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Studies on Human Mandibles

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Abstract: *Identification of human skeletal remains is a critical problem and is very important in medicolegal and anthropological work. The determination of sex of an individual is important and necessary both in the living and the dead for medico legal purpose. It is particularly essential when only skeletal remains are available. In the living and the dead, in fresh conditions. Difficulty arises when sex is to be decided based on a few skeletal remains. Good number of human mandibles was collected from the burial grounds in and around Tirupati. They were sorted out and intact adult normal mandibles were selected for the present work.For each mandible accurate measurements were taken for 22 variables namely, (1) Symphyseal height, (2) Coronoid height, (3) Minimum breadth of ramus, (4) Maximum breadth of ramus, (5) Height of ramus – right, (6) Height of ramus – left, (7) Body height, (8) Body thickness, (9) Body length,(10) Bigonial dimeter, (11) Bicondylar diameter, (12) Bimental breadth, (13) Mandibular angle, (14) Length of lowe jaw, (15) Interincisor width, (16) Interprmolar width, (17) Intermolar width, (18) Arch length, (19) Anthropometric arch length, (20) Anthropometric arch width, (21) Bicornoid width and (22) Mandibular index.The measurements were compared to the values of known sex to distinguish the sex of mandible.*

Keywords: *Mandible, Symphyseal height, coronoid height, Bigonial diameter, Bicondylar diameter, Mandibular angle*

I. Introduction

The mandible is a latin word which means lower jaw. Mandere means to chew. Thus the word mandible is derived.The mandible is the largest, strongest and lowest bone in the face. This is only bone in the skull (with the exception of tympanic ossicles) that is capable of separate movement. Mandible is formed to carry the lower teeth opposing those of upper jaw, gives insertion to the muscles of mastication and origin to muscles of tongue, floor of the mouth and some muscles of facial expression.Identification of human skeletal remains is a critical problem and is very important in medicolegal and anthropological work. The determination of sex of an individual is important and necessary both in the living and the dead for medico legal purpose. It is particularly essential when only skeletal remains are available. In the living and the dead, in fresh conditions. difficulty arises when sex is to be decided based on a few skeletal remains. The reconstruction of man's part after death would be impossible without bones. Bones often survive the process of decay and therefore provide the major evidence of human age and sex after death. The teeth and craniofacial skeleton are best preserved parts of human remains. The mandible is the strongest bone of facial skeleton and the best preserved after death. In mass disaster like air crashes, wars, railway accidents, floods etc., it is the medicolegal job to work with unknown variable to describe the skeletal remains and provide identification. By sex determination, the job of identification would be reduced to half.Sex can be more accurately determined after attainment of puberly. The sex differences are well marked in the bony pelvis and skull. An accurate determination of sex can be done in over 90 percent of cases using only pelvis and skull (Krogman, 1962, Modi, 1977,Ref.19,24). Sex determination from a given bone of an individual is of great value for medical jurist who often gives expert opinion from the available skeletal remains. Skull is the most easily sexed portion of skeleton next to pelvis. As a component of the skull, mandible shares the character. The study of identification of sex for a single bone is not only important medicolegally but anthropologically. If the mandible alone is available besides sex, age and race also can be determined. Mandible, maxilla and teeth are best preserved parts of the body after death. The mandible has been extensively studied (Martin 1936, Morant 1936, Clever 1937, Hrdlicka 1940, Stewart 1954, Hanihara 1959, Giles 1964,Ref.23,25,7.15,32,13,12). Their work was based on biometric study, mathematical methods, parameters like symphyseal height, gonial angle, bigonial breadth and discriminant function analysis etc. In India, Heereshchandra and Malaviya (1972Ref.14,15) studied subjective signs of mandible taking into account that chin is squarer in male and round in female. They also studied angle of mandible. Diwan (1987Ref.9), Fakruddin (1987Ref.9) and Shroff (1987,Ref.9) studied using discriminant function scores (Rajagopal Reddy, 1978,Ref.28).

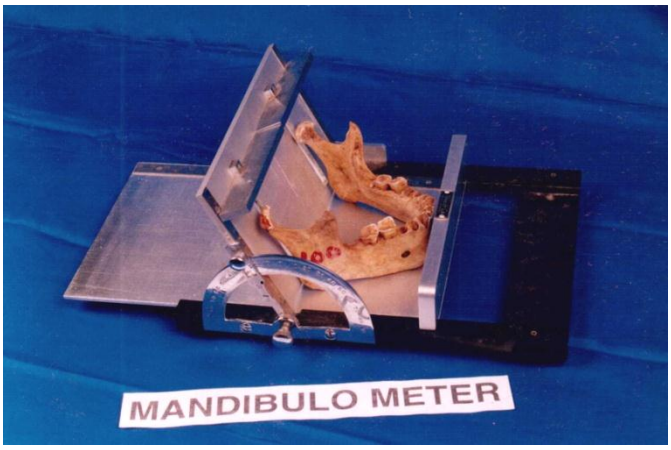
II. Materials And Methods

The material used for the study contained 88 human mandibles of unknown sex obtained from different grave yards in Tirupati town and from the Departmental pool. The bones collected are free from any pathological lesions or fractures. Totally edentulous mandibles with absorbed alveolar margins were excluded from this study. The bones collected roughly belong to the age group of18 to 60 years.

The following parameters were taken with Metal sliding calliper , Mandibulometer(fig.1) measured on mandible in order to determine the sex. 1.Symphyseal height, 2.Coronoid height,3.Minimum breadth of ramus, 4.Maximumbreadth of ramus, 5.Height of ramus – right, 6.Height of ramus – left,7.Body height,8.Body thickness,9.Body length,10.Bigonial diameter,11.Bicondylar diameter,12.Bimental breadth, 13.]Mandibular angle,14.Length of lower jaw,15.Interincisor width,16.Interpremolar width,17.Intermolar width,18.Arch length,19.Anthropometric arch length,20.Anthropometric arch width,21.Bicoronoid width22.Mandibular indexThe data collected is statistically analyzed, subjected to Factor analysis and tabulated.

The data collected on the 22 characteristics is possibly intercorrelated. There could be significant interrelationships among these variables. In order to identify certain latent factors that could explain the variation in these characteristics, Factor analysis has been applied. This method is based on another statistical principle called principal components. The objective of Factor analysis is to identify as many factors as possible in such a way that they are uncorrelated (a sort of independence). The calculations are quite involved and the procedure also requires an in depth knowledge of statistical tools. This procedure is however available in a number of software packages and SPSS (Statistical Packages for Social Sciences) is one such software. This tool has been applied to the present data with the objective of identifying the principal components. The data on 88 cases has been analyzed in SPSS with the following options.Extraction of factors by principal components. Factors whose Eigenvalue is < 1.0 are not considered (table – 5)Correlation matrix among the variables (table - 4)Rotation of factors by Varimax method. This portion of analysis ensures that the extracted factors are almost independent.Rearrangement of factors by the size of their loadings.

Figure. 1



III. Discussion

Dry human mandibles of unknown sex were collected in large number from different grave yards in the around Tirupati and from the departmental pool. By eliminating pathologically misfit mandibles, 88 numbers fit for the present work were selected. Each mandible was carefully measured for 22 parameters already described in Materials and Methods. The data thus obtained is tabulated (table – 1). An attempt is made to identify the mandibles of either sex by measuring various parameters and by comparing the data with the data of known sex.

The symphyseal height varies from 23 mm to 40 mm with a mean value of 29.6 mm (table – 2). When this compared to the range of the known sex, 44 mandibles out of 88 could be identified as belonging to male and 37 to female while 7 remain undecided (table – 3). However, when other parameters are taken into consideration the significance of symphyseal height deciding the sex decrease. Higher mandibular symphyseal height in male has been reported earlier (Mallik, 1969, Surendranath, 1989REF.22,33). This is in correlation with the present observation.

When coronoid height of all the mandibles under investigation is measured it ranges from 48 mm to 71 mm with a mean value of 59 mm. with the help of this parameter out of 88 mandibles 52 could be designated as belonging to male and 36 to female. In males there is well developed coronoid process (Brothwell, 1981,Ref.2). Minimum breadth of the ramus ranges from 23 mm to 36 mm with a mean value of 30.5 mm. With the help of this parameter, out of 88 mandibles 55 could be said to be male, 28 to be female and 5 remain undecided. Maximum breadth of ramus ranges from 28mm to 47 mm with a mean value of 39 mm by which 44 could be

regarded as male, 40 as female and 4 undecided. It is stated earlier that in white races the mandible shows higher and narrower ramus while in the black races the ramus is lower, wider and more vertical (Shultz, 1933Ref.31). There was greater breadth of the ascending ramus compared to 15 female mandibles (Mallik, 1969). Male mandibles will have broader and longer ascending ramus (Brothwell 1981, Surendranath 1989,Ref.2,33). The ramus was more vertical in males than females (Prakash and Abdi, 1987,Ref.27). In this connection it is interesting to note that the mandibles that are regarded as belonging to male in the present study show that the maximum and minimum breadth of ramus are in correlation with the earlier findings. The height of the ramus is measured on right and left sides for all the mandibles. Right side mean value shows slight higher value by 3 mm than left side. This difference may be due to the difference in the chewing habit of the individual. This needs further investigation since there were no such observations in the past.

Body height of the mandible ranges from 18mm to 33mm with a mean value of 26.5mm. By this parameter alone 71 can be said to be male, 14 to be female and 3 remain undecided. Body thickness ranges from 11mm to 18mm with mean value of 14.6 mm by which 81 belong to male,6 female and 1 undecided. Body length ranges from 60mm to 85mm with a mean value of 75mm by which 21 belong to male, 61 to female and 6 undecided. The body height, length and thickness though facilitating to sex the mandibles at higher percentage, this is regard as an insignificant factor in the known sex (seshaiah, 1992,Ref.30).

Bigonial diameter ranges from 80 mm 112 mm with a mean value of 92 mm by which 55 mandibles are said to be male and 33 to be female. The bigonial diameter is influenced by the eversion or inversion of gonial angle. Eversion of gonial angle is characteristic of male and inversion is that of female (lockhart, 1965,Ref.21). In the present study,55 mandibles have shown higher biogonial diameter and hence they are regarded as belonging to male and the rest female.

Bicondylar diameter ranges from 91 mm to 126 mm with a mean value of 110mm by which 46 mandibles can be said to be male,37to be female and 5 undecided. It is stated that sharp tubercles on the medial and lateral aspects of anterior surfaces of mandibular condyles are stress indicators (krogman,1962,Ref.19). Mandibular condyles were smaller in females (Tedeshi,1977,Ref,34). In the present study those mandibles that are designated as belonging to females showed smaller condyles resulting in lesser diameters. This is in accordance with the findings of Tedeshi, 1977. However the difference in the bicondylar diameter of male and female mandibles were reported to be insignificant. Bimental breadth from 37 mm to 50 mm with a mean value of 43 mm by which 52 mandibles can be said to be male and 36 to be female. This parameter was reported to be significant.

Mandibular angle ranges from 104^0 to 137^0 with a mean value 123^0 by which 62 mandibles have greater and everted gonial angle (Shultz, 1933,Ref.31). Eversion of angle is characteristic of male and inversion in that of female (Lockhart, 1965,Ref.21). It was concluded that round chin mandible with inversion or eversion can not be a female one oand 59.26 percent of accuracy in sex determination is possible with mandible (Heereshchandra and Malaviya, 1972,Ref.14,15). Male mandibles will have well developed and flaring gonial regions (Brothwell, 1981,Ref.2). Mean value of mandibular angle was more in females-118.6^0, females 123.0^0 (prakash and Abdi, 1987,Ref.27) In males the lateral aspsect of the angle of the mandible shows rough or rigid appearance. In females the angle of the jaw is often more rounded and gracile in construction. The attachment surface of the masseter muscle is often much smoother (Whittaker, D.K.and Mcdonald,1989,Ref.36). In the present study. Those that are considered as females presented with higher mandibular angle and males with lower mandibular angle. These findings are in agreement with the findings of Prakash and Abdi,1987,Ref.27).

Inter incisor width ranges from 13 mm to 20 mm with mean value of 16 mm by which 48 mandibles belong to male and 40 to female. Inter premolar width ranges from 28 mm to 40 mm with mean value of 34 mm by which 65 mandibles can be said to be male and 23 to be female. Intermolar width ranges from 39 mm to 53 mm with a mean value of 44 mm by which 67 mandibles can be said to be male and 21 to be female. Though the mandibles are sexed based on the above parameters they were considered as insignificant in the earlier studies. However, these parameters are taken into account for the purpose of factor analysis.

Arch length ranges from 34 mm to 5o mm with mean value of 42 mm by which 86 mandibles shows male measurements and 2 females. In the known sex the difference between the male and female is insignificant and hence in the present study almost all are falling into one category. It has been stated that the dental arch forms appear to be strongly influenced by genetic factors, although environmental factors are more important (Christopher-L.B.Lavelle,1977,Ref.5). Anthropometric arch length ranges from 48 mm to 64 mm with a mean value of 42 mm by which 31 mandibles can be grouped as males and 57 as females. In the known sex the difference between the male and female of anthropometric arch width is said to be a significant parameter.

Bicoronoid width ranges from 70 mm to 107 mm with a mean value of 92 mm by which 49 mandibles can be grouped as males and 39 as females. Though the difference between male and female is considered as insignificant in the earlier studies, a clear difference is observed in the present study.

The values of the two parameters, namely length of lower jaw and mandibular index in the present study totally differ from the values of the mandibles of known sex. Therefore, these two parameters were not applied to identify the sex of the mandible with reference to known sex and they are taken into consideration for factor analysis.

The foregoing account reveals that every parameter independent of other parameters contributes certain percent of certainty to decide the sex of mandible of unknown sex. This percentage of certainty tilts when considered in the light of the percentage of other parameters. Therefore, it is clear that based on no single parameter, sex of the mandible can not be decided. All the parameters have to be considered together and for this purpose Factor analysis is resorted to. Thus 6 factors have been extracted and they could explain 75.2 percent of total variation in the data from all variables. The factors are shown in the table-5. Subject to the limitations of the sample data, 6 dominating characteristics that could possibly explain the nature of mandibles are Height of the ramus – right,Body thickness,Anthropometric arch width,Inter incisor width,Mandibular index,Mandibular angleThese six variables are identified by selecting the first variable in each factor. In the present study the 88 mandibles of unknown sex by carefully studying all the 22 parameters with reference to known values of either sex and by subjecting the data to Factor analysis it is known that with 75 percent certainty one can sex the mandible.

Table-1. Anthropometric data of different parameters of human mandibles (in mm)

61	29	67	34	42	71	71	26	14	70	88	107	43	120	58	18	35	44	45	58	44	90	54.20
62	34	63	32	41	63	58	27	16	78	100	112	44	128	65	19	39	50	48	64	48	95	58.03
63	29	55	24	36	61	55	26	15	68	85	96	40	130	55	17	30	40	41	55	37	83	57.29
64	28	48	25	31	51	48	24	14	74	87	96	46	130	63	20	40	46	43	62	44	92	65.62
65	31	64	29	39	67	64	27	14	69	86	116	41	119	58	14	30	40	42	52	40	94	50.00
66	24	51	33	39	58	54	24	15	78	88	108	40	129	65	15	34	46	40	55	44	83	60.18
67	33	60	32	42	69	69	30	15	80	94	122	48	114	64	16	32	41	42	57	40	98	52.45
68	28	61	30	42	60	56	27	14	71	87	123	41	122	61	16	34	46	39	54	44	95	49.59
69	26	59	30	42	60	60	28	14	78	101	114	45	130	67	18	36	43	44	53	45	95	58.77
70	32	56	29	36	66	65	24	13	65	107	124	40	126	55	18	33	53	45	56	52	103	44.35
71	26	60	32	40	68	68	30	16	78	91	107	44	116	66	17	34	47	43	53	45	89	61.68
72	30	64	34	39	60	60	24	15	81	99	112	44	120	69	17	35	50	43	57	47	98	61.60
73	32	51	29	35	58	58	26	14	72	86	109	43	135	60	16	33	41	46	57	40	89	55.04
74	29	57	28	38	56	56	27	12	73	82	105	42	124	63	17	33	41	34	49	39	84	60.00
75	24	53	29	34	60	58	24	16	69	92	114	48	125	57	16	34	43	42	55	42	92	50.00
76	24	51	27	33	53	53	23	14	70	94	112	42	127	70	14	36	47	43	56	45	93	62.50
77	31	54	32	33	56	52	26	14	73	84	106	42	123	59	17	32	42	42	57	40	83	55.66
78	27	65	31	41	67	69	26	14	77	87	109	44	113	65	18	33	44	41	56	42	92	59.63
79	29	62	30	41	63	54	27	13	77	100	112	46	120	65	15	35	48	45	58	47	90	58.03
80	40	64	36	46	70	68	32	16	80	97	121	46	120	63	16	34	40	44	59	40	100	52.06
81	28	67	30	36	64	62	25	14	78	97	111	43	118	63	19	34	48	45	55	46	102	56.75
82	35	65	28	38	70	70	28	13	74	90	120	43	124	62	15	33	44	45	58	43	107	51.66
83	35	64	32	46	74	71	27	14	80	94	116	42	119	68	17	33	43	47	57	42	90	58.62
84	32	60	30	40	69	64	30	15	82	100	122	42	134	68	19	36	47	50	64	46	103	55.73
85	25	60	31	41	58	56	28	13	79	88	106	43	119	67	16	33	44	40	52	43	93	63.20
86	31	65	30	39	63	60	27	12	75	90	110	46	120	63	19	40	49	47	57	48	96	57.27
87	28	59	33	40	57	57	25	16	80	89	105	40	118	68	16	37	42	45	60	40	87	64.76
88	33	62	30	41	68	65	26	13	75	98	118	46	115	63	16	36	49	47	60	45	100	53.38

* Mandibular angle measured in degrees

Table-2. Descriptive Statistics

S.No.	Name of the variable	Range		Mean	Standard Deviation
		Minimum	Maximum		
1	Symphyseal height	23.00	40.00	29.63	3.51
2	Coronoid height	48.00	71.00	59.37	5.03
3	Minimum breadth of ramus	23.00	36.00	30.50	2.73
4	Maximum breadth of ramus	28.00	47.00	39.21	3.42
5	Height of ramus – right	51.00	76.00	62.92	5.30
6	Height of ramus – left	48.00	76.00	61.05	5.72
7	Body height	18.00	33.00	26.55	2.68
8	Body thickness	11.00	18.00	14.60	1.35
9	Body length	60.00	85.00	75.31	4.83
10	Bigonial diameter	80.00	112.00	92.22	6.37
11	Bicondylar diameter	91.00	126.00	110.32	6.52
12	Bimental breadth	37.00	50.00	43.19	2.76
13	Mandibular angle	104.00*	137.00*	122.55*	67.83*
14	Length of lower jaw	50.00	74.00	63.98	4.78
15	Inter incisor width	13.00	20.00	15.89	1.68
16	Inter premolar width	28.00	40.00	33.75	2.36
17	Inter molar width	39.00	53.00	44.35	2.76
18	Arch length	34.00	50.00	42.40	2.82
19	Anthropometric arch length	48.00	64.00	56.21	2.94
20	Anthropometric arch width	34.00	52.00	42.39	2.99
21	Bicoronoid width	70.00	107.00	91.97	5.69
22	Mandibular index	44.35	67.59	58.13	4.75

N = 88;
Measurements in mm
* measured in degrees

Table-3. Sexing of the mandible by individual parameters

S.No.	Name of the parameter	Male	Female	Undecided	Total
1	Symphyseal height	44	37	7	88
2	Coronoid height	52	36	--	88
3	Minimum breadth of ramus	55	28	5	88
4	Maximum breadth of ramus	44	40	4	88
5	Height of ramus – right	82	6	--	88
6	Height of ramus – left	77	11	--	88
7	Body height	71	14	3	88
8	Body thickness	81	6	1	88
9	Body length	21	61	6	88
10	Bigonial diameter	55	33	--	88
11	Bicondylar diameter	46	37	5	88
12	Bimental breadth	52	36	--	88
13	Mandibular angle	62	26	--	88
14	Inter incisor width	48	40	--	88
15	Inter premolar width	65	23	--	88
16	Intermolar width	67	21	--	88
17	Arch length	86	2	--	88
18	Anthropometric arch length	42	47	--	88
19	Anthropometric arch width	31	57	--	88
20	Bicoronoid width	49	39	--	88

Table-4. Factor analysis - correlation matrix

SYHT	CORHT	MIBR	MXBR	HTRR	HTRL	B HT	B TH	B LE	BIG D	BIC D	BI M B	M ANG	LLJ	IIW	IPW	IMW	AL	AAL	AAW	BIC W	MI
1.000	0.271	0.199	0.336	0.343	0.272	0.529	0.037	0.162	0.230	0.217	0.157	0.152	0.017	0.103	-0.060	-0.135	0.265	0.418	-0.192	0.199	-0.137
0.271	1.000	0.389	0.600	0.713	0.709	0.465	0.110	0.410	0.422	0.444	0.262	-0.428	0.315	0.205	0.199	0.179	0.248	0.195	0.249	0.411	-0.037
0.199	0.389	1.000	0.668	0.356	0.343	0.457	0.536	0.649	0.348	0.400	0.384	-0.367	0.476	0.006	0.069	-0.008	0.261	0.279	-0.020	0.088	0.134
0.336	0.600	0.668	1.000	0.515	0.496	0.541	0.298	0.580	0.470	0.533	0.340	-0.127	0.428	0.106	0.094	0.072	0.208	0.278	0.074	0.129	-0.005
0.343	0.713	0.356	0.515	1.000	0.907	0.541	0.183	0.357	0.457	0.415	0.207	-0.334	0.232	0.056	0.078	0.062	0.307	0.276	0.191	0.267	-0.085
0.272	0.709	0.343	0.496	0.907	1.000	0.491	0.241	0.343	0.401	0.437	0.191	-0.352	0.251	0.096	0.076	0.035	0.267	0.210	0.163	0.300	-0.084
0.529	0.465	0.457	0.541	0.541	0.491	1.000	0.314	0.437	0.369	0.352	0.333	-0.114	0.291	0.098	0.070	-0.155	0.187	0.311	-0.091	0.182	0.013
0.037	0.110	0.536	0.298	0.183	0.241	0.314	1.000	0.413	0.340	0.202	0.379	-0.110	0.285	-0.063	-0.003	-0.242	0.188	0.238	-0.236	0.027	0.115
0.162	0.410	0.649	0.580	0.357	0.343	0.437	0.413	1.000	0.373	0.317	0.394	-0.264	0.869	0.164	0.326	0.064	0.303	0.411	0.102	0.123	0.558
0.230	0.422	0.348	0.470	0.457	0.401	0.369	0.340	0.373	1.000	0.557	0.424	0.067	0.268	0.041	0.239	0.353	0.330	0.361	0.434	0.363	-0.156
0.217	0.444	0.400	0.533	0.415	0.437	0.352	0.202	0.317	0.557	1.000	0.251	-0.138	0.248	0.074	0.105	0.283	0.329	0.219	0.278	0.546	-0.484
0.157	0.262	0.384	0.340	0.207	0.191	0.333	0.379	0.394	0.424	0.251	1.000	-0.134	0.271	0.168	0.345	0.109	0.270	0.278	0.146	0.244	0.063
0.152	-0.428	-0.367	-0.127	-0.334	-0.352	-0.114	-0.110	0.264	0.067	-0.138	-0.134	1.000	-0.309	0.018	-0.082	-0.025	-0.070	-0.008	-0.053	-0.150	-0.182
0.017	0.315	0.476	0.428	0.232	0.251	0.291	0.285	0.869	0.268	0.248	0.271	-0.309	1.000	0.129	0.423	0.187	0.306	0.344	0.186	0.093	0.725
0.103	0.205	0.006	0.106	0.056	0.096	0.098	-0.063	0.164	0.041	0.074	0.168	0.018	0.129	1.000	0.468	0.266	0.410	0.352	0.272	0.348	0.065
-0.060	0.199	0.069	0.094	0.078	0.076	0.070	-0.003	0.326	0.239	0.105	0.345	-0.082	0.423	0.468	1.000	0.546	0.438	0.474	0.524	0.330	0.311
-0.135	0.179	-0.008	0.072	0.062	0.035	-0.155	-0.242	0.064	0.353	0.283	0.109	-0.025	0.187	0.266	0.546	1.000	0.283	0.179	0.831	0.351	-0.027
0.265	0.248	0.261	0.208	0.307	0.267	0.187	0.188	0.303	0.330	0.329	0.270	-0.070	0.306	0.410	0.438	0.283	1.000	0.598	0.333	0.454	0.047
0.418	0.195	0.279	0.278	0.276	0.210	0.311	0.238	0.411	0.361	0.219	0.278	-0.008	0.344	0.352	0.474	0.179	0.598	1.000	0.226	0.299	0.155
-0.192	0.249	-0.020	0.074	0.191	0.163	-0.091	-0.236	0.102	0.434	0.278	0.146	-0.053	0.186	0.272	0.524	0.831	0.333	0.226	1.000	0.395	-0.021
0.199	0.411	0.088	0.129	0.267	0.300	0.182	0.027	0.123	0.363	0.546	0.244	-0.150	0.093	0.348	0.330	0.351	0.454	0.299	0.395	1.000	-0.290
-0.137	-0.037	0.134	-0.005	-0.085	-0.084	0.013	0.115	0.558	-0.156	-0.484	0.063	-0.182	0.725	0.065	0.311	-0.027	0.047	0.155	-0.021	-0.290	1.000

Table-5. Factor Analysis - Extraction of Factors

Total Variance Explained						
	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.7681	30.7641	30.7641	6.7681	30.7641	30.7641
2	3.0081	13.6731	44.4373	3.0081	13.6731	44.4373
3	2.6052	11.8416	56.2789	2.6052	11.8416	56.2789
4	1.7155	7.7977	64.0766	1.7155	7.7977	64.0766
5	1.3942	6.3374	70.4139	1.3942	6.3374	70.4139
6	1.0573	4.8060	75.2199	1.0573	4.8060	75.2199
7	0.8273	3.7603	78.9802			
8	0.7918	3.5992	82.5794			
9	0.6453	2.9333	85.5127			
10	0.5896	2.6799	88.1926			
11	0.4217	1.9170	90.1096			
12	0.3769	1.7134	91.8230			
13	0.3653	1.6605	93.4835			
14	0.3098	1.4082	94.8916			
15	0.2729	1.2406	96.1322			
16	0.2459	1.1176	97.2499			
17	0.1940	0.8818	98.1317			
18	0.1479	0.6721	98.8038			
19	0.1112	0.5057	99.3095			
20	0.0892	0.4055	99.7150			
21	0.0612	0.2782	99.9932			
22	0.0015	0.0068	100.0000			

Factor1	Factor2	Factor3	Factor4	Factor5	Factor6
0.8974	0.0895	0.0595	0.1027	0.0063	-0.0338
0.8736	0.1098	0.0392	0.0994	-0.0146	-0.1318
0.8278	0.1156	0.1786	0.1529	0.0499	-0.1733
0.6270	0.3170	-0.2140	0.1518	0.1174	0.2996
0.6235	0.4708	0.1127	-0.0450	0.1926	0.2265
0.0366	**0.8006**	-0.2715	0.0385	0.0882	-0.0681
0.3764	**0.7049**	-0.0560	-0.0009	0.2602	-0.0759
0.0806	**0.6229**	0.0983	0.2886	0.0623	-0.0079
0.3663	**0.5256**	0.4897	0.0663	-0.0774	0.3191
0.4673	**0.5074**	0.3695	0.0842	-0.3437	0.0447
0.0982	-0.0674	**0.8917**	0.2341	0.0235	-0.0587
0.0041	-0.0585	**0.8913**	0.2133	0.0306	-0.0192
0.0392	-0.1013	0.1136	**0.7437**	0.0609	-0.0286
0.1617	0.2458	0.1622	**0.7293**	0.0235	0.0442
0.1627	0.2480	0.0510	**0.6798**	0.2113	0.3047
-0.0465	0.0660	0.4875	**0.6056**	0.3456	-0.0620
0.2719	0.1844	0.3222	**0.5574**	-0.3742	-0.1549
-0.1252	-0.0427	-0.0787	0.0793	**0.9488**	-0.1122
0.2316	0.3570	0.1993	0.1445	**0.7851**	-0.0851
0.3492	0.5134	0.0819	0.1501	**0.6735**	0.0164
-0.3828	-0.1098	0.0620	-0.0501	-0.1671	**0.7839**
0.4579	0.0340	-0.3031	0.3182	-0.0796	**0.6028**

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
Rotation converged in 9 iterations.

IV. Conclusion

For each mandible accurate measurements were taken for 22 variables namely, (1) Symphyseal height, (2) Coronoid height, (3) Minimum breadth of ramus, (4) Maximum breadth of ramus, (5) Height of ramus – right, (6) Height of ramus – left, (7) Body height, (8) Body thickness, (9) Body length,(10) Bigonial dimeter, (11) Bicondylar diameter, (12) Bimental breadth, (13) Mandibular angle, (14) Length of lowe jaw, (15) Interincisor width, (16) Interprmolar width, (17) Intermolar width, (18) Arch length, (19) Anthropometric arch length, (20) Anthropometric arch width, (21) Bicornoid width and (22) Mandibular index.The measurements were compared to the values of known sex to distinguish the sex of mandible. Every parameter, independent of other parameters provides certain percentage of certainity about the sex of mandible of unknown sex. This percentage of certainity significantly shifts when considered in combination with other parameters. Therefore, based only on one or two variables the sex of mandible cannot be decided. When all the variables are considered together and treated statistically, six factors have been extracted which could explain 75.2 percent of total variation in the data from all variables.Six dominating characters that possibly explain the nature of the mandible are (1) height of the ramus-right, (2) body thickness, (3) anthropometric arch width, (4) inter incisor width, (5) mandibular index and (6) mandibular angle.The present study reveals that mandibles of unknown gender can be sexed to the extent of 75 percent accuracy by carefully studying all the 22 parameters listed above and by statistically treating the data.

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