Original Research

The Value of Panoramic Radiography in Gender Specification of Edentulous Iranian Population

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Abstract

Introduction: gender specification among the forensic dentistry and human anthropology, is mainly based on anatomic variations. Due to racial differences and environmental factors such as time of tooth extraction, osteoporosis, dietary habits, usage of dental prosthetics and periodontal diseases, there will be different results achieved. The purpose of this study is to classify the gender specification in edentulous patient by using anatomical variations in panoramic radiography. **Methods:** Panoramic radiographs of a population including 45 men and 45 women which were aged between 51 to 79 years were assessed and statistically analyzed. **Results:** Analysis of data demonstrated that the average of measured distances in male were significantly higher than female except for the distance between the two mental foramina. It should be signified that the accuracy of gender specification with this method was ranged between 78 to 84.5 percent in female and between 80 to 89 percent in male. **Conclusion:** The Method of this study can be used as a quantitative technique along with other methods of gender specification. Furthermore, this study has been illustrated as one of the most significant approvals for the existence of sexual dimorphism in Iranian population.

Key Words: Edentulouse, identification, panoramic radiography, sexual dimorphism.

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Introduction

One of the most significant components of forensic dentistry is the identification by means of human body; therefore numerous studies have been researched on teeth and skeletal structure of human body. On the other hand, most of these studies were focused on morphology, odontometric and osteometric varieties. Moreover, the main results of these studies were specification of race and gender (1-3).

Dental identification is one of the commonest means which is applied in identifying deceased individuals who cannot be recognized visually. Postmortem identification requires the investigation of biometric features that are unique to the individual and are capable of withstanding severe perimortem conditions. To this end, dental features still remain as one of the most effective modalities for postmortem identification. Variations in dental characteristics such as tooth angulation, morphology, and/or degree of restoration mostly provide a satisfactory number of distinguishing characteristics comparing with dental records and antemortem radiographs. Nevertheless, what does the forensic dentist do when faced with a deceased edentulous individual who has lost all or most of the aforementioned characteristics is proven so valuable? The bone morphology and anatomic variation of such

individuals provides a potentially reliable source of information in such cases. Additionally, in these cases the usage of panoramic radiography (orthopanthomography) is considered in the postmortem identification since it has the capability of showing anatomic landmarks of the jaw bone (2,4-9).

It should be signified that the gathered results of studies are applicable for each specific race due to the differences in racial and environmental factors such as time of tooth extraction, osteoporosis, dietary habits, and usage of dental prosthetics and periodontal diseases, which can make differences in the results achieved.

On the base of these studies, the purpose of this study is to classify the gender specification in edentulous patient by using anatomical variations in panoramic radiography.

Materials and Methods

The present research is a descriptive cross-sectional study. Whereas, Panoramic radiographies consisting of 45 men and 45 women who were all edentulous and between 51 to 79 years were selected using the convenience sampling method. On the other hand, all radiography samplings were taken in Department of Oral and Maxillofacial Radiology of Islamic Azad university (Khorasgan Branch) and by one technician, also our panoramic machines offer some type of positioning guides (lights) to position the patient along 3 major axes: anterior-posterior (too far forward or back), vertically (alartragus, Frankfurt plane, or cantho-meatal lines), and midsagittal alignment (patient twisted or rotated) (Panmeca EC2002, Proline Model, Finland Country, Kodak film (15.30), 18 Sec, 80 Kvp, 12 mili-ampere).

Inclusion criteria were lack of teeth and pathologic bone lesion, obvious mental foramina and superior and inferior borders of mandibular alveolar ridge and high quality standard radiography without distortion. Nonqualified radiography and patient with any osteogenic disease were excluded.

After all, the entire borders of alveolar ridge and the mental foramina of both sides were drawn. This was done after copying the schema of edentulous mandible from the panoramic radiographies on the tracing paper which was accurately performed using negatoscope and black pencil.

A number of hypothetical lines were drawn to provide more precision, including lines drawn parallel to the inferior border of mandible, the inferior border of mental foramina and lastly the alveolar ridge. Furthermore, all the drawn lines were thought to be parallel to each other due to the inharmonic shape of the mandible borderlines. In addition, from the hypothetical line paralleled to the inferior border of mandible, a line were drawn perpendicular to the inferior border of mental foramina that exactly passed through the center of the foramina which was eventually perpendicular to the hypothetical line paralleled to the alveolar ridge. So briefly a line initiating from the inferior border of mandible, continuing to the alveolar ridge and passing through the center of mental foramina was drawn (Fig. 1).

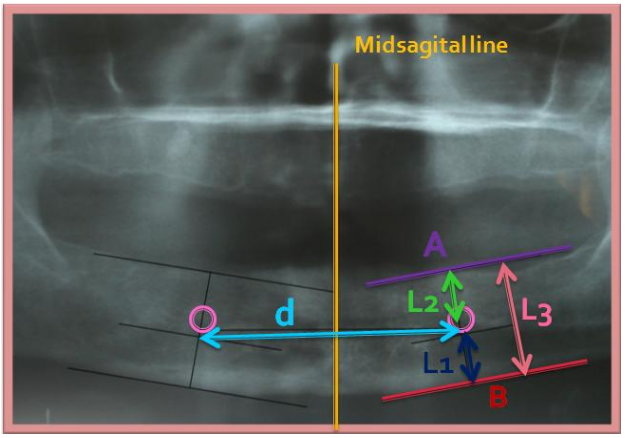

Figure 1. A: Line parallel to the alveolar ridge B: line parallel to the inferior border of mandible d: distance along with the two mental foramina L_1: Distance between the inferior border of mandible and the inferior border of mental foramina $L_{2:}$ Inferior border of mental foramina to the alveolar ridge L_3: height of mandibular trunk

These distances were measured using a caliper with the accuracy of 0.01 millimeters. First, the distance between hypothetical line passing the inferior border of mandible and the line passing the inferior border of mental foramina were recorded by placing the caliper on the previously drawn orthogonal lines. Ultimately, the distance between the inferior border of mental foramina and the alveolar ridge (E) were recorded using the orthogonal line as guidance for the caliper.

Two horizontal lines were drawn from the mid-sagittal line to the center of mental foramina on each side. In fact, the total of their values illustrated the distance between the two mental foramina. Finally, the caliper was placed on the orthogonal lines to measure the distance between the inferior border of mandible and the alveolar ridge that showed the height of the mandibular trunk.

The recorded values were divided by 1/2 in order to produce more reliable records and to avoid the disturbance of panoramic radiography magnification. It should be signified that that the resulted values were used for comparison between genders. On the other hand, since the magnification amount in all panoramic radiographs is almost equal, the comparative

magnification does not have any effect on overall accuracy of study.

In this study the distance between the inferior border of mandible and the inferior border of mental foramina (R_1, L_1), inferior border of mental foramina to the alveolar ridge (R_2, L_2), height of mandibular trunk (R_3, L_3), the inferior border of mandible and the alveolar ridge (R_4, L_4), along with the two mental foramina (d) were measured, recorded and analyzed amongst a population of Iranian men and women.

Eventually the SPSS software version 11 was used to analyze the data by means of statistical functions. Three specific functions were produced for each three different situation. Moreover, these situations included having the right side of edentulous mandible values, the left side values or both sides. Additionally, the accuracy of gender specification was measured in each one of the 3 functions. It is considerable that all the data which were attained from people prescribed with panoramic radiography. Furthermore, this study was performed under the ethical confirmation of the research council and the committee of medical ethics in Dental Faculty of the Islamic Azad University of Khorasgan.

Results

The basic characteristics of edentulous individuals are illustrated in Table 1. While as, the mean age was 69.2 ±6.04 for men and 67.8±5.1 for women which did not show a significant difference (P-value= 0.24).

Descriptive statistics including median and standard deviation intervals (L_1, L_2, L_3, L_4, R_1, R_2, R_3 and R_4) are shown in Table 2. Furthermore, the t-test indicated that the average measure of interspaces in men were significantly greater than women. In other words, there was a significant relationship between gender and measured interspaces.

Table 1. Frequency table and mean age

Age (years)	Male No (%)	Female No (%)
51-59	4 (9.8)	2 (4.5)
60-69	18 (40)	29 (64.4)
70-79	23 (51.1)	14 (31.1)
Mean $\pm$ SD	69.2 $\pm$ 6.04	67.8 $\pm$ 5.10

Table 2. Analyses of lower jaw interspaces measured (the achieved numbers were divided by 1.2 in order to decrease the effect of panoramic radiography magnification)

Measured interspaces	Male	Female	t-test results
	Mean$\pm$SD (mm)	Mean$\pm$SD (mm)	P-value
Inferior border of mandible to the inferior border of mental foramina on the left side – L_1	11.62 $\pm$ 2.24	8.33 $\pm$ 2.10	< 0.001 *
Inferior border of mental foramina to the alveolar ridge on the left side – L_2	16.43 $\pm$ 3.33	13.60 $\pm$ 3.32	< 0.001 *
Height of mandible body on the left side – L_3	28.05 $\pm$ 4.24	21.95 $\pm$ 4.32	< 0.001 *
Inferior border of mandible to the alveolar ridge on the left side – L_4	28.05 $\pm$ 4.24	21.95 $\pm$ 4.32	< 0.001 *
Inferior border of mandible to inferior border of mental foramina on the right side – R_1	12.02 $\pm$ 2.83	8.72 $\pm$ 2.28	< 0.001 *
Inferior border of mandible to the alveolar ridge on the right side – R_2	16.88 $\pm$ 3.33	14.08 $\pm$ 2.71	< 0.001 *
Height of mandible body on the right side – R_3	28.90 $\pm$ 4.25	22.80 $\pm$ 4.12	< 0.001 *
Inferior border of mandible to the alveolar ridge on the right side – R_4	28.90 $\pm$ 4.25	22.80 $\pm$ 4.12	< 0.001 *
Interspaces between two mental foramina - d	51.7 $\pm$ 5.15	51.18 $\pm$ 8.09	<0.737 **

* The average of measured distances in male was significantly higher than female with the accuracy of 99.9.

** T-test indicates that the average of "d" is not significantly different in men and women (P-value=0.737) and is not an accurate variable for gender specification.

Mathematical step functions used for presenting gender specification formulas in this study are described below.

Function 1 has all the variables (L_1, L_2, L_3, $_4$ L, R_1, R_2, R_3 and R_4) except for "d". It should be noted, when analyzing the model, variables that have slight importance (R_3, R_4, L_4) are omitted and other variables remaining (R_2, R_1, L_3, L_2, L_1) are the high influence parameters in respect of importance.

The centrality, which is the mean specification measure for each gender, was measured for each group. Moreover, the border line, which denotes male from female, is the average of each groups' centralities and any number lower than the border line indicates the state of being female.

Formula 1:

$Y= -6.2+1.95L1+1.7L2-1.7L3+0.1R1+0.14R2$

The achieved numbers are compared with the border line and gender denotation is performed. On the other hand, higher results than the border line indicate the state of being male and lower results indicated the state of being female.

As illustrated in Table 4, it is concluded that the numbers of 10 out of 45 women were predicted incorrectly that indicated a gender specification accuracy of 77.8 % in female individuals. While as, among 45 men only 5 were predicted incorrectly that indicated the accuracy of 89% in male individuals. Eventually, the overall gender specification accuracy in both genders was 83.3% when all the measures of edentulous mandible were available.

Function 2 was provided only with the measurements from the left side of edentulous mandible, and then L_4 was omitted from the model due to less importance and other variables that had high influence (L_1, L_2, L_3), had the most importance in gender specification.

Formula 2:

$Y=-5.67+1.8L1+1.5L2-1.46L3$

According to Table 4, from all the 45 women, 7 subjects were predicted as men, which indicated the accuracy of 84.4 % for women. Whereas, from all the 45 men, 6 subjects were predicted as women, which indicated the accuracy of 86.7% for men. It is calculated that the overall accuracy of gender specification for both genders using the left side measurements was 85.6%.

Function 3 was calculated only with R_1 and R_2 in the model, which other variables (R_3, R_4) were omitted from the model. Hence, the following formula was achieved using the crude coefficient and the fixed proportion according to Table 3.

Formula 3:

$Y= -5.9+0.26R_1+0.14R_2$

From all the 45 women, 10 were predicted incorrectly, which indicated the accuracy of 77.8% in women. On the other hand, amongst all 45 men, 9 were predicted incorrectly, which indicated the accuracy of 80% in men. It is resulted that the overall gender specification accuracy in both genders was 79% only using the right side measurements.

Discussion

Despite the vast anatomic differences of each gender, variations should be considered based on each specific race (10,11). Additionally, it is realized that sexual dimorphism is related to anatomic regions and their functions (12). Many researchers concluded that gender denotation with the accuracy of 98 % is performable by using the skull and the hipbone. Despite these facts, the sexual differences are not a dominant and static phenomenon while as, there are overlaps in each gender's characteristics (10,13).

Thomas and colleagues conducted a study on panoramic radiographs of 47 edentulous Australian men and women aged between 36 yeas and 90 years. Furthermore, statistical results indicated that alveolar ridge recession is in relationship with aging and generally the alveolar ridge height has greater measures in men (14). The results of present study that was performed on panoramic radiographies of 90 Iranian men and women aged between 51 years and 79 years determined that the alveolar ridge recession which is related to aging directly in both genders and generally the alveolar ridge height in men has greater measures comparing to women.

Rai and Arand (15) indicated that measurement of the mental foramina to alveolar ridge can be useful for specifying gender and also found out that alveolar ridge recession measure is greater in female gender. Therefore, the present study indicated the same measurement which in addition, the results concluded that recession measure of alveolar ridge is greater in women.

Atay et al. (16) studied the panoramic radiographs of 620 (360 men and 260 women) edentulous individuals aged between thirties to fifties. They concluded that the measure of alveolar ridge recession in women was higher and the interspaces of two mental foramina on both sides of mandible were bigger in men. Moreover, the analysis of panoramic radiographies of lower jaw in our study indicated that the recession measures of alveolar ridge were higher in women and the interspaces between two mental foramina on both sides of mandible were equal in each gender. It should be signified that these differences could be due to the skeletal conditions of Iranian race in comparison with the European race. Furthermore, the number of samples was lower in the present study.

In conclusion, the interspaces between the inferior border of mandible and the inferior border of mental foramina and also the interspaces between the alveolar ridge and the inferior border of mental foramen and the overall height of mandible body is greater in men, but the differences are not sufficient for performing gender specification. On the other hand, the function analyzes are performed with the accuracy of 89% which this method can be used as an auxiliary method along with other methods of gender specification. Ultimately, this study is an approval for past studies that indicated the dependence of sexual dimorphism on race and indicated that gender-dependent differences are stronger in some societies whereas, it is weaker in others.

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