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Research Article

Mandible-An Indicator for age and sex determination using digital Orthopantomogram

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Abstract: Mandible is a dimorphic bone of the skull and has aided in determining the sex as well as the age of an individual. Mandibular condyle as well as the ramus of the mandible have particularly shown sexual dimorphism. Digital panoramic radiographs can be used to determine age and sex. The Aim & Objective of the present study to evaluate various radiomorphometric indices in digital dental panoramic radiograph in order to identify possible interrelationships between these indices and sex and age of the patients analyzed. Forty digital panoramic radiographs were selected. Age, sex and dental status of the patients were recorded. The radiographs were grouped into four 10-year age groups (by decades). The mental index, maximum and minimum breadth of ramus of mandible and the height of the coronoid were measured. In relation to the mental index, high significance was found between male and females in both the right and left side. In regards to the maximum breadth of ramus of the mandible in both the right and left side a high significant difference is observed between male and female of higher age group. The height of coroniod in both right and left side between male and female of all age group showed a significant result for sex determination. While comparing the different age groups it was noticed group I (21-30yrs) and group IV (51-60yrs) showed highly significant results in regards to mental index in both right and left of males. The maximum and minimum breadth of ramus of the mandible did not yield any significance for the age determination. Comparison of the height of the coronid in both male and female irrespective of right and left side yielded highly significant results in between all the four age groups. In the present study while comparing the different age groups it was noticed group I (21-30yrs) and group IV (51-60yrs) showed highly significant results in regards to mental index in both right and left of females. The results concluded that coronoid height and the mental index can be used effectively in identification of both age and sex. Whereas maximum and minimum breadth of ramus of the mandible can be used for sex determination only in older age group and for the age determination can be used only for females.
Keywords: Mandible, Age indicator, Ramus of Mandible, Coronoid height, Mental Index, sex determination, Orthopantomogram.

INTRODUCTION

Skeleton has always aided in genetic, anthropological, odontological and forensic investigation of living and non- living individual[1]. Skull bones and pelvis have been majorly used in sex and age determination[2]. The first phase of forensic is to evaluate the difference in morpho- metric characteristics to identify an individual, and many studies reveal that there exist differences in the skull and other bones of male and female, as well as different age groups[2-4].

In the adult skeleton, sex determination is usually the first step of the identification process as subsequent methods for age and stature estimation are sex dependent. The reliability of sex determination depends on the completeness of the remains and the degree of sexual dimorphism inherent in the population[5]. When the entire adult skeleton is available for analysis, sex can be determined up to 100% accuracy, but in cases of mass disasters where usually fragmented bones are found, sex determination with 100% accuracy is not possible and it depends largely on the available parts of skeleton[5-6].

Skull is the most dimorphic and easily sexed portion of skeleton after pelvis, providing accuracy up to 92%[6]. But in cases where intact skull is not found, mandible may play a vital role in sex determination as it is the most dimorphic, largest, and strongest bone of skull[5-7]. Presence of a dense layer of compact bone makes it very durable, and hence remains well

preserved than many other bones. Dimorphism in mandible is reflected in its shape and size[6]. Male bones are generally bigger and more robust than female bones[5].

The relative development (size, strength, and angulations) of the muscles of mastication is known to influence the expression of mandibular dimorphism as masticatory forces exerted are different for males and females[8]. Greatest morphological changes showing the sexual dimorphism in the mandible are particularly seen in the mandibular condyle and ramus than the body of the mandible[8-9]. Methods based on measurements and morphometry are accurate and can be used in determination of sex[10].

Chronological age assessment is an important part of medico legal practice. The procedures for age determination are complex and involve the consideration of many factors.[4] Amongst the hard tissues, bones are important as they undergo a series of changes from prenatal to postnatal life and changes in their composition and structure continue into old age and even after death. Hence, bones form a reliable source of information regarding growth and growth changes. Normally well-defined skeletal development in bones, cranial sutures and teeth take place at specific ages. However, these changes are significantly affected by genetics, general health and other environmental factors[11].

The determination of age becomes more difficult as maturity increases. Where fetal material is concerned, a result may be achieved with an accuracy measured almost in days. As age advances, the situation remains fairly satisfactory until about the cessation of growth and especially the cessation of dental changes so that by the age of 20–25 years all growth markers have ceased to be of assistance. As time goes on through adult life into middle age and into old age, matters become progressively more difficult and the margin of error increases[12].

A number of methods for age determination have been proposed. These can be classified in four categories, namely, clinical, radiological, histological and chemical analysis. In the living persons, any or all of the above methods can be used to determine age, in cases where actual age is not known or is to be confirmed. However, in case of a dead person, post-mortem changes such as decomposition, mutilation or skeletonisation may make identification progressively more difficult almost to the point of impossibility[13].

Mandible has been used in age and sex determination as it can retain its shape than any other bone in the forensic and physical anthropological field[14]. The mandible is amongst the first bones in the body to start ossifying and is unique in that it has both the patterns of ossification (endochondral and intramembranous). The body of mandible is ossified intramembranously whereas the ossification of the coronoid and condyloid processes is endochondral. Until the third decade of life, morphological and dental changes (time and sequence of eruption of teeth) serve as an aid to estimate age[15]. For ages above the third decade, the changes are subtle and have to be studied in greater detail[16].

Radiograph is a less invasive method, which can be employed in both living and dead individuals. Dental orthopantomogram has been used as a valuable tool in forensic science and studies have been conducted to make a biometric system for human identification[17].

The accuracy of digital panoramic radiography in providing anatomic measurements has been established. The principal advantages of digital panoramic images are their broad coverage, low patient radiation dose, and the short time required for image acquisition[18]. Other advantages are that interference of superimposed images are not encountered. Also the contrast and brightness enhancement and enlargement of images provide an accurate and reproducible method of measuring the chosen points[19-20].

AIM & OBJECTIVE

To evaluate various radiomorphometric indices such as mental index (MI), the maximum and the minimum breadth of the ramus of the mandible and the coronoid height in digital dental panoramic radiograph in order to identify possible interrelationships between these indices and sex and age of the patients analyzed.

MATERIALS & METHOD

The out patients were selected and the digital radiographs were taken at Chennai Dental Centre, Rajivgandhi Salai, Kottivakkam, OMR, Chennai-60004, Tamil Nadu, India. Forty digital panoramic radiographs were selected subsequently. Only radiograph with good quality in regards to patient positioning, head alignment, film density, contrast and clear visible lower border of the mandible, posterior border of the ramus, condyle, and both the mental foramina were selected. Images that did not achieve these predetermined requirements were not included in the study. Age, sex and dental status of the patients were recorded. The radiographs were grouped in to four 10-year age groups (by decades). The youngest group was Group 1 (21-30yrs) and the oldest age group was Group 4 (51-60yrs). The maxillary and the mandibular dentitions were recorded using a simple classification system (third molar not included): D1=full dentition, D2= partial dentition (any tooth missing), D3=completely edentulous. Radiographic measurements- linear measurements were made using the planmeca software (Planmeca). In this study, the measurements were not corrected for magnification (magnification was constant at 1.2). The MI (mental index) was measured which

was the mandibular cortical width at the mental foramen. (Fig. 1) It was assessed by identifying the mental foramen and then tracing a line, which passes perpendicular to the tangent, to the lower border of the mandible and through the inferior border of the mental foramen. Maximum ramus breadth (A) was measured as the distance between the most anterior point on the mandibular ramus to the most posterior point on the mandibular ramus. (Fig.2) Minimum ramus breadth (B) was the line drawn between the smallest anterior posterior width of the ramus. (Fig.2) The coronoid height was measured (C) as the projective distance between coronion and angle of the mandible. (Fig.3)

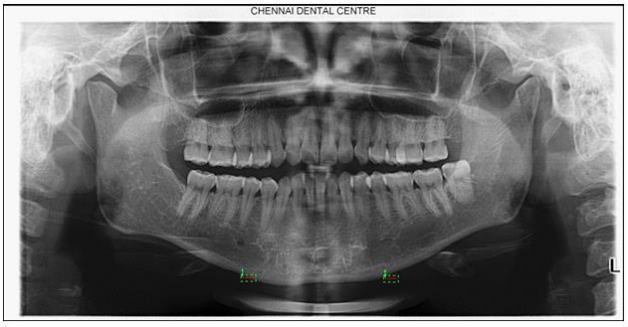

Fig-1: Measurement of MI of Both Left And Right Side

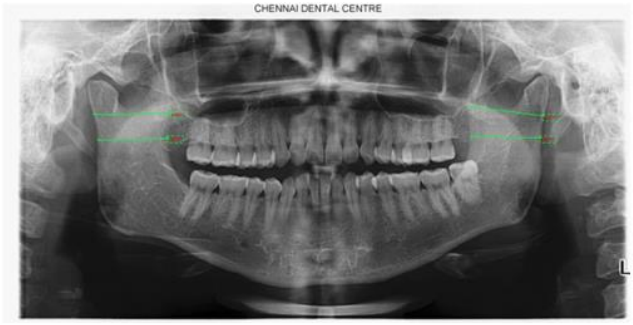

Fig-2: Measurement of Maximum and Minimum Breadth Of Ramus Of Mandible Of Both Left And Right Side

Fig- 3: Measurement of Height of Coronoid Of Both Left And Right Side

The data were analyzed with Student's independent't' test and one-way analysis of variance (ANOVA) test. All statistical analyses are performed with the program Statistical Package for the Social Science.

RESULTS

In group 1 (21-30yrs), the comparison of mean value of all the 4 parameters (left and right side) in both male and female were as follows with the p value of mental index of the left side yielding 0.004 and right side yielding 0.001. The P value of maximum breadth of ramus of the mandible of left side was 0.087 and right side was 0.531. The P value of minimum breadth of ramus of the mandible of left side was 0.227 and right side was 0.154. The P value of height of the coronoid of left side was <0.001 and right side was <0.001. The P value was statistically significant for right and left mental index and height of the coronoid. (Table 1) In group 2 (31-40yrs), the comparison of mean value of all the 4 parameters (left and right side) in both male and female were as follows with the P value of mental index of the left side was 0.087 and right side was 0.184. The p value of maximum breadth of ramus of the mandible of left side was 0.143 and right side was 0.140. The P value of minimum breadth of ramus of the mandible of left side was 0.022 and right side was 0.027. The P value of height of the coronoid of left side was <0.001 and right side was <0.001. The P value was statistically significant for right and left minimum breadth of ramus of mandible and height of the coronoid. (Table 2) In group 3 (41-50yrs), the comparison of mean value of all the 4 parameters (left and right side) in both male and female were as follows with the P value of mental index of the left side was 0.050 and right side was 0.081. The P value of maximum breadth of ramus of the mandible of left side was 0.002 and right side was 0.003. The P value of minimum breadth of ramus of the mandible of left side was 0.048 and right side was 0.050. The P value of height of the coronoid of left side was <0.001 and right side was <0.001. The P value was statistically significant for right and left mental index, maximum breadth of the ramus of the mandible, minimum breadth of the ramus of the mandible and height of the coronoid. (Table 3) In group 4 (51-60yrs), the comparison of mean value of all the 4 parameters (left and right side) in both male and female were as follows with the P value of mental index of the left side was 0.007 and right side was 0.050. The P value of maximum breadth of ramus of the mandible of left side was 0.001 and right side was 0.026. The P value of minimum breadth of ramus of the mandible of left side was 0.034 and right side was 0.023. The P value of height of the coronoid of left side was <0.001 and right side was <0.001. The P value was statistically significant for right and left mental index, maximum breadth of the ramus of the mandible, minimum breadth of the ramus of the mandible and height of the coronoid. (Table 4)

The Mental index (left) of males in each group were compared with each other group and was found

that p value of group I and group II was 0.261, group I and group III was 0.029, group I and group IV was <0.001, group II and group III was 0.619, group II and group IV was 0.014, group III and group IV was 0.142. The P value is statistically significant in comparison with group I and group III, group I and IV, group II and group IV. (Table 5) The Mental index (right) of males in each group were compared with each other group and it was found that P value of group I and group II was 0.101, group I and group III was 0.035, group I and group IV was <0.001, group II and group III was 0.943, group II and group IV was 0.015, group III and group IV was 0.044. The P value is statistically significant in comparison with group I and group III, group I and IV, group II and group IV, group III and group IV. (Table 6)The maximum breadth of ramus of the mandible (left) of males in each group were compared with each other group and was found that P value of group I and group II is 1.000, group I and group III was 0.870, group I and group IV is 0.781, group II and group III is 0.882, group II and group IV is 0.766, group III and group IV is 0.351. The P value is not statistically significant in comparison with any group. (Table 7) The maximum breadth of ramus of the mandible (right) of males in each group were compared with each other group and found that p value of group I and group II is 0.999, group I and group III is 0.841, group I and group IV is 0.278, group II and group III is 0.783, group II and group IV is 0.328, group III and group IV is 0.068. The P value is not statistically significant in comparison with any group. (Table 8) The minimum breadth of ramus of the mandible (left) of males in each group were compared with each other group and found P value of group I and group II is 0.991, group I and group III is 0.807, group I and group IV is 0.988, group II and group III is 0.930, group II and group IV is 0.926, group III and group IV is 0.62. The P value is not statistically significant in comparison with any group. (Table 9) The minimum breadth of ramus of the mandible (right) of males in each group were compared with each other group and found that p value of group I and group II is 1.000, group I and group III is 0.558, group I and group IV is 0.979, group II and group III is 0.570, group II and group IV is 0.981, group III and group IV is 0.786. The P value is not statistically significant in comparison with any group. (Table 10).

The height of the coronoid (left) of males in each group were compared with each other group and its found that P value of group I and group II is 0.003, group I and group III is <0.001, group I and group IV is <0.001, group II and group III is 0.006, group II and group IV is <0.001, group III and group IV is 0.001. The P value is statistically significant in comparison with group I and group II, group I and group III, group I and IV, group II and group III, group II and group IV, group III and group IV. (Table 11) The height of the coronoid (right) of males in each group were compared with each other group and its found that p value of group I and group II is 0.003, group I and group III is <0.001, group I and group IV is <0.001, group II and group III is 0.067, group II and group IV is <0.001, group III and group IV is 0.001. The P value is statistically significant in comparison with group I and group II, group I and group III, group I and IV, group II and group IV, group III and group IV. (Table 12) The Mental index (left) of females in each group were compared with each other group and its found that P value of group I and group II is 0.057, group I and group III is 0.011, group I and group IV is <0.001, group II and group III is 0.834, group II and group IV is 0.002, group III and group IV is 0.013. The p value is statistically significant in comparison with group I and group III group I and IV, group II and group IV, group III and group IV. (Table 13) The Mental index (right) of females in each group were compared with each other group and its found that p value of group I and group II is 0.268, group I and group III is 0.061, group I and group IV is <0.001, group II and group III is 0.803, group II and group IV is 0.008, group III and group IV is 0.048. The P value is statistically significant in comparison with group I and IV, group II and group IV, group III and group IV. (Table 14) The maximum breadth of the ramus of the mandible (left) of females in each group were compared with each other group and its found that p value of group I and group II is 0.204, group I and group III is 0.001, group I and group IV is <0.001, group II and group III is 0.064, group II and group IV is 0.001, group III and group IV is 0.130. The P value is statistically significant in comparison with group I and III, group I and group IV, group II and group IV. (Table 15) The maximum breadth of the ramus of the mandible (right) of females in each group were compared with each other group and its found that p value of group I and group II is 0.012, group I and group III is 0.001, group I and group IV is <0.001, group II and group III is 0.606, group II and group IV is 0.015, group III and group IV is 0.159. The p value is statistically significant in comparison with group I and II, group I and group III, group 1 and group IV, group II and group IV. (Table 16) The minimum breadth of the ramus of the mandible (left) of females in each group were compared with each other group and its found that p value of group I and group II is 0.014, group I and group III is 0.016, group I and group IV is 0.002, group II and group III is 1.000, group II and group IV is 0.708, group III and group IV is 0.669. The p value is statistically significant in comparison with group I and II, group I and group III, group 1 and group IV. (Table 17) The minimum breadth of the ramus of the mandible (right) of females in each group were compared with each other group and its found that p value of group I and group II is 0.002, group I and group III is 0.025, group I and group IV is 0.001, group II and group III is 0.670, group II and group IV is 0.902, group III and group IV is 0.298. The p value is statistically significant in comparison with group I and II, group I and group III, group 1 and group IV, group II and group IV. (Table 18) The height of the coronoid (left) of females in each group were compared with each other group and

its found that p value of group I and group II is <0.001, group I and group III is <0.001, group I and group IV is <0.001, group II and group III is <0.001, group II and group IV is <0.001, group III and group IV is 0.001. The p value is statistically significant in comparison with group I and II, group I and group III, group 1 and group IV, group II and group III, group II and group IV, group III and group IV. (Table 19)

The height of the coronoid (right) of females in each group were compared with each other group and its found that P value of group I and group II is <0.001, group I and group III is <0.001, group I and group IV is <0.001, group II and group III is <0.001, group II and group IV is <0.001, group III and group IV is <0.001. The P value is statistically significant in comparison with group I and II, group I and group III, group 1 and group IV, group II and group III, group II and group IV, group III and group IV (Table 20).

Table 1: group 1 (21-30yrs) the comparison of the mean value of all the 4 parameters (left and right side) of both male and female and the respective p values

	Sex		
	Male	Female	
Group I	Mean	Mean	P value
Mental Index - Left	6.22 ±.21	5.51±.34	0.004**
Mental Index - Right	6.14±.20	5.29±.16	<0.001**
Maximum Breadth - Left	41.60±4.24	41.93±1.21	0.0871
Maximum Breadth - Right	41.01±3.08	42.04±1.76	0.531
Minimum Breadth – Left	35.14±3.17	37.62±2.81	0.227
Minimum Breadth - Right	34.51±2.87	37.05±2.14	0.154
Coronoid - Left	79.76±1.60	70.85±.74	<o.oo1**
Coronoid - Right	79.97±1.27	71.04±.39	<o.oo1**

Table 2: group 2 (31-40yrs) comparison of the mean value of all the 4 parameters (left and right side) of both male and female and the respective p values

	Sex		
	Male	Female	
Group II	Mean	Mean	P value
Mental Index - Left	5.64±.76	4.87±.44	0.087
Mental Index - Right	5.39±.83	4.83±.27	0.184
Maximum Breadth - Left	41.65±2.25	39.73±1.39	0.143
Maximum Breadth - Right	40.82±2.51	38.54±1.85	0.140
Minimum Breadth - Left	35.65±2.48	32.35±.82	0.022*
Minimum Breadth - Right	34.54±1.71	31.71±1.60	0.027*
Coronoid - Left	76.83±1.05	65.73±.86	<0.001**
Coronoid - Right	76.99±.87	66.57±1.13	<0.001**

Table 3: group 3 (41-50yrs) comparison of the mean value of all the 4 parameters (left and right side) of both male and female and the respective p values

	Sex		
	Male	Female	
Group III	Mean	Mean	P value
Mental Index - Left	5.26±.44	4.68±.36	0.050*
Mental Index - Right	5.23±.32	4.60±.63	0.081*
Maximum Breadth - Left	42.90±2.21	36.83±1.90	0.002**
Maximum Breadth - Right	42.33±2.54	37.31±.91	0.003**
Minimum Breadth - Left	36.70±2.94	32.45±2.81	0.048*
Minimum Breadth - Right	36.72±3.12	33.11±1.64	0.050*
Coronoid – Left	74.14±.65	63.09±1.02	<0.001**
Coronoid – Right	74.36±.67	63.32±1.06	<0.001**

Table 4: group 4 (51-60yrs) comparison of the mean value of all the 4 parameters (left and right side) of both male and female and the respective p values

Group IV	Sex		P value
	Male	Female	
	Mean SD	Mean SD	
Mental Index - Left	4.57±.32	3.86±.30	0.007**
Mental Index - Right	4.34±.28	3.88±.37	0.050*
Maximum Breadth - Left	40.00±.94	34.35±2.07	0.001**
Maximum Breadth - Right	38.01±1.82	35.12±1.52	0.026*
Minimum Breadth - Left	34.58±2.31	30.74±2.44	0.034*
Minimum Breadth - Right	35.16±2.58	30.87±2.27	0.023*
Coronoid - Left	70.92±.79	60.59±.48	<0.001**
Coronoid - Right	69.65±2.57	60.55±.67	<0.001**

Table 5: Multiple comparison of mental index (left) of males of each group with each other groups

Dependent Variable	Group	Group multiple comparison	Sig.
Male Mental Index – Left	Group I	Group II	.261
		Group III	.029*
		Group IV	<0.001**
	Group II	Group I	.261
		Group III	.619
		Group IV	.014*
	Group III	Group I	.029*
		Group II	.619
		Group IV	.142
	Group IV	Group I	<0.001**
		Group II	.014*
		Group III	.142

Table 6: Multiple comparison of mental index (right) of males of each group with each other groups

Dependent Variable	Group	Group multiple comparison	Sig.
Males Mental Index - Right	Group I	Group II	.101
		Group III	.035*
		Group IV	<0.001**
	Group II	Group I	.101
		Group III	.943
		Group IV	.015*
	Group III	Group I	.035*
		Group II	.943
		Group IV	.044*
	Group IV	Group I	<0.001**
		Group II	.015*
		Group III	.044*

Table 7: Multiple comparison of maximum breadth of the ramus of the mandible (left) of males of each group with each other groups

Dependent Variable	Groups	Groups multiple comparison	Sig.
Males Maximum Breadth - Left	Group I	Group II	1.000
		Group III	.870
		Group IV	.781
	Group II	Group I	1.000
		Group III	.882
		Group IV	.766
	Group III	Group I	.870
		Group II	.882
		Group IV	.351
	Group IV	Group I	.781
		Group II	.766
		Group III	.351

Table 8: Multiple comparison of maximum breadth of the ramus of the mandible (right) of males of each group with each other groups

Dependent Variable	Groups	Groups multiple comparison	Sig.
Males Maximum Breadth - Right	Group I	Group II	.999
		Group III	.841
		Group IV	.278
	Group II	Group I	.999
		Group III	.783
		Group IV	.328
	Group III	Group I	.841
		Group II	.783
		Group IV	.068
	Group IV	Group I	.278
		Group II	.328
		Group III	.068

Table 9: Multiple comparison of minimum breadth of the ramus of the mandible (left) of males of each group with each other groups

Dependent Variable	Groups	Groups multiple comparison	Sig.
Males Minimum Breadth - Left	Group I	Group II	.991
		Group III	.807
		Group IV	.988
	Group II	Group I	.991
		Group III	.930
		Group IV	.926
	Group III	Group I	.807
		Group II	.930
		Group IV	.624
	Group IV	Group I	.988
		Group II	.926
		Group III	.624

Table 10: Multiple comparison of minimum breadth of the ramus of the mandible (right) of males of each group with each other groups

Dependent Variable	Groups	Groups multiple comparison	Sig.
Males Minimum Breadth - Right	Group I	Group II	1.000
		Group III	.558
		Group IV	.979
	Group II	Group I	1.000
		Group III	.570
		Group IV	.981
	Group III	Group I	.558
		Group II	.570
		Group IV	.786
	Group IV	Group I	.979
		Group II	.981
		Group III	.786

Table 11: Multiple comparison of height of the coronoid (left) of males of each group with each other groups

Dependent Variable	Groups	Groups multiple comparison	Sig.
Males Coronoid - Left	Group I	Group II	.003**
		Group III	<0.001**
		Group IV	<0.001**
	Group II	Group I	.003**
		Group III	.006**
		Group IV	<0.001**
	Group III	Group I	<0.001**
		Group II	.006**
		Group IV	.001**
	Group IV	Group I	<0.001**
		Group II	<0.001**
		Group III	.001**

Table 12: Multiple comparison of height of the coronoid (right) of males of each group with each other groups

Dependent Variable	Groups	Groups multiple comparison	Sig.
Males Coronoid - Right	Group I	Group II	.033*
		Group III	<0.001**
		Group IV	<0.001**
	Group II	Group I	.033*
		Group III	.067
		Group IV	<0.001**
	Group III	Group I	<0.001**
		Group II	.067
		Group IV	.001**
	Group IV	Group I	<0.001**
		Group II	<0.001**
		Group III	.001**

Table 13: Multiple comparison of mental index (left) of females of each group with each other groups

Dependent Variable	Group	Group multiple comparison	Sig.
Females Mental Index - Left	Group I	Group II	.057
		Group III	.011*
		Group IV	<0.001**
	Group II	Group I	.057
		Group III	.834
		Group IV	.002**
	Group III	Group I	.011*
		Group II	.834
		Group IV	.013*
	Group IV	Group I	<0.001**
		Group II	.002**
		Group III	.013*

Table 14: Multiple comparison of mental index (right) of females of each group with each other groups

Dependent Variable	Group	Group multiple comparison	Sig.
Females Mental Index - Right	Group I	Group II	.286
		Group III	.061
		Group IV	<0.001**
	Group II	Group I	.286
		Group III	.803
		Group IV	.008**
	Group III	Group I	.061
		Group II	.803
		Group IV	.048*
	Group IV	Group I	<0.001**
		Group II	.008*
		Group III	.048*

Table 15: Multiple comparison of maximum breadth of the ramus of the mandible (left) of females of each group with each other groups

Dependent Variable	Groups	Group multiple comparison	Sig.
Females Maximum Breadth - Left	Group I	Group II	.204
		Group III	.001**
		Group IV	<0.001**
	Group II	Group I	.204
		Group III	.064
		Group IV	.001**
	Group III	Group I	.001**
		Group II	.064
		Group IV	.130
	Group IV	Group I	<0.001**
		Group II	.001**
		Group III	.130

Table 16: Multiple comparison of maximum breadth of the ramus of the mandible (right) of females of each group with each other groups

Dependent Variable	Groups	Group multiple comparison	Sig.
Females Maximum Breadth - Right	Group I	Group II	.012*
		Group III	.001**
		Group IV	<0.001**
	Group II	Group I	.012*
		Group III	.606
		Group IV	.015*
	Group III	Group I	.001**
		Group II	.606
		Group IV	.159
	Group IV	Group I	<0.001**
		Group II	.015*
		Group III	.159

Table 17: Multiple comparison of minimum breadth of the ramus of the mandible (left) of females of each group with each other groups

Dependent Variable	Groups	Group multiple comparison	Sig.
Females Minimum Breadth - Left	Group I	Group II	.014*
		Group III	.016*
		Group IV	.002**
	Group II	Group I	.014*
		Group III	1.000
		Group IV	.708
	Group III	Group I	.016*
		Group II	1.000
		Group IV	.669
	Group IV	Group I	.002**
		Group II	.708
		Group III	.669

Table 18: Multiple comparison of minimum breadth of the ramus of the mandible (right) of females of each group with each other groups

Dependent Variable	Groups	Group multiple comparison	Sig
Females Minimum Breadth - Right	Group I	Group II	.002**
		Group III	.025*
		Group IV	.001**
	Group II	Group I	.002**
		Group III	.670
		Group IV	.902
	Group III	Group I	.025*
		Group II	.670
		Group IV	.298
	Group IV	Group I	.001**
		Group II	.902
		Group III	.298

Table 19: Multiple comparison of height of the coronoid (left) of females of each group with each other groups

Dependent Variable	Groups	Group multiple comparison	Sig.
Females Coronoid - Left	Group I	Group II	<0.001**
		Group III	<0.001**
		Group IV	<0.001**
	Group II	Group I	<0.001**
		Group III	<0.001**
		Group IV	<0.001**
	Group III	Group I	<0.001**
		Group II	<0.001**
		Group IV	.001**
	Group IV	Group I	<0.001**
		Group II	<0.001**
		Group III	.001**

Table 20: Multiple comparison of height of the coronoid (right) of females of each group with each other groups

Dependent Variable	Groups	Group multiple comparison	Sig.
Females Coronoid - Right	Group I	Group II	<0.001**
		Group III	<0.001**
		Group IV	<0.001**
	Group II	Group I	<0.001**
		Group III	<0.001**
		Group IV	<0.001**
	Group III	Group I	<0.001**
		Group II	<0.001**
		Group IV	.001**
	Group IV	Group I	<0.001**
		Group II	<0.001**
		Group III	.001**

DISCUSSION

Age and sex determination plays an extremely important role in identification of an individual. Determination of age and sex are mutually dependent. According to the sex of an individual the age can be identified and according to age the sex[25]. A forensic odontologist can play a role in the identification of sex and age[21] using facial bones especially mandible, which is considered to be a stronger bone[6, 30]. Mandible shows sexual dimorphism, is a durable bone for identification, as it's made of dense compact bones. The size of the mandible, its strength and angulation has been found to be influenced by muscles of mastication and the masticatory force[31].

In the present study it has been observed that there is high significance between male and females of group I (21-30yrs) in reference to the mental index in both the right and left side and similar high significant difference has been noted between male and female of group IV (51-60yrs). But with no significant difference between male and females of group II (31-40) and less significance in group III (41-50), which is in correlation with the studies conducted by Ragdhaa A Mostafa et al [35] whose study concluded mental index showed high significant sexual dimorphism.The group II (31-40yrs) did not show any significant difference because the third decade of life both male and female undergo minimal physiological changes in the bone in comparison with the other age groups where second decade the growth continues and during the fourth and fifth decade the female undergo hormonal changes causing changes in the bone. In regards to the maximum breadth of ramus of the mandible in both the right and left side, no significant difference between male and female have been observed in group I (21-30yrs) and group II (31-40yrs). And a high significant difference is observed between male and female of group III (41-50yrs) and group IV (51-60yrs), which is in correlation with study conducted by Giles [31], Vinnetha Saini et al [6] who concluded that maximum breadth of ramus of mandible yielded significant difference between male and female because of the difference seen between the sexes in realtion to remodelling of bone. The significance difference between male and female on both right and left side, group I (21-30yrs) group II (31-40yrs) did not show significance may be due to smaller sample size.

In the present study comparing the minimum breadth of ramus of the mandible in both the right and left side between male and female yielded no significant difference in group I (21-30yrs),] and a less significance is observed in group II (31-40yrs), group III (41-50yrs), group IV (51-60yrs) which are not in correlation with study conducted Annamalai Ponnuswamy Indira et al [31], they concluded that minimum breadth of ramus of mandible is highly significant in determining the sex of an individual. The above obtained result may be due to the smaller sample size in the present study. The height of coroniod in both right and left side between male and female in relation to group I (21-30yrs), group II (31-40yrs), group III (41-50yrs) and group IV (51-60yrs) yielded high significant difference which is in correlation with the study conducted by Vineetha Saini et al [6] concluding that the height of the coronid to be the best parameter with 74.1% accuracy in determining the sex, The present study concluded that the height of the coronoid showed difference between sexes irrespective of age groups. In the present study while comparing the different age groups it was noticed group I (21-30yrs) and group IV (51-60yrs) showed highly significant results in regards to mental index in both right and left of males, which was in correlation with the studies conducted[35, 3737]. The studies concluded there was general decrease in value of mental index seen in male as age progressed. It has been observed that the comparison between group I (21-30yrs) and group III (41-50yrs), group II (31-40yrs) and group IV (51-60yrs)

showed a less significant value. The present study is not in correlation with the study done by Ledgerton et al [36] where the mental index showed no significant correlation in respect to age within males. The immediate age groups did not show any significance when compared with each other, making it noticeable that when a decade is skipped the bone showed changes making the value significant. In relation to the comparison of maximum breadth of ramus of the mandible between all the four age groups [group I (21-30yrs), group II (31-40yrs), group III (41-50yrs) and group IV (51-60yrs)], the present study yielded no significant result in male regardless of the right and left side. No similar study has been conducted. The obtained results may due to the smaller sample size In relation to the comparison of maximum breadth of ramus of the mandible between all the four age groups [group I (21-30yrs), group II (31-40yrs), group III (41-50yrs) and group IV (51-60yrs)], the present study yielded no significant result in male regardless of the right and left side. No similar study has been conducted. The obtained results may due to the smaller sample size. Comparison of the height of the coronid in male irrespective of right and left side yielded highly significant results in between all the four age groups [group I (21-30yrs), group II (31-40yrs), group III (41-50yrs) and group IV (51-60yrs)], No similar study has been conducted. The result obtained in the present study may be due to remodelling of bone, muscle attatchment to the coroniod and angle of the mandible with the addition of change in the height of the coronoid from childhood to old age.

In the present study while comparing the different age groups it was noticed group I (21-30yrs) and group IV (51-60yrs) showed highly significant results in regards to mental index in both right and left of females, which was in correlation with the studies conducted [37]. In their studies they have concluded that the mental index in female decreases as the age progressed. It has been observed that the comparison between group I (21-30yrs) and group III (41-50yrs), group II (31-40yrs) and group IV (51-60yrs), group III (41-50yrs) and group IV (51-60yrs) showed a less significant value. The present study is not in correlation with the study done by Ledgerton et al [37] where the mental index showed no significant correlation in respect to age within females. The immediate age groups did not show any significance when compared with each other, making it noticeable that when a decade is skipped the bone showed changes making the value significant. But the Group III (41-50yrs) and group IV (51-60yrs) inspite of being the immediate group showed significance because of high resorptive activity in older age groups. In the present study the maximum breadth of the ramus of the mandible was measured in females and the result yielded highly significant difference between group I (21-30yrs) and group IV (51-60yrs), group I (21-30yrs) and group III (41-50yrs) and group II (31-40yrs) and group IV (51-60yrs), which is in contrast with the male counterpart may be due to increased hormone related bone changes happening in female as the age advances. No similar study has been conducted. The comparison of minimum breadth of ramus of mandible among females, group I (21-30yrs) and group IV (51-60yrs) yielded highly significant results in the present study in both the left and right side,. It has been observed that the comparison between group I (21-30yrs) and group II (31-40yrs), group I (21-30yrs) and group III (41-50yrs) showed a less significant value. No similar study has been conducted. Comparison of the height of the coronid in female irrespective of right and left side yielded highly significant results in between all the four age groups [group I (21-30yrs), group II (31-40yrs), group III (41-50yrs) and group IV (51-60yrs)]. No similar study has been conducted. The result obtained in the present study may be due to remodelling of bone caused by increased hormonal changes, muscle attatchment to the coroniod and angle of the mandible with the addition of change in the height of the coronoid from childhood to old age.

CONCLUSION

This is a pioneer study, as previously no studies have been reported in the literature in use of maximum breadth of ramus of the mandible, minimum breadth of ramus of the mandible and height of the coronoid in age determination both in male and female. In the present study, it was noticed that the mental index and height of the coronoid indices showed less values in female when compared to male. The maximum and the minimum breadth of the mandible indices did not contribute much in determining the sex of an individual. In regards to age determination in males and in females, in the present study it was noticed that all 4 indices showed gradual decreases in size as age progressed.

The present study which has been conducted to evaluate various radiomorphometric indices in digital dental panoramic radiograph in order to identify possible interrelationships between indices and sex and age of the patient analysed the results concluded that coronoid height and the mental index can be used effectively in identification of both age and sex. Whereas maximum and minimum breadth of ramus of the mandible can be used for sex determination only in older age group and for the age determination can be used only for females. Considering the small sample size used in this present study, the study with large proportion of samples may be necessary to confirm the results of our study conclusively.

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