Abstract

Objectives: To determine the posteroanterior cephalometric norms in Palestinian adults, and to compare the Palestinian norms with the norms of other ethnic groups.

Materials and Methods: PA cephalometric radiographs for 70 Palestinian adults aged between 17-23 years were selected on the basis of Class I molar relationship, good facial symmetry, and no history of previous orthodontic treatment. Fourteen transverse linear measurements, including 10 skeletal measurements and 4 dental measurements, were determined on each radiograph.

Results: Dentofacial transverse dimensions in Palestinian adults were generally similar to Rocky Mountain clinical norms. All skeletal transverse measurements demonstrated a significant increase in Palestinian men compared to women except for the inter-orbital distance. Regarding dental transverse measurements, both maxillary and mandibular inter-molar widths increased significantly in Palestinian males than in females, while the upper and lower midline deviations were nearly similar in both genders.

Conclusion: These posteroanterior cephalometric norms are recommended to be used when formulating a treatment plan for this particular ethnic group.

Key words: Palestinian adults, Posteroanterior cephalometric norms, Transverse dimensions.

Introduction

Cephalometric evaluation of the craniofacial structure plays an important role as a diagnostic guide in orthodontic treatment planning. Nevertheless, orthodontic treatment is best when the facial and cephalometric characteristics of the ethnic background of patients are considered. Since the advent of cephalometric radiography by Broadbent and Hofrath in 1931, orthodontists focused on the lateral cephalograms as their primary source of skeletal and dentoalveolar data; however, posteroanterior cephalometric projections and relevant analyses constitute an important adjunct for qualitative and quantitative evaluation of the dentofacial region.

Several attempts have been made to report the lateral cephalometric standards of various ethnic groups including European-Americans, African-Americans, Puerto Ricans, Brazilians, Japanese, Chinese, and Koreans but few for frontal cephalometric standards. The low percentage may be attributed to the fact that orthodontic educational centers do not emphasize such evaluation.

Assessment of posteroanterior cephalometric views are increasing in demand nowadays, particularly in cases associated with dentoalveolar and facial asymmetries, dental and skeletal crossbites and functional mandibular displacement.

In literature, there is lack in studies which describe the posteroanterior cephalometric norms in Palestinian adults, and as there is a marked increase in the number of Palestinian patients seeking orthodontic treatment, it is becoming crucial to determine the posteroanterior cephalometric values for this particular ethnic group and to base the treatment plan accordingly.

So the purposes of this study were (1) to evaluate the posteroanterior cephalometric features of Palestinian population and to establish PA cephalometric norms for this ethnic group, (2) to compare Palestinian norms with the norms of other ethnic groups, (3) to determine any sexual
differences between Palestinian men and women and (4) to evaluate the linear correlations among and between skeletal and dental measurements.

Materials and Methods
The subjects included 31 Palestinian men and 39 Palestinian women aged between 17-23 years, with a mean age of 20.5 years. All subjects were selected from the dental students of Ajman University of Science and Technology on the basis of the following criteria:

- Patients of Palestinian origin.
- Bilateral class I molar and canine relationship based on Angle classification.
- Balanced and symmetrical faces.
- No history of orthodontic, orthognathic and orthopedic treatment.
- Minor or no crowding.
- Full set of normal permanent teeth in both jaws (excluding third molars).
- No history of facial trauma.

Frontal (Posteroanterior) cephalometric radiographs were taken for each subject under standardized conditions. During taking this view, the subject’s face was directed toward the cassette by rotating the cephalostat at 90° to the lateral cephalometric view position, and the distance between the X-ray tube and the porion axis was fixed at 5 feet. All radiographs were taken with the teeth in maximum intercuspation.

Tracings of the radiographs were made on 8” × 10” 0.003” matte acetate sheets (Orthotrace; Rocky Mountain Orthodontics, Denver, Colo).

All cephalometric radiographs were traced by hand by a single author to avoid interobserver variability. All measurements were taken to the nearest 0.5mm.

Twelve landmarks were identified on the right and left sides of the cephalometric tracings (Fig. 1):

- Cr: The most lateral points on cranium parallel to the superior aspect of the orbit.
- Ant: point located at the intersection of the radiographic shadow of the frontozygomatic process with outline of the anterior cranial base.
- Frz: the outer edge point of the frontozygomatic suture.
- Za: point at lateral border of zygomatic arch.
- Mas: point located at the apex of the mastoid process.
- Or: point located at the inner bony wall of the orbit, measured between the points where the radiographic shadow of the cribriform plate intersects the inner orbital margin.
- Nas: point located at the lateral bony walls of the nasal cavity.
- J: the intersection of the lateral contour of the maxillary alveolar process and the lower contour of the maxillozygomatic process of the maxilla.
- Ag: the lateral and inferior border of antegonial notch.
- Go: point located at the gonial angle of the mandible.
- Um: outermost point of maxillary first permanent molar.
- Lm: outermost point of mandibular first permanent molar.

Three midline landmarks were identified on the cephalometric tracings (Fig. 1):
- Cg: the most superior point of crista galli.
- ANS: the tip of the anterior nasal spine.
- Me: most inferior midline point in the mandibular symphysis.

A total of fourteen transverse linear measurements, including 10 skeletal measurements and 4 dental measurements, were used to assess the transverse dimensions of the face.

Skeletal Measurements:
1. Cranial width (Cr-Cr): width of the cranium from the most lateral points on the cranium parallel to the superior aspect of the orbits.
2. Anterior cranial base width (Ant-Ant): distance between right and left sides of anterior cranial base.
3. Bifrontozygomatic width (Frz-Frz): distance between the outer edges of the frontozygomatic suture.
4. Facial width (Za-Za): width of the zygomatic arch at its most lateral aspect.
5. Bimastoid width (Mas-Mas): distance between the apices of right and left mastoid processes.
6. Inter-orbital width (Or-Or): distance between the inner bony walls of the right and left orbits.
7. Nasal width (Nas-Nas): distance between the right and left lateral bony walls of the nasal cavity.
8. Maxillary width (J-J): distance between right and left Jugale points.
9. Antegonial width (Ag-Ag): distance between right and left antegonial points.
10. Bigonial width (Go-Go): widest distance between right and left gonions.

Dental Measurements:
1. Intermolar width of maxillary first molars (Um-Um): distance between the outermost points of the crowns of maxillary permanent first molars.
2. Intermolar width of mandibular first molars (Lm-Lm): distance between the outermost points of the crowns of mandibular permanent first molars.
3. Upper midline deviation (UMD): distance between the contact point of the maxillary central incisors and the mid sagittal plane.

4. Lower midline deviation (LMD): distance between the contact point of the mandibular central incisors and the mid sagittal plane.

To assess the intra-observer errors, the author traced 15 randomly selected radiographs at two different time intervals. Intra class correlation coefficient was applied to the first and second measurements in order to evaluate the author variability of repeated measurements (Table 1).

For each linear measurement, minimum value, maximum value, mean, and standard deviation were calculated (Table 2). Differences between genders were evaluated with independent samples t-tests for different parameters.

Pearson product-moment correlation coefficient was used to evaluate relationships among and between transverse skeletal and dental measures.

Results
The results of the intra-observer correlation coefficient were greater than $r = 0.95$ (Table 1). The landmarks identified were generally well visualized on the PA radiographs.

Table 2 shows the arithmetic mean, minimum value, maximum value, and standard deviation for 14 skeletal and dental measurements, for a sample size of 70 Palestinian adults.

An independent samples $t$-test was used to compare men with women. Table 3 compares the mean and standard deviation of the PA cephalometric measurements between both genders. Nine of 10 skeletal transverse linear measurements (Cr-Cr, Ant-Ant, Frz-Frz, Za-Za, Mas-Mas, Nas-Nas, J-J, Go-Go, and Ag-Ag) showed significant differences between men and women, where the mean values of men subjects exceeded women in all skeletal width dimensions except for the Or-Or distance. Regarding the dental linear transverse measurements, both Um-Um and Lm-Lm distances were significantly increased in men compared to women ($P < .001$), while UMD and LMD showed no significant difference between both sexes.

The linear association among and between the skeletal and dental measurements was evaluated using Pearson correlation coefficient (Table 4). The association ranged from 0.96 to -0.23. The highest correlation was found between Frz-Frz distance and Ant-Ant distance, while the lowest correlation was determined between UMD and both Ag-Ag and Go-Go distances.

The standard deviations of most of the skeletal and dental measurements were relatively small when they were compared with their corresponding mean values.

Discussion
The facial, and skeletal characteristics of the patient play a critical role in orthodontic and orthognathic treatment planning.

This research was the first to study normative values for cephalometric transverse linear measurements on a sample of 70 untreated Palestinian adults having good facial symmetry and ideal occlusion.

Nowadays, large numbers of Palestinian adults are seeking orthodontic and orthognathic treatments, so it has become increasingly important to determine the posteroanterior
cephalometric norms for this particular ethnic group and to base our treatment plans accordingly.

Most of the facial and radiographic records in orthodontics are based on the profile. The frontal view of the face, and consequently the posteroanterior (PA) cephalograms, should be an integral part of facial evaluation, as man presents himself to the world face forward. The relationship between the widths of maxillary and mandibular skeletal bases is presumably the most critical information sought from the PA record.

Among several analyses Rocky Mountain analysis seems to be the most widely used for diagnosis of transverse relationship between the jaws, as it provides normative values for different ages.

Athanasiou emphasized that the data obtained from PA cephalograms are of value for the diagnosis of various types of craniofacial anomalies and for monitoring the growth of persons or groups of corresponding age and race, and for comparison with other studies.

Weil presented the width dimensions obtained from PA cephalograms for Chinese subjects. Recently, Uysal et al. established PA cephalometric norms for 100 Turkish Adults, and stated that their findings can be used for diagnosis and treatment planning of orthodontic treatment and orthognathic surgery.

Therefore, the aim of the present study was to investigate the PA cephalometric values for selected skeletal and dental transverse linear measurements in Palestinian adults, and to compare those values with the norms of other ethnic groups.

Uysal et al. found that Turkish adults have cranial width (Cr-Cr) value of 159.72 ± 7.55mm, with mean values for females and males of 155.35 ± 6.84mm and 164.85 ± 4.56mm respectively. In the present study, cranial width measurement was 148.71 ± 6.12mm with mean values for females and males of 147.46 ± 5.98mm and 150.31 ± 5.92mm respectively, indicating that the cranial width is smaller in Palestinian adults than in their Turkish counterparts.

Regarding anterior cranial base width (Ant-Ant), Weil found that the mean values were 93.9 ± 0.45mm and 91.8 ± 0.85mm for Chinese men & women respectively, while in Palestinian adults the results showed that Ant-Ant distance exceeded considerably those of Chinese subjects with the values of 103.99 ± 5.77mm and 100.25 ± 4mm in men and women respectively.

According to Ricketts et al. they found that facial width (Za-Za) had a mean value of 115.7mm at age of 9 years with 2.4mm increases per year; which predicts that adults at the age of 18 would have Za-Za distance of 137.3mm. In the present study the mean value was 135.88mm, slightly less than the clinical norm of Ricketts et al.

Ricketts et al. found nasal width (Nas-Nas) to have a mean value of 25mm at age 9 years with 0.7mm increase per year. The estimated nasal width at the age of 18 is 31.3mm. Similar results were obtained by Uysal et al. who stated that nasal width in Turkish adults was similar to Ricketts norms (32.43 ± 3.85mm). Our results showed that the mean value of nasal width in Palestinian adults was 32.19 ± 3.48mm, which is very similar to the previous findings.

Ricketts et al. stated that the width of the maxilla (J-J), had a mean value of 61.9mm for a 9-year-old subject increasing 0.6mm per year. At age 18, the J-J distance is estimated to be 67.3mm.

Cortella et al. used data from the Bolton-Brush growth study to generate new norms for the PA analysis. In their study, they found that maxillary width (J-J) had a mean value at the age of 18 of 64.7 ± 2.7mm. Our results showed that Palestinian adults have mean values for J-J distance of 65.56 ± 5.25mm, very close to previous findings.

Regarding the Antegnial Width (Ag-Ag), the average value in Palestinian adults was 87 ± 5.93mm. This finding matched with the results obtained by Ricketts et al. and Cortella et al. Ricketts et al. found that this value have a norm of 76.1mm at age 9 years with 1.4mm increases per year. At age of 18, the Ag-Ag distance is estimated to be 88.7mm. Cortella et al. stated that

(Table 4): Correlation Coefficients of All Parameters

<table>
<thead>
<tr>
<th></th>
<th>Cr-Cr</th>
<th>Ant-Ant</th>
<th>Frz-Frz</th>
<th>Za-Za</th>
<th>Mas-Mas</th>
<th>Or-Or</th>
<th>Nas-Nas</th>
<th>J-J</th>
<th>Ag-Ag</th>
<th>Go-Go</th>
<th>Lm-Lm</th>
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Ag-Ag distance in young adults have a mean value of 86.40 ± 4.50mm. On the other hand, Uysal et al.21 reported an Ag-Ag distance in Turkish adults of 98.03 ± 7.36mm, which exceeded their previous counterparts.

Krogman28 mentioned that growth in width of both jaws, including the width of the dental arches, tends to be completed before the adolescent growth spurt and is affected minimally, if at all, by adolescent growth changes. Similarly, Athanasiou et al.20 studied the transverse dentofacial structure of 6- to 15-year-old Austrian schoolchildren and stated that the maxillary intermolar width during the period from 9 to 12 years did not present any increase, and the mandibular intermolar width remained approximately the same during the whole observation period. Furthermore, Snodell et al.19 reported that the increase in the maxillary intermolar width (Um-Um) occurs prior to age 16, and the average increase between ages 16 to 18 was only 1.4mm. Uysal et al.21 reported that Turkish adults have an Um-Um distance of 61.17 ± 3.45mm, and an Lm-Lm distance was 59.52 ± 3.68mm. In the present study, the mean value for Um-Um distance and Lm-Lm distances were 59.48 ± 3.80mm and for men and 58.40 ± 3.98mm, respectively.

Most of the previous studies have found that male subjects had greater facial widths than female subjects for each age group studied. Wei16 stated that craniofacial widths in Chinese males were highly correlated with each other. Facial width correlated with all skeletal transverse linear measures except for inter-orbital width. Cranial width correlated with the bifrontozygomatic width. Cranial width correlated with the facial width. Facial width correlated with all skeletal transverse measurements. Maxillary width was correlated with maxillary and mandibular intermolar widths. All dental width measurements were highly correlated with each other.

Numerous significant correlations were found among and between skeletal and dental measures. The highest correlation was found between anterior cranial base widths with bifrontozygomatic width. Cranial width correlated with the facial width. Facial width correlated with all transverse skeletal measures. Maxillary width was correlated with maxillary and mandibular intermolar widths. All dental width measurements were highly correlated with each other.

Conclusions
- PA cephalometric norms for Palestinian adults were established.
- Dentofacial transverse dimensions in Palestinian adults were generally similar to Rocky Mountain clinical norms.
- In comparison of sexes, significant differences were found in all skeletal transverse linear measures except for inter-oralbital width. Regarding dental transverse linear measures, both maxillary and mandibular inter-molar widths were increased signiﬁcantly in Palestinian men than in women, while upper and lower midline deviations were nearly similar in both genders.

References