molar, to thedistobuccal cusp tip of the other [20].

Dental Arch Length:

1. Canine vertical distance(CVD): The verticaldistance from the incisal point perpendicular toa line joining the inter-canine distance at thecusp tips [22].
2. Molar Vertical Distance (MVD): The vertical distance from the incisal point perpendicular toa line joining the mesiobuccal cusp tips of firstpermanent molars [20].
3. Total Arch Length (TAL): The inter– incisal point to the mid distance of the maxillary andmandibular inter – second molar width at the mesiobuccal cusp [26].

Arch Form [27]

Six dental cast's measurements were divided into three sagittal measurements, and three transversemeasurements were utilized to calculate threeindependent ratios, which are:

1. Canine vertical distance / inter-caninedistance.
2. Molar vertical distance / inter-first molardistance.
3. Total arch length / inter-second molardistance.

The standardize number was calculated for eachof three ratios for each subject by the excelprogram. Then the mean of these standardizednumbers was calculated for each subject whichgave the base for classification as follows:

1. Narrow form the mean of standardizednumber >+1.
2. Mid form the mean of standardized numberbetween (+1 and -1).
3. Wide the mean of standardized number <-1.

Statistical Analysis:

All the data of the sample were subjected tocomputerized statistical analysis using SPSSversion 17for windows XP. The statistical analysis included:

A. Descriptive Statistics

Means, standard deviations, Minimum and maximum values, frequency, percentage and statistical table and figures.

B. Inferential Statistics

1. Independent sample t-test: to compare between genders regarding dental archesand facial dimensions.
2. Chi square test: to test gender difference regarding the dental arch form and facial form. Likelihood Ratio: it is an alternative to Chi square used in case of table with more than 2*2 when the expected frequency less than 1 in any cell or when it is less than 5 in 20% of the cells.
3. One way Analysis of Variance (ANOVA): to compare the dental arches and facialmeasurements among the three Groups in each gender and total sample.
4. Least Significant Difference (LSD): test was preformed when (ANOVA) testshowed a statistical significant difference, to assess any statistical significantdifference between each pairs of groups.

In the statistical evaluation, the following levels of significance are used:

Non-significant NS $P > 0.05$
Significant * $0.05 \geq P > 0.01$

RESULTS AND DISSCUSSION

Descriptive statistics of dental arches with comparison of dental arch dimensions between both genders in each Group.

All of the widths and lengths measurements havegreater mean value in male than females but the difference is not significant in the 1st and 2nd group, while in the 3rd group significantdifference was found inmaxillary and mandibularinter molar distance(IMD), mandibularinter second molar distance (I2nd MD), mandibular canine vertical distance (CVD), maxillary molar vertical distance (MVD) and maxillary and mandibular total arch length (TAL).That may be due to:The smaller and smoother bony ridge and alveolar process of females [28] , the average weakness of musculature infemales that play an important role in widthand height of dental arch [28]andlonger growth period for males than females [29].

Mean values and groups' difference for maxillary and mandibular dental arches dimensions in both genders.(figure. 3)

-The Maxillary Dental Arch

All the width measurement show significant differencebetween the 1st and 3rd Group and between the 2nd and 3rd Group (the 3rd group show higher mean value than 1st and 2nd group), while the non-significant difference was between the 1st and 2nd Group.That's mean that the 3rdgroup has a wider maxillary dental arch as

compare to the 1st and 2nd group which may be due to restricted width growth in themaxillary dental arch in subject with Class II malocclusion [30, 31].

In the length measurement, we notice that, the canine vertical distance(CVD) and total arch length(TAL) show significant difference between the 1st and 3rd Group and between the 2nd and 3rd Group (1st and 2nd group show higher mean value than the 3rd group), while the non-significant difference was between the 1st and 2nd Group, that's mean that the 2nd group has longer maxillary dental arch length as compare to the 1st and 3rd group, which is an expected result, considering the proclination of the maxillary central incisors in Class II division 1 comparedwith other type of malocclusion.

-The Mandibular Dental Arch

All the mean value of the width and length measurements of the 3rd Group was larger than that of the 1st and 2nd Group with significant difference, which mean that the 3rd group has wider and longer mandibular dental arch as compare to the 1st and 2nd group, This can be attributed to the increased growth potential of mandible in Class III patients [30,32,33]

Arch form. (figure. 4)

A. Distribution of the three forms of maxillary dental arch in males, females and the total sample and gender difference.

In the three groups, no significant difference was found, in distribution of the three forms of maxillary dental arch between males and females for each group [34].The most frequent maxillary dental arch form for male, female and totalsample in the 1st and 3rd group is the mid arch formfollowed by narrow then the wide arch form, while in the 2nd group the most frequent maxillary dental arch form is the mid arch form followed by narrow and there is no incidence for the wide dental arch form [35].

B. Distribution of the three forms of mandibular dental arch in male, females and the total sample and gender difference.

In the 1st group, significant difference was found in distribution of the three forms of mandibular dental arch between males and females, while in the 2nd and 3rd groups, no significant difference was found.The most frequent mandibular dental arch form for the total sample in the 1stand 2nd Group is the mid arch form followed bynarrow then the wide arch, while in the 3rd Group the most frequent mandibular dental arch form is the mid arch form followed bythe widethen narrow arch form [36].

Mean values and groups' difference for facial measurements for both genders.

There was non-significant difference among the three Groups in the facial width (Inter-zygomatic distance) , while in facial length (nasion–gnathion distance) we found that there was significant difference between the 1st and 2ndgroup and between the 1st and 3rdgroup, while non-significant difference was found between the 2nd and 3rdgroup, which may be due to that the regional feature that produce long face in cl III was the mandibular protrusion, while in class II was the narrowing and elongation in the nasal region [37].

The most predominant type of the face in the males, females and total sample, of the 1st, 2nd and 3rd group.(figure. 5)

Non- significant difference was found in distribution of the three facial types between males and females within the 1st, 2nd and 3rd group. The most frequent facial type in the total sample is the Mesoprosopic one, followed by the Leptoprosopic while the least frequent is the Euryprosopicface type in the 1st Group, while in the 2nd and 3rd Group the most frequentfacial type is the Leptoprosopic one, followed by the Mesoprosopic while theleast frequent is the Euryprosopic face type [8, 37].

Association between the facial type and dental arch forms described as frequency and percentage for each group.

This study is one of the least researches that have studied the facial dimensions of the face from a photograph, and its association with the maxillary and mandibular dental arch form in cl II div 1 and cl III angle classification of malocclusion. Therefore, there is a very little information to make a comparison between this study and other studies.In the 1st Group there was an association between the mid arch form and themesoprosopic facial type in maxillary dental arch of both gender and themandibular dental arch in female, while no clear association was foundbetween mandibular dental arch form and facial form in male.

In the 2nd and 3rd Group no clear association was found between coordinatedental arch form(mid, narrow and wide) and facial type (mesoprosopic,leptoprosopic and europrosopic).

Figure 1: Facial land marks

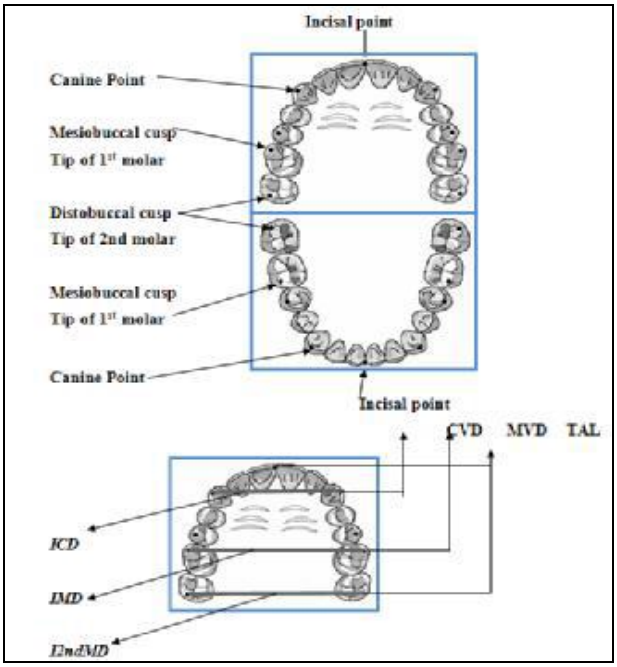

Figure 2: Dental cast land marks and linear measurements

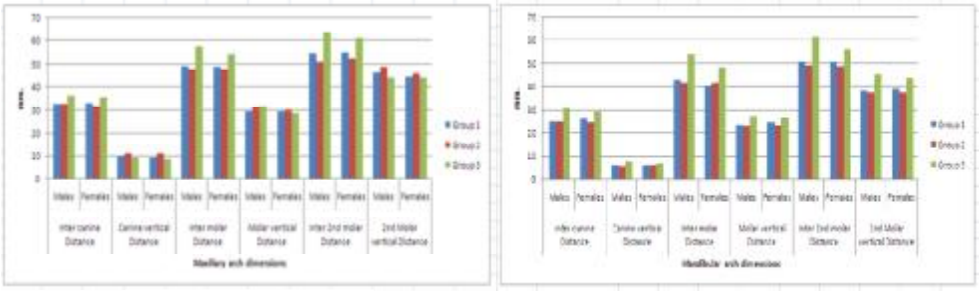

Figure 3: Mean values and groups' difference for dental arches dimensions

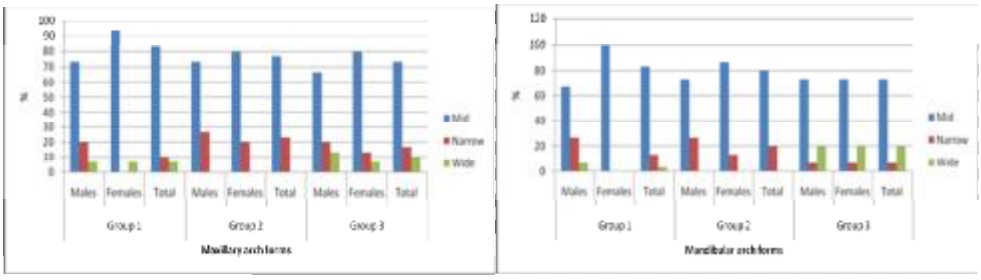

Figure 4: Distribution of the three forms of Maxillary and mandibular dental arch in Males, Females and the total sample and gender difference.

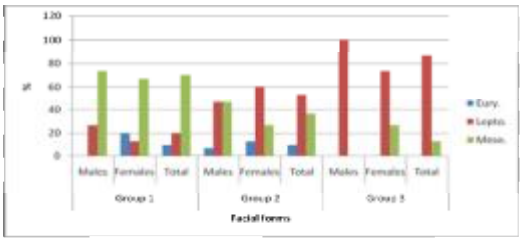

Figure 5: The most prominent facial type in the males, females and total sample of 1st, 2nd and 3rd group

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