Original Article

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Dental arch morphology of Mazahua and mestizo teenagers from central Mexico

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Abstract

Aim: The aim of this study was to determine the morphologic characteristics of the dental arches in the ethnic group "Mazahua" and mestizo teenagers from central Mexico. **Methods**: A sample of 80 Mazahua and 80 mestizo teenagers with normal occlusion, divided into two age groups, were evaluated. A digital caliper was used to measure in cast models the intercanine width, intermolar width, length and perimeter of the arch, occlusal intermaxillary curve (of Spee), overjet, and overbite. A comparative analysis with Student's t-test was applied between gender and population groups. **Results**: Comparison of the dental arches between Mazahua and mestizo teenagers revealed that statistically significant differences existed with respect to most of the measurements. In most cases, they were greater in males; the Mazahua teenagers had intercanine and intermolar widths greater than mestizo teenagers. **Conclusions**: Each group has a characteristic dental arch form. The ethnic group Mazahua has squared arches, whereas the mestizo teenagers have oval arches, which give them their particular facial characteristics. These findings indicate that population-specific standards are necessary for clinical assessments.

Keywords: dental arch, odontometry, ethnic groups.

Introduction

Evaluation of dental arches is of great importance for definitive diagnosis and optimal craniofacial treatment. The values of the dimensions of the arch include: width, depth and circumference, intercanine and intermolar distances, overjet and overbite, which change during growth in different ways (the width of the teeth remains the same, whereas the lengths of the mandibular and maxillary bones increase)[1].

The circumference or perimeter is the most important dimension of the dental arch and changes according to age and gender. The increases in the arch are more related to the events underlying tooth development and somewhat less to skeletal growth.

The intercanine distance increases significantly in the changeover dentition. The primate spaces allow the eruption of the permanent canines. The intercanine and intermolar widths do not change after 13 years old in females and 16 years old in males[2,3].

The overjet and overbite can be described in millimeters or in percentage; both go through significant changes during the transition from primary to permanent dentition. The overbite

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is related to the facial vertical dimensions, whereas the overjet is related to the skeletal anteroposterior relation and is also affected by the labial function and abnormal tongue. Both can modify the skeletal growth of the patient[4,5].

The occlusal intermaxillary curve (of Spee) has been related to overbite, lower arch circumference, lower incisor proclination and craniofacial morphology[6]. The final form of the arch is obtained by the configuration of the supporting bone, tooth eruption, orofacial muscles and intraoral functional forces[7].

Most studies indicate that normal measurements for one group may not be considered normal for other race or ethnic groups. Different racial groups must be treated according to their own characteristics[8]. However, there is no published study addressing the morphologic characteristics of the dental arches for ethnic and mestizo groups. Mexico has enormous racial and sub-racial diversity, which is characterized by particular facial and oral characteristics. The Mazahua is one of the most numerous indigenous groups of central Mexico and the descendents of the Tolteca-Chichimeca culture. They live in isolated locations and preserve their own traditions. Their craniofacial constitution differs from the settlers of the big cities. Few anthropometric and dental studies have been made with the Mazahua group. Kiyomura[9] found similarities of the metric and non-metric dental characteristics between Mazahua and African and Japanese races, establishing Mongoloid characteristics in Mazahuas, as determined by other studies on American inhabitants[10].

The aim of this study was to determine the morphologic characteristics of the dental arches of Mazahua and mestizo teenagers from the central region of Mexico, with the purpose of establishing similarities or differences between these population groups.

Material and methods

A sample of 80 Mazahua teenagers was selected from two schools in the municipality of San Felipe del Progreso in the central region of Mexico, and 80 mestizo cast models obtained from the files of the Orthodontics Department of the Research Center at School of Dentistry, Universidad Autónoma del Estado de México, also in the central region of Mexico.

The teenagers were divided into groups based on age (12-14 and 15-17 years old) and gender. The inclusion criteria were: 1) for the Mazahua group, those of Mazahua origin (parents and grandparents from Mazahua); 2) for the mestizo group, those of Tolucan origin (parents and grandparents from Toluca city); 3) 12-17 years old; 4) permanent dentition; 5) no dental crowding; 6) teeth free of visible interproximal decay and clinically visible cavities as well as misadjusted restorations which compromise the integrity of the contact point; 7) class I Angle molar relation; and 8) no previous orthodontic, orthopedic or surgical treatment. The procedures followed ethical standards, with prior permission from the authorities and the informed consent from the parents and the subjects.

Complete dental impressions were obtained from the upper and lower arches, using alginate with an impression tray of rigid plastic that had been previously disinfected. An electrical vibrator was used (Dv34, Ray Dental Foster Equipment, Huntington Beach, CA, USA) to fill the impressions. After obtaining the cast models, measurements were made with a digital caliper (NTD12-6"CX, Mitutoyo Co., Utsunomiya, Japan) directly from the cast models under natural light.

The following parameters were measured (**Figure 1**): 1. Intercanine width: the distance in millimeters between the cuspid of the right and left permanent canines, in both arches; 2. Intermolar width: the distance in millimeters between the central fossae of the right and left first permanent molars, in both arches; 3. Length of the arch: the distance in millimeters from the central line to one point in the half distance between central incisors until a tangent that touches to the distal faces of the permanent second molars; 4. Perimeter of the arch: measurement in millimeters from the distal face of the permanent first molar around the arch on the contact points and incisal edges, in a smooth curve to the distal face of the permanent first molar in the other arch side; 5. Occlusal intermaxillary curve (of Spee): the depth was measured in millimeters as the perpendicular distance between the deepest cusp tip and a flat plane that was laid on the top of the mandibular dental cast, touching the incisal edges of the central incisors and the distal cusp tips of the most posterior teeth in the lower arch. The measurement was made on the right and left sides of the dental arch and the mean value of these two measurements was used as the depth of the occlusal intermaxillary curve (of Spee); 6. Overjet: the horizontal distance in millimeters between the labial surface of the mandibular central incisors and the incisal tips of the maxillary central incisors; 7. Overbite: the vertical distance between the incisal tips of the maxillary and mandibular central incisors.

In order to eliminate the variability among examiners, two people measured the models and compared their measurements, repeating all the parameters when the difference between the first and second measurement was ± 1 mm.

Taking into account, the approximately normal distribution of each studied parameter, a Student's t-test was applied to assess differences in gender and population groups. All analyses were carried out using SPSS version 12.0 (Statistical Package for Social Sciences; SPSS Inc., Chicago, IL, USA). Statistical significance level was determined at $p \leq 0.05$.

Results

Comparison of the dental arches between Mazahua and mestizo teenagers at the ages of 12-14 and 15-17 revealed statistically significant differences with respect to the majority of the measurements ($p < 0.05$) (**Tables 1** and **2**; **Figure 2**).

In the comparative analysis of the dental arches between the Mazahua and mestizo males who were 12-14 years old, there were statistically significant differences in most of the measurements.

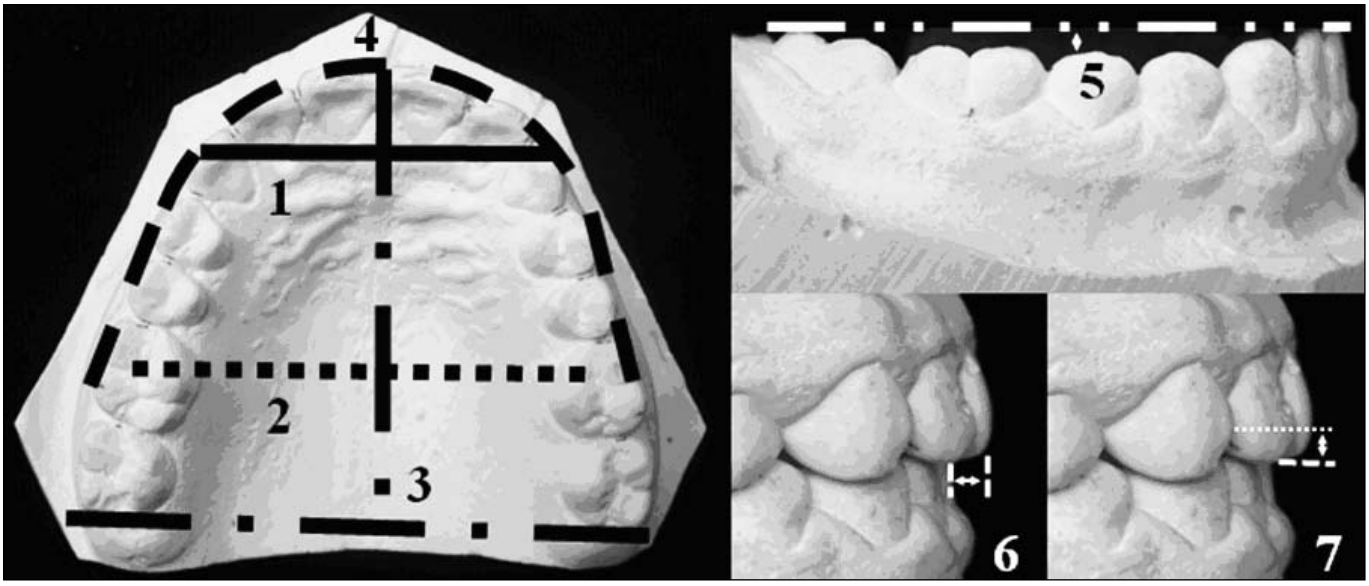

Figure 1. Measurements in cast models: 1. ▬▬ Intercanine width. 2. ▪▪▪▪▪▪▪▪▪ Intermolar width; 3. ▬▪▬ Arch length; 4. ▬ ▬ ▬ Perimeter of arch; 5. ▬▪▪▬ Curve of Spee; 6. Overjet; 7. Overbite.

Table 1. Comparison of the dental arches between Mazahuas and mestizos by genders (12 to 14 years old)

Measurements	Gender	Ethnicity		
		Mazahua	Mestizo	p-value
Upper intercanine width	Male	38.41 ± 2.31	36.69 ± 1.75	0.02
	Female	35.76 ± 2.40	34.97 ± 1.84	NS
	p-value	0.01	0.01	
Lower intercanine width	Male	29.11± 2.61	27.66 ± 1.45	0.05
	Female	26.87 ± 1.86	26.13 ± 1.07	NS
	p-value	0.01	0.01	
Upper intermolar width	Male	48.87 ± 2.91	47.71 ± 2.71	NS
	Female	47.34 ± 2.05	47.71 ± 2.35	NS
	p-value	NS	NS	
Lower intermolar width	Male	43.48 ± 2.52	41.48 ± 2.61	0.02
	Female	41.24 ± 2.04	41.92 ± 1.68	NS
	p-value	0.01	NS	
Length of the upper arch	Male	48.15 ± 2.20	47.01 ± 1.94	NS
	Female	44.86 ± 3.20	44.32 ± 2.04	NS
	p-value	0.01	0.01	
Length of the lower arch	Male	44.49 ± 2.02	43.47 ± 2.05	NS
	Female	41.82 ± 3.20	40.87 ± 2.11	NS
	p-value	0.01	0.01	
Perimeter of the upper arch	Male	11.20 ± 0.39	10.84 ± 0.44	0.02
	Female	10.65 ± 0.30	10.41 ± 0.42	0.05
	p-value	0.01	0.01	
Perimeter of the lower arch	Male	10.12 ± 0.49	9.81 ± 0.43	0.05
	Female	9.58 ± 0.41	9.30 ± 0.34	0.02
	p-value	0.01	0.01	
Curve of Spee	Male	2.28 ± 0.69	1.65 ± 0.53	0.01
	Female	1.97 ± 0.78	1.56 ± 0.50	0.05
	p-value	NS	NS	
Overjet	Male	2.76 ± 0.90	2.71 ± 1.07	NS
	Female	2.26 ± 0.74	2.45 ± 0.91	NS
	p-value	NS	NS	
Overbite	Male	1.65 ± 0.76	2.77 ± 0.65	0.01
	Female	1.72 ± 1.14	2.17 ± 0.61	NS
	p-value	NS	0.01	

Data shown as mean ± SD; Based on Student's t-test; NS: non significant; n=20 per group.

Table 2. Comparison of the dental arches between Mazahuas and mestizos by genders (15-17 years old)

Measurements	Gender	Ethnicity		
		Mazahua	Mestizo	p-value
Upper intercanine width	Male	38.01 + 2.0	36.01 + 1.48	0.01
	Female	36.19 + 2.80	35.03 + 1.81	NS
	p	0.02	NS	
Lower intercanine width	Male	28.50 + 1.94	26.49 + 1.18	0.01
	Female	27.43 + 2.33	26.72 + 1.43	NS
	p	NS	NS	
Upper intermolar width	Male	50.11 + 2.41	48.34 + 1.71	0.02
	Female	47.62 + 2.42	47.77 + 2.04	NS
	p	0.01	NS	
Lower intermolar width	Male	43.89 + 2.23	41.89 + 1.56	0.01
	Female	41.67 + 1.84	42.12 + 1.87	NS
	p	0.01	NS	
Length of the upper arch	Male	46.75 + 3.29	46.80 + 1.71	NS
	Female	45.21 + 2.13	45.37 + 2.01	NS
	p	NS	0.02	
Length of the lower arch	Male	43.83 + 2.49	42.38 + 1.40	0.02
	Female	41.82 + 2.12	42.24 + 2.25	NS
	p	0.01	NS	
Perimeter of the upper arch	Male	11.08 + 0.55	10.70 + 0.40	0.02
	Female	10.66 + 0.50	10.58 + 0.45	NS
	p	0.02	NS	
Perimeter of the lower arch	Male	9.92 + 0.54	9.65 + 0.29	NS
	Female	9.52 + 0.56	9.57 + 0.45	NS
	p	0.02	NS	
Curve of Spee	Male	2.75 + 0.71	1.76 + 0.62	0.01
	Female	2.25 + 0.77	1.73 + 0.49	0.01
	p	0.05	NS	
Overjet	Male	2.29 + 0.88	2.51 + 0.84	NS
	Female	2.30 + 0.78	2.34 + 0.75	NS
	p	NS	NS	
Overbite	Male	1.85 + 0.98	2.34 + 1.17	NS
	Female	1.67 + 1.07	2.25 + 1.23	NS
	p	NS	NS	

Data shown as mean + SD; Based on Student's t-test; NS: non significant; n=20 per group.

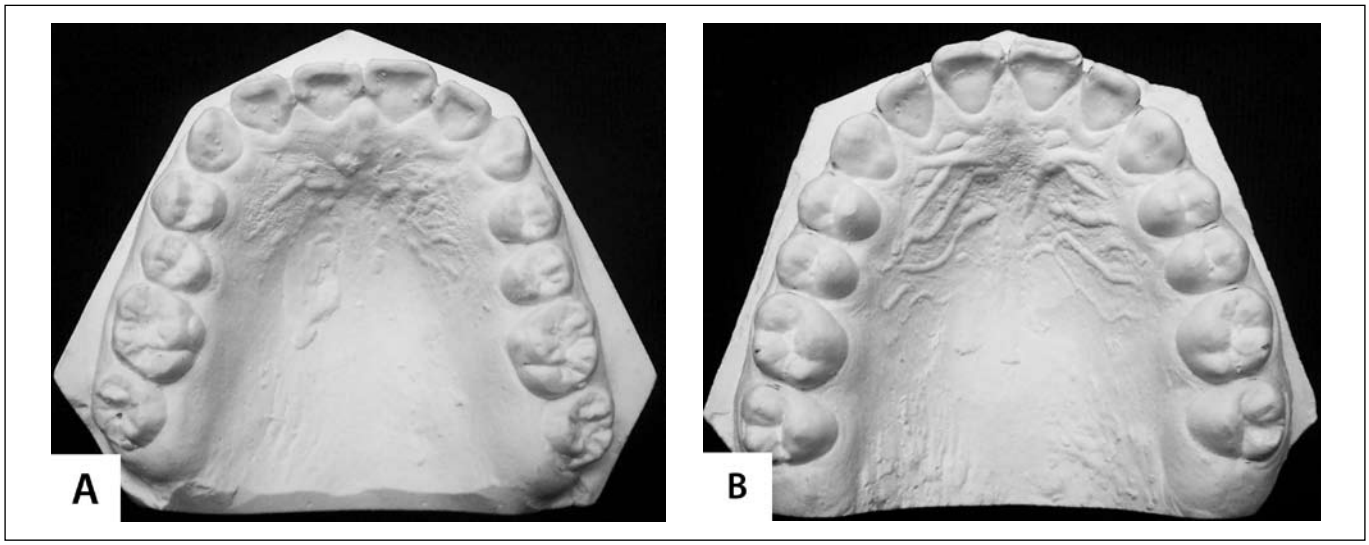

Figure 2. (A) Representative Mazahua dental arch and (B) representative Mestizo dental arch.

On the other hand, in the statistical analysis of the females between the Mazahua and mestizo teenagers from the same age group, there were only significant differences in the perimeter of the upper and lower arches and in the occlusal intermaxillary curve (**Table 1**).

The measurements of the dental arches between the Mazahua and mestizo males in the 15 to 17-year-old age group showed statistically significant differences in most variables. According to the analysis between the Mazahua and mestizo females from this age group, a significant difference was observed in the occlusal intermaxillary curve in which the Mazahua group had the greater depth of curve (**Table 2**).

The 12 to 14-year-old group showed significant differences between genders in most variables. The males in both ethnicity groups had significant larger values in most measurements than females except for overbite for Mazahua population and lower intermolar width for the mestizo population.

In the 15 to 17-year-old group, males had values significantly larger than females in most measurements, except for overjet for Mazahuas and in lower intercanine and intermolar widths for the mestizo teenagers. In this age group, most measurements with statistically significant differences were observed among Mazahuas, while among the mestizo population there was only one, in the length of the upper arch.

Discussion

The analyses of dental size and arch dimensions establish human biological characteristics, such as the genetic relationship between populations and the adaptation of humans to their place of residence. Odontometrics is one of the least studied areas of dentistry, so the variations and factors that affect normal growth are not understood[11]. Rivera et al.[7] suggested that the dimensions of arch width are genetically determined in a more specific way than the dimensions of arch length.

In the present study, the morphologic characteristics of the dental arches of Mazahua and mestizo teenagers from the central region of Mexico were investigated. The results between genders in both ethnic groups differed with respect to the size of dental arches; males had larger dimensions, which is in accordance to the findings of previous studies[4,12-16] that reported statistically significant differences between genders, males having greater dimensions. Specifically, after ten years of age, males have a greater growth than females. At the same time, our results differed from those reported by Nojima[17] and Ward[18], who concluded that there is no sexual dimorphism in the dental arches and that is not necessary to establish gender groups because there are similar male-to-female ratios in ethnic populations.

In the present study, Mazahua and Mestizo teenagers from the youngest age group showed significant differences between genders in most measurements. In the older age group, the Mazahuas also had statistically differences between genders in most variables; but the mestizo population demonstrated some similarities between genders. It is probable that the pubertal growth spurt starts later in males than females in the mestizo population.

It is interesting to observe that in both Mazahua and mestizo populations, the occlusal intermaxillary curve increased with age. There is a natural tendency of this measurement to deepen with time. A deep curve of Spee is usually associated with an increased overbite because the lower jaw's growth downwards and forwards sometimes is faster and continues longer than that of the upper jaw[6]. In spite of this, no significant differences in the overbite were observed between age groups.

Intermolar and intercanine widths increased in the older population, but were more extreme in females, probably because girls finish tooth eruption before boys, except for third molars[19].

The data obtained in this study indicate that the Mazahua group had larger arch dimensions than the mestizo population and, clinically, Mazahuas are less likely to exhibit dental crowding. In Mazahuas, the arch form differs, being more squared than in the mestizos

(**Figure 2A**) because they showed greater intercanine and intermolar widths. There was a larger arch perimeter and a steeper occlusal intermaxillary curve, which reflects greater overjet. The mestizo population had an oval arch (**Figure 2B**) because the diameter of the intercanine and intermolar widths was smaller. Hence, there are noticeable differences between these two ethnic groups that probably reflect greater miscegenation in the mestizo than in the Mazahua population. In this way, it is reaffirmed that variations in the size of the dental arches are influenced by factors such as race, inheritance, and environment, as previously reported[13,20-27]

Burris[15] reported similar characteristics in African-Americans compared to Caucasian Americans; African-Americans 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.

Some other studies carried out with Australians[27] or Amazonian's aborigines[7] determined a good maxillary width development, as demonstrated by harmonic occlusal relations, little crowding and almost total absence of open bite or crossbite; in accordance to this Mazahua sample.

In conclusion, the findings of the present study indicate that there are morphologic characteristics of the dental arches of the Mazahua and mestizo teenagers that differ between genders; males had larger diameters in both age groups. It was established that there is a characteristic form of the arches for each ethnic group. Mazahuas have an arch with a squared form, since they have greater intercanine and intermolar widths, whereas the Mestizos have oval arches because they have smaller intercanine and intermolar widths. Characteristics in each population should be considered because or their influence on the craniofacial morphology. Further studies should be developed to identify correlations between the different parameters measured in this study in order to establish the interactions among them in the human face growth. These ethnic differences should be considered particularly in specialties such as prosthodontics or orthodontics, in which arch shape matters for the treatment.

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