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Forensic value of mandibular anthropometry in gender and age estimation

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Abstract: Forensic identification, a very important tool for medical practice, has its bases mainly on the study of anthropometrical characters. In this study we have applied dental identification methods at the mandible level, the work material being represented by 80 dry mandible specimens from the charnel house of Constanța`s Central Memorial. We have applied the discriminate F2 function (we have chosen this function because it is applicable even on one half of the mandible - when the other half is missing, damaged or incomplete) for all 80 mandibles specimens. The results where centralized in several tables with the others measurements and submitted to a statistic study. The first step was to identify the gender. More then half of the female mandibles (52,2%) where edentulous, 32,6% an extended edentulous and only 15,2% were fully dentate. 65% of the males mandibles were fully dentate, 7,5% edentulous and 27,5% were extended edentulous. We have analyzed the data and conclude that applying the odontostomatological methods, a forensic specialist is able to identify certain characteristics of the individual such as gender and age working only with the under-jaw (or pieces of it).

Key words: mandible, forensic identification, gender and age estimation, statistic analysis

Forensic identification is a very important and necessary tool in medical practice and every document in the field of forensic medicine start with a person identification chapter (either is a live person or the remains – dead body or skeletal remains).

For the task of identification, a forensic specialist can use the anthropological characters of our species – characters that differentiate humans from others animals (ex. great apes have a series of skeletal similarities with ours) – group characters (species, race, age, sex); and it can also use the individual characters, characters that individualize a person (morphological characters – normal or pathologic, unique or rare by conformation, size or positions).

Material and Method

This study was realized using a number of 80 mandibles (dry specimens) from the charnel-house of Constanța`s Central Memorial. The mandibles were macroscopically analyzed and measured using Aesculap accuracy tools.

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We have realized the following measures:

1. The height of the mental symphysis – the direct distance from the infradentale point to the gnathion point (instrument – beam compass)
2. The height of the ascendant branch – direct distance between the highest point in the mandible condile and the gonion point (instrument – beam compass).
3. At the mental foramina level we have measured the height of the mandible body (the distance between the alveolar ridge and the lower border mandible), the distance between lower foramina and lower border mandible (infra mental foramina height) and the distance between superior mental foramina and the crest of alveolar ridge (supra mental foramina height). The measures were taken in the third and 4th quadrant (instruments: beam compass and square).

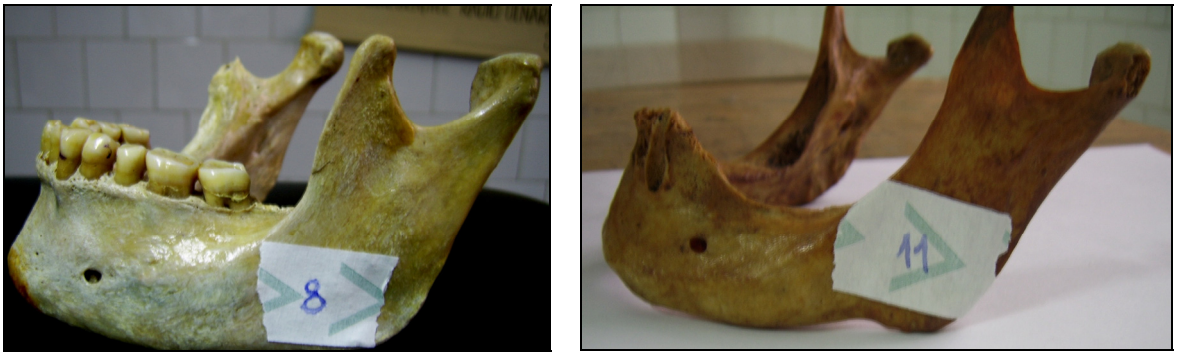

Fig. 1 A. Analized fully dentated mandible specimen**; B.** Analized extended edentulous mandible specimen

For gender identification of each of the analyzed mandible we used discriminate formulas (after Ionescu S., M. Yaşar Işcan, Panaitescu V) [1]

We have calculated the discriminate function F2 – function that is applicable even on a half of a mandible (in cases when the other half is missing or incomplete). For acquiring the function 2 measures were selected:

a) height of the mandible symphysis (HMS) and
b) height of the ascending brunch (HAB)

The discriminate formula for gender identification is:

Y(sex) = a+b1 x HMS +b2 x HAB

Y – result (score) of the discriminate function,
a – a constant,
b1 – nonstandard coefficient for HSM variable,
b2 – nonstandard coefficient for HRA variable

Example 1:

Y (sex) = -15.1464752 + 0.16569111 x 27 + 0.18474021 x 56 =
-15.1464752 + 4.47365997 +10.34545176 = **-0,32736347** (a value smaller than the section point, which indicates the ***feminine gender***)

Example 2:

Y (sex) = -15.1464752 + 0.16569111 x 30 + 0.18474021 x 62 =
-15.1464752 + 4.9707333 +11.45389302 = **1,27815112** (a value bigger than the section point, which indicates the ***masculine gender***)

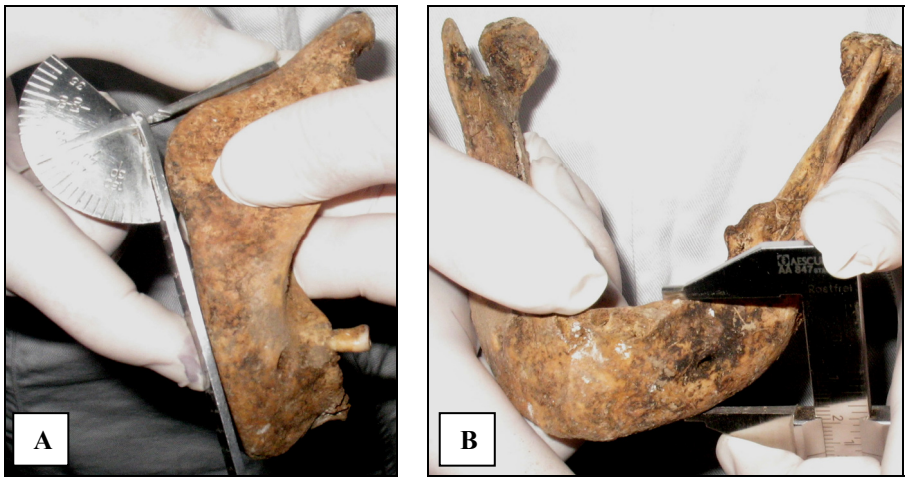

Fig. 2 Measures taken at mandible level: **A** Osteometrical standard measure at the mandible angle (mandible angle measuring instrument), **B** Measuring the total height of the mandible body – from the crest of the alveolar ridge to the lower border mandible (instrument: beam compass)

The formula was applied for all 80 dry mandible specimens, and the results were centra-lized in tables along with other measures. Then we have submitted the results to a statistical analysis.

Results

Table I Gender distribution of the analized mandibules

Case No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	F	M	F	F	F	F	F	M	M	F	M	M	M	F	M	F	M	M	M	F
Case No	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
	F	M	F	F	M	M	M	M	F	F	F	M	F	F	F	M	F	F	M	F
Case No	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
	F	F	F	M	M	M	M	F	F	F	F	F	F	F	M	F	M	M	F	M
Case No	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
	M	M	M	F	M	F	M	F	F	F	M	M	M	F	F	M	M	M	M	M

After analyzing the data obtained from the all 80 mandible, the gender distribution was: 44 mandible were identified to be feminine gender and 36 male gender.

Table II Data distribution according to the presence of teeth

Case No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	FD	FD	EE	EE	EE	E	EE	FD	FD	FD	EE	FD	FD	E	FD	FD	E	FD	FD	E
Case No	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
	E	FD	EE	EE	EE	E	FD	EE	EE	E	E	E	E	E	E	E	E	E	E	E
Case No	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
	E	E	E	FD	FD	FD	FD	FD	EE	EE	EE	EE	E	E	E	E	FD	FD	FD	FD
Case No	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
	FD	FD	FD	E	FD	FD	FD	EE	EE	E	FD	FD	FD	FD	EE	EE	E	E	E	E

* Dentition type: FD = fully dentate, EE = extended edentulous, E = edentulous

More than half of the female gender mandibles analyzed were edentulous 52,2%, in comparison with those with extended edentulous 32,6% and 15,2% fully dentate.

65% of the male gender mandible were fully dentate, 27,5% edentulous and only 7,5% were extended edentulous.

Fig. 3 Dentition type for female gender and male gender mandible

Analyzing all of the mandibles we conclude that higher frequency of edentulous and extended edentulous are characteristic to the female gender, edentulous type being encountered more often.

Table III Results distribution according to the position on the mental foramina

Case No	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
	2,7	3	2,6	2,8	2,1	1,8	2,8	3,1	2,9	2,5	3	3,1	3,2	1,5	3,1	2,8	3,5	2	2,2	2,2
Case No	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
	2,5	2,7	2,6	2,9	2,4	3,2	2,9	2,5	2,5	2,7	2,7	1,8	2,5	2,8	2,1	1,5	2,7	2,8	3,5	2
Case No	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
	2,2	2,2	2,5	3,2	3,1	3,2	3,4	2,8	2,6	2,9	2,8	2,5	2,5	2,6	1,7	2,5	3,4	3,1	2,8	3,2
Case No	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
	3,1	3	3,1	1,4	3,1	2,8	3,4	2,5	2,9	2,4	3,2	3,1	3,3	2,7	2,7	2,8	2,7	2,1	1,5	2,7

* All measures are made in mm

Analyzing the obtained results we observed a correlation between the position of the mental foramina and the gender. Masculine gender is characterized by a higher position of the mental foramina, unlike the feminine gender where the mental foramina is on a lower position.

Table IV The height of the bone substrate in quadrant III

Case No	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Dentition Type	D	D	EE	EE	EE	ET	EE	D	D	D	EE	D	D	ET	D	D	ET	D	D	ET
Total 3	2,9	2,6	2,6	2,2	2	1,5	2,5	3,4	2,7	2,7	2,6	2,3	3,2	1,5	3,2	2,6	3,5	2,2	1,9	1,4
Supra 3	1,75	1	1,1	1	0,7	0,3	0,9	1,8	1,2	1,3	1,3	1,1	1,4	0,3	1,8	1,1	1,2	1,1	0,8	0.0
Case No	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
Dentition Type	E	FD	EE	EE	EE	E	FD	EE	EE	E	E	E	E	E	E	E	E	E	E	E
Total 3	2,3	2,9	2,6	2,9	2,7	2	3,5	2,9	2,4	2,4	2,5	1,4	2,5	2,2	2	1,5	2,5	2,6	3,5	2,2
Supra 3	1	1,3	1,1	1,2	1,4	0,8	1,8	1,3	1	1	1,2	0,7	1,1	1	0,7	0,3	1,1	1,1	1,2	1,1
Case No	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
Dentition Type	E	E	E	FD	FD	FD	FD	FD	EE	EE	EE	EE	ET	E	E	E	FD	FD	FD	FD
Total 3	1,9	1,4	2,3	3,5	2,4	3,2	3,2	2,5	2,6	2,6	2,7	2,3	2,4	2,5	1,7	2,5	3,5	3,5	2,5	2,4
Supra 3	0,8	0.0	1	1,8	1,1	1,4	1,8	1,1	1,2	1,3	1,3	1	1	1,2	0,6	1,1	1,8	1,8	1,1	1,1
Case No	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
Dentition Type	FD	FD	FD	E	FD	FD	FD	EE	EE	E	FD	FD	FD	FD	EE	EE	E	E	E	E
Total 3	3,1	2,4	3,2	1,6	3,2	2,6	3,5	2,9	2,6	2,1	3,5	3,2	3,2	2,5	2,6	2,6	2,3	2,2	1,6	2,5
Supra 3	1,4	1,1	1,4	0,3	1,8	1,1	1,3	1,2	1,4	0,7	1,8	1,4	1,8	1,1	1,2	1,3	1	0,8	0,4	1,1

* All measures are made in mm

Total 3 – The total height of the bone substrate in quadrant III, at the mental foramina level, from the crest of the alveolar ridge to the lower border mandible

Supra 3 – The height of the bone substrate from the crest of the alveolar ridge to the superior margin of the mental foramina

Table V The height of the bone substrate in quandrant IV

Case No	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Dentition Type	D	D	EE	EE	EE	ET	EE	D	D	D	EE	D	D	ET	D	D	ET	D	D	ET
Total 4	2,7	2,9	2,7	2,7	2	1,8	2,5	3,2	-	-	2,1	2,8	3,3	1,3	2,9	2,6	3,5	2,5	2,2	1,5
Supra 4	1,3	1,3	1,1	1,3	0,4	0,6	1	1,5	-	-	0,6	1,1	1,5	0	1,5	1,2	2,1	1,2	1	0
Case No	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
Dentition Type	E	FD	EE	EE	EE	E	FD	EE	EE	E	E	E	E	E	E	E	E	E	E	E
Total 4	2,4	2,9	2,9	2,9	3	2,3	3	2,7	2,5	2,6	2,8	1,8	2,7	2,7	2	1,3	1,7	2,6	3,5	2,5
Supra 4	1,1	1,2	1,4	1,1	1,5	1	1,2	1,2	1,4	1	1,3	0,6	1,1	1,3	0,4	0	1,3	1,2	2,1	1,2
Case No	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
Dentition Type	E	E	E	FD	FD	FD	FD	FD	EE	EE	EE	EE	E	E	E	E	FD	FD	FD	FD
Total 4	2,2	1,5	2,4	3,2	2,8	3,3	2,9	2,5	2,6	3	2,7	2,3	2,5	2,7	1,7	2,6	3	2,9	2,7	2,7
Supra 4	1	0	1,1	1,5	1,1	1,5	1,5	1,2	1,1	1,5	1,2	1,3	1	1,3	0,5	1,1	1,2	1,5	1,3	1,1
Case No	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
Dentition Type	FD	FD	FD	E	FD	FD	FD	EE	EE	E	FD	FD	FD	FD	EE	EE	E	E	E	E
Total 4	3,2	2,7	3,2	1,4	2,9	2,6	3,4	2,8	3,1	2,3	3,1	3,3	2,9	2,5	2,6	3	2,7	2	1,3	1,7
Supra 4	1,5	1,1	1,5	0	1,5	1,2	2,1	1,1	1,5	1,1	1,2	1,5	1,5	1,2	1,3	1,5	1,3	0,4	0	1,3

* All measures are made in mm

Total 4 – The total height of the bone substrate in quadrant IV, at the mental foramina level, from the crest of the alveolar ridge to the lower border mandible

Supra 4 – The height of the bone substrate from the crest of the alveolar ridge to the superior margin of the mental foramina

The data presented in the tables IV and V can suggest that there is a correlation between the height measured from the crest of the alveolar ridge to the superior margin of the mental foramina and age determination. The data shows a decrease of the distance between those points correlated with the advanced age; and also a shorter distance is given by the dentition type (the lower values being encountered at edentulous mandibles). Those values are also lower in feminine gender.

A similar study realized by Balwant Rai [4] shows a correlation between those measures and the approximate age of the individual.

Table VI Various parameters correlated with the age groups (after Balwant Rai)

Parameters	**Sex**	**55-60 years**	**60-65 years**	**65-70 years**	**70-75 years**
Height of body of mandible	**M**	6.2 ± 1.3	6.1 ± 1.7	6.1 ± 1.8	6.1 ± 1.2
	F	5.3 ± 1.2	5.3 ± 1.2	5.2 ± 1.9	5.2 ± 1.4
Distance between the superior foramina to crest of alveolar ridge	**M**	1.9 ± 1.3	1.5 ± 1.2	1.4 ± 1.2	1.2 ± 1.6
	F	1.6 ± 1.2	1.3 ± 1.2	1.1 ± 1.1	0.7 ± 1.2
Distance between lower border mandible to superior margin of mental foramina	**M**	2.4 ± 1..8	2.3 ± 1.3	2.3 ± 1.5	2.3 ± 1.5
	F	2.3 ± 1.5	2.3 ± 1.4	2.2 ± 1.3	2.2 ± 1.7

* All measures are made in mm

Correlating our data with these values we had obtain the following age group:
55-65 years – 7 cases, 60-65 years – 9 cases, 65-70 years – 25 cases, 70-75 years – 39 cases.

Conclusions

After craniometrical measures at the mandible level, we can conclude:

1. Sex identification is possible using the discriminate F2 function
2. A higher frequency of edentulous and extended edentulous dentition types was encountered in female gender, edentulous type being more frequent. Regarding the medico-legal identification it is possible to correlate gender identification with the discriminate function F2 and the percentage of edentulous cases in feminine gender.
3. Age identification can be realized without accuracy (as a rough guide) analyzing the mandible dentition, and considering a series of factors which are incriminate to have an influence – way of life, food habits, various oral pathology – age identification cannot be accurate and our study did not found a possible formula between the dentition type and the age of the individual, but we can stipulate that in the edentulous mandibles with severe bone resorption cases the age of the person is above 55 years old.
4. The mental foramina – in new born is situated near the lower border mandible, in adults it is situated on the half way between the superior and lower border mandible and in elders it is near the crest of the alveolar ridge (after Beliş V.) [3]. The position of the mental foramina is an indicator of a person`s age, but in elder persons case the positioning of the mental foramina is also a result of bone resorption, the same position can also be found in young adults suffering from various oral pathologies. From the measures taken in this study regarding the position of the mental foramina we have obtain general information for gender identification, a function or a formula remains to be discovered.
5. The height measured from the crest of the alveolar ridge to the superior border mandible decreases with age, especially in the edentulous cases and in feminine gender.
6. A correlation can be established between the mental symphysis and gender determination

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