Original Article

Study of Mandibular Canines and Its Role in Establishing Sex Identity in Subjects of North Bihar

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ABSTRACT

Background: In highly decomposed and mutilated dead body remains dentures are frequently sent for the medicolegal examination by the forensic experts for identification. Dental tissues like bones resist putrefaction for much more longer period and these are in many cases available for examination due to its tough texture and ability to escape destruction. **Methods:** The present prospective study was done on 450 subjects (225 males and 225 females) of known age and sex, from different socio-economic strata and religion belonging to north region of Bihar state. Their age ranges vary from 14-73 years. The mandibular and maxillary canines of both sides were measured in both sexes. Various dimensions namely, mandibular and maxillary canine crown width, crown length and canine separation width were taken in each case with the help of dividers and vernier calipers with a resolution of 0.1mm. **Results:** In the present study, regarding mandibular canines in males, crown length showed the maximum accuracy (92.0%) of sex identity in the age group (E) 54-63 years and canine separation width showed the minimum accuracy of 40% in the age group (D) 44-53 years. In females, crown width showed the maximum accuracy of 83.33% in the age group (D) 44-53 years and minimum accuracy of 30% by crown length in the age group (F) 64-73 years. Regarding the maxillary canines, in males, the crown length showed the maximum accuracy (90%) of sex identity in the age group (D) 44-53 years and the minimum accuracy of 44% in the age group (A) 14-23 years. In females, both crown width and crown length showed the maximum accuracy of 96.66% in the age group (D) 44-53 years and minimum accuracy of 22% by crown width in the age group (B) 24-33 years. **Conclusion:** The present study revealed this method could be useful as a reliable tool for sex identity when use of other methods are not possible or there is no definite features indicating the sex as in cases when parts of decomposed and skeletonised dead bodies are recovered after a mass disaster or exhumation and also in cases when smaller fragmented part of the body is only available for examination.

Keywords: Mass Disasters, Mandibular canines, Sex identity, Crown width, Crown length, Canine Separation width.

INTRODUCTION

For the purpose of establishing the identity of unidentified and decomposed body remains, it is of primary importance to identify the sex of the individual. It is comparatively easy to determine sex in normal cases from external appearances and inspection of genitals but it is difficult in cases of highly decomposed, mutilated bodies and in skeletal remains. Examination of skeletal remains provides the clue to determine the sex in most of the cases. At times, even these remains are incomplete or fragmented thus not enough and dependable for determination of sex in the medico-legal cases which require utmost care and accuracy.

Sometimes bodies of the victims are intentionally dismembered by the criminals to conceal identity of deceased and to hide their crimes. In all such cases

and many others, only fragments of a single bone are often recovered from some places and made available by the investigating officer to the medico-legal experts for their opinion. After the fragments are identified to be human, identification of sex of such remains become the foremost task for the Forensic experts.

The teeth resist putrefaction more as skeletal remains which play important role in yielding information about the identity of such unfortunate individuals whose decomposed remains are discovered very late and then sent to the Forensic experts for examination.

In mass disasters such as aeroplane crashes, hurricanes, explosions, fire and railways accidents, very many times, only a part of the skeleton, like a portion of mandible or maxilla remains available for identification of the sex. Similarly difficulty arises in sexing the individual when only a few teeth are available for study.

Many observers have found definite landmarks for sex differentiation in the teeth and have claimed that

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sex differentiation may be done on the basis of study of teeth morphology.

Various experts emphasize that out of all teeth, canines are less affected by periodontal diseases, trauma and are the last teeth to fall out with respect to age. It is also claimed that the mandibular canines show greater sex difference in mesio-distal crown size and canine separation width as well as in form, position and development. The canines, therefore, are considered the "key teeth" for purpose of identification of sex.

It is interesting that the mandibular canine crown width alone has been found to be 88.8% accurate in determination of sex by some workers. Variations in the observations made by different workers in different countries from time to time have been reported and these have been attributed to the changes in the climatic, dietary, racial and other conditions of the subjects selected for each work. Very little work has been done on the canine teeth in this regard and it is essential to examine the importance of the canines in sex determination in our country. For this reason, the present work has been undertaken. The aim and object of the present worker is to know the sex from the human mandibular canines for establishing sex identity and also to compare these findings with those of maxillary canines. This may provide an important tool for sex determination in medico-legal cases met with not so infrequently.

MATERIALS AND METHODS

The present study has been undertaken in the Department of Forensic Medicine and Toxicology, Darbhanga medical college, Bihar. A total number of four hundred and fifty human volunteers of age group 14 to 73 years were studied. Out of which 225 were male and 225 were female. All volunteers of both sexes had well erupted, healthy and non-attritioned mandibular as well as maxillary canines. They were selected from the population of North Bihar (India) including those who attended the hospital as well as schools and colleges.

The different dimensions of mandibular and maxillary canine measured, are as follows-

1. The greatest mesio-distal crown width (AA' and aa') measured between the two contact points of the teeth.
2. The greatest crown- length (BB' and bb') measured from the tip of the tooth on biting edge to the mid-point of the cervical line of the tooth below.
3. The canine separation width or the canine arch-width (BC' and bc') measured between the tips of either side in the upper and lower jaws.

(Where AA', BB' and BC represent maxillary canine).

These above mentioned measurements were taken with the help of dividers and vernier calipers with a resolution of 0.1mm in both sexes. Vernier caliper was tested properly for zero error. Separate measurements for the right and left mandibular and maxillary canine dimensions were taken.

All the observations were recorded in separate case sheets utilising one such sheet for each case which also containing other details like name, age, dentition etc. of the case.

Further, records were tabulated for each age group (i.e. A-F ; 10 years for each group) and for either sex separately. The age range varied between 14 and 73 years for each sex.

After obtaining all the data required for the present study, a master chart was prepared and a common mean value (average mean value) for each of the parameter was derived statistically.
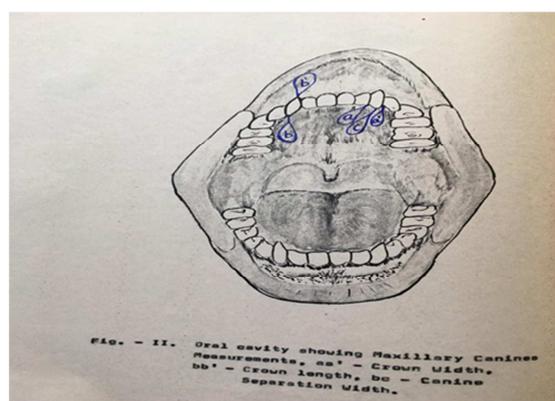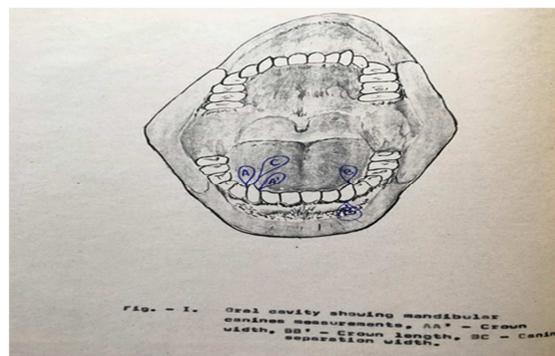
The common mean value for the mandibular and maxillary canines crown width, crown length and crown separation width were tabulated, processed, compared and utilising those value further observations were made and inference drawn.
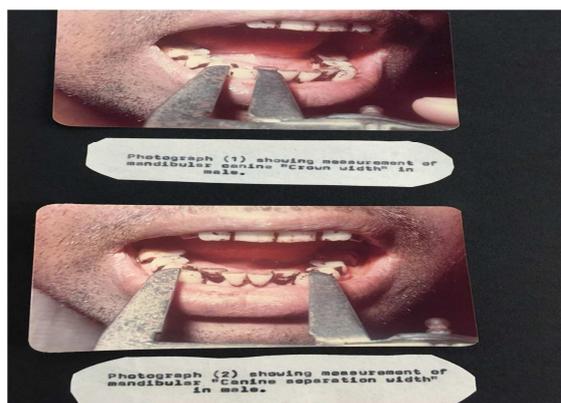
The formula adopted to obtain a common mean value for each of the parameter is as follows:

Common Mean Value = Maximum mean value (with S.D) in the female + Minimum mean value (with S.D) in the male / 2

Method of Statistical Analysis:

The Ranges, Mean Values, Standard Deviation and Common Mean Values of different measurements of mandibular and maxillary canines were worked out with the help of Casio-College Fx-100A scientific calculator. All the measurements were recorded casewise (in millimeters) and tabulated. The results were compared and calculated in both the sexes

Fig. – I. Oral cavity showing mandibular canines measurements. AA' – Crown width, BB' – Crown length, BC – Canine separation width.

Fig. – II. Oral cavity showing Maxillary Canines Measurements. aa' – Crown width, bb' – Crown length, bc – Canine Separation Width.

Photograph (1) showing measurement of mandibular canine "Crown width" in male.

Photograph (2) showing measurement of mandibular "Canine separation width" in male.

RESULTS

In the present study, the average mandibular canine crown width was 7.27 mm with S.D. 0.50 in males and 6.68 mm with S.D. 0.54 in females. The mean difference was 0.60 mm in between both sexes. The average maxillary canine crown was 8.33 mm with S.D. 0.58 in males and 7.92 mm with S.D. 0.59 in females. The mean difference was 0.41 mm in between the both sexes. The percent dimorphism was 8.9% for mandibular canine crown width, whereas maxillary canine crown width showed 5.1 percent dimorphism.

In males, the mandibular canine crown width varied between 7.18 - 7.36 mm with an average of 7.27 mm and S.D. 0.50. In females it varied between 6.54 - 6.82 mm. with an average of 6.68 mm and S.D. 0.54. The common mean value for crown width was derived 7.0 mm and on this basis sex assessment was done with an accuracy of 75.1% in females and 70.22% in males.

In males, the maxillary canine crown width showed a mean value of 8.33 mm ranging 8.05 - 8.69 mm with S.D. 0.58 and 7.92 with a range of 7.46 - 8.69 mm and S.D. 0.59 in females. It permitted 61.33% correct classification of sex in males and 60.44% in females.

The maxillary canine crown length varied between 9.98 - 11.44 mm with an average of 10.9 mm and S.D. 1.13 in males and 9.54 mm ranging 8.29 - 10.35 with S.D. 0.86 in females (mm) and showed 72.88%

correct classification in males and 62.22% in females.

The maxillary canine separation width, in males, varied between 35.23 - 36. 52 mm with an average of 35.53 and S.D. 2.32 and 34.76 mm, ranging 34.00 - 35.4 mm with S.D. 1.82 in females and showed 64.89% correct classification of sex in males and 44% in females.

The mandibular canine crown width showed the maximum accuracy i.e. 75.1% in establishing sex identity in females and the maxillary canine crown length showed maximum accuracy of i.e. 72.88% in males. The mandibular canine separation width showed the minimum accuracy of sex identity in both sexes i.e. 51.11% in males and 43.11% in females. In males, the maxillary canine separation width showed a higher accuracy of sex identity 64.89% in comparison to mandibular canine separation width 51.11% , whereas in females, it showed only a little difference (43.11% - 44.0%) in sex differences.

Mandibular canines, in males, crown length showed the maximum accuracy 92.0% of sex identity in the age group (E) 54-63 years and canine separation width showed the minimum accuracy of 40% in the age group (D) 44-53 years. In females, crown width showed the maximum accuracy of 83.33% in the age group (D) 44-53 years and minimum accuracy of 30% by crown length in the age group (F) 64-73 years.

Maxillary canines, in males, crown length showed the maximum accuracy 90% of sex identity in the age group (D) 44-53 years and the minimum accuracy of 44% in the age group (A) 14-23 years. In females, both crown width and crown length showed the maximum accuracy of 96.66% in the age group (D) 44-53 years and minimum accuracy of 22% by crown width in the age group (B) 24-33years.

Mandibular Canine crown width alone permits 72.66% correct identification of sex and seems to be a dependable tool in the hands of the Forensic Pathologists in matters of sex identity.

DISCUSSION

Table 1: Comparative study of male and female measurements of the mandibular and maxillary canines with other statistical data in the age group (A) 14-23 years (in mm.)

Sex (Total no. of cases)	Mandibular Canine Average crown width with S.D	Mandibular Canine Average crown length with S.D	Mandibular Canine Average separation width S.D	Maxillary Canine Average crown width with S.D	Maxillary Canine Average crown length with S.D	Maxillary Canine Average separation width S.D
Male (50)	7.29(0.54)	9.97(1.17)	27.1(2.3)	8.05(0.82)	10.2(1.3)	35.3(2.5)
Female(50)	6.82(0.65)	9.30(0.95)	26.0(2.39)	7.97(0.64)	9.5(0.96)	34.0(2.47)

Table 2: Comparative study of male and female average measurements of the mandibular and maxillary canines with other statistical data in the age group (B) 24-33 years (in mm.)

Sex (Total no. of cases)	Mandibular Canine	Mandibular Canine	Mandibular Canine	Maxillary Canine	Maxillary Canine	Maxillary Canine

	Average crown width (S.D)	Average crown length (S.D)	Average separation width (S.D)	Average crown width (S.D)	Average crown length (S.D)	Average separation width (S.D)
Male (50)	7.18(0.64)	9.91(1.08)	25.81(2.27)	8.23(0.51)	11.0(1.13)	34.5(3.4)
Female(50)	6.80(0.45)	9.78(0.61)	26.04(1.76)	8.69(0.62)	9.98(0.74)	35.23(1.78)

Table 3: Comparative study of male and female average measurements of the mandibular and maxillary canines with other statistical data in the age group (C) 34-43 years (in mm.)

Sex (Total no. of cases)	Mandibular Canine	Mandibular Canine	Mandibular Canine	Maxillary Canine	Maxillary Canine	Maxillary Canine
	Average crown width (S.D)	Average crown length (S.D)	Average separation width(S.D)	Average crown width (S.D)	Average crown length (S.D)	Average separation width (S.D)
Male (50)	7.27(0.48)	9.55(0.71)	25.26(1.55)	8.54(0.69)	11.09(1.2)	35.51(2.46)
Female(50)	6.66(0.55)	9.63(1.17)	25.3(1.59)	7.83(0.70)	10.21(1.10)	34..89(2.02)

Table 4: Comparative study of male and female average measurements of the mandibular and maxillary canines with other statistical data in the age group (D) 44-53 years (in mm.)

Sex (Total no. of cases)	Mandibular Canine	Mandibular Canine	Mandibular Canine	Maxillary Canine	Maxillary Canine	Maxillary Canine
	Average crown width (S.D)	Average crown length (S.D)	Average separation width(S.D)	Average crown width (S.D)	Average crown length (S.D)	Average separation width (S.D)
Male (30)	7.36 (0.40)	10.48(0.88)	25.20(1.49)	8.54(0.56)	11.44(0.95)	36.32(1.81)
Female(30)	6.54(0.40)	8.3(1.25)	24.76(1.27)	7.46(0.42)	8.29(0.65)	34..23(1.47)

Table 5: Comparative study of male and female average measurements of the mandibular and maxillary canines with other statistical data in the age group (E) 54-63 years (in mm.)

Sex (Total no. of cases)	Mandibular Canine	Mandibular Canine	Mandibular Canine	Maxillary Canine	Maxillary Canine	Maxillary Canine
	Average crown width (S.D)	Average crown length (S.D)	Average separation width(S.D)	Average crown width (S.D)	Average crown length (S.D)	Average separation width (S.D)
Male (25)	7.21(0.50)	10.20(0.56)	25.53(1.52)	8.24(0.40)	10.96(0.93)	35.59(1.99)

Table 6: Comparative study of male and female average measurements of the mandibular and maxillary canines with other statistical data in the age group (F) 64-73 years in (in mm.)

Sex (Total no. of cases)	Mandibular Canine	Mandibular Canine	Mandibular Canine	Maxillary Canine	Maxillary Canine	Maxillary Canine
	Average crown width (S.D)	Average crown length (S.D)	Average separation width(S.D)	Average crown width (S.D)	Average crown length (S.D)	Average separation width (S.D)
Male (20)	7.34(0.42)	10.16(0.74)	25.54(1.41)	8.37(0.47)	10.72(0.98)	35.72(1.73)
Female(20)	6.67(0.57)	9.65(1.31)	25.39(1.43)	8.06(0.77)	10.35(1.04)	35.4(1.93)

Table 7: Comparative study of various average measurements of the mandibular and maxillary canines in different age groups (A-F), ranging 14-73 years, in males (in mm.)

Sex (Total no. of cases)Male	Mandibular Canine	Mandibular Canine	Mandibular Canine	Maxillary Canine	Maxillary Canine	Maxillary Canine
	Average crown width (S.D)	Average crown length (S.D)	Average separation width(S.D)	Average crown width (S.D)	Average crown length (S.D)	Average separation width (S.D)
A - (50)	7.29(0.54)	9.97(1.17)	27.1(2.3)	8.05(0.82)	10.22(1.33)	35.3(2.57)
B - (50)	7.18(0.45)	9.78(0.61)	26.04(1.76)	8.69(0.62)	9.98(0.74)	35.23(1.78)
C - (50)	7.27(0.48)	9.55(0.71)	25.26(1.55)	8.54(0.69)	11.09(1.2)	35.51(2.46)
D - (30)	7.36(0.4)	10.48(0.89)	25.2(1.49)	8.54(0.56)	11.44(0.95)	36.52(1.81)
E - (25)	7.21(0.5)	10.2(0.56)	25.53(1.52)	8.24(0.4)	10.96(0.93)	35.59(1.99)
F - (20)	7.34(0.42)	10.16(0.74)	25.54(1.41)	8.37(0.47)	10.72(0.98)	35.72(1.73)

Table 8: Comparative study of various average measurements of the mandibular and maxillary canines in different age groups (A-F), ranging 14-73 years, in females (in mm.)

Sex (Total no. of cases) Female	Mandibular Canine	Mandibular Canine	Mandibular Canine	Maxillary Canine	Maxillary Canine	Maxillary Canine
	Average crown width (S.D)	Average crown length (S.D)	Average separation width(S.D)	Average crown width (S.D)	Average crown length (S.D)	Average separation width (S.D)
A - (50)	6.82(0.65)	9.3(0.95)	26.07(2.39)	7.97(0.64)	9.51(0.96)	34.0(2.47)
B - (50)	6.8(0.45)	9.78(0.61)	26.04(1.76)	8.69(0.62)	9.98(0.74)	35.23(1.78)
C - (50)	6.66(0.55)	9.63(1.17)	25.3(1.59)	7.83(0.70)	10.21(1.1)	34.89(2.02)
D - (30)	6.54(0.40)	8.3(1.25)	24.76(1.27)	7.46(0.42)	8.29(0.65)	34.23(1.47)
E - (25)	6.61(0.52)	8.72(1.38)	25.53(1.57)	7.5(0.44)	8.92(0.67)	34.88(1.28)
F - (20)	6.67(0.57)	9.65(1.31)	25.39(1.43)	8.06(0.77)	10.35(1.04)	35.4(1.93)

CONCLUSION

To conclude, the following facts and findings emerged after completion of this work.

1. The crown width, crown length and canine separation width of mandibular and maxillary canines in males are greater than those of females.

2. The common mean values of mandibular canine crown width upto 7.0 mm, crown length upto 9.7 mm and canine separation width upto 25.5 mm are suggestive of female sex, whereas all correspondence values above these limits are indicative of male sex.

3. The common mean value of maxillary canine crown width upto 8.1 mm, crown length upto 10.0 mm and canine separation width upto 34.8 mm are suggestive of female sex, whereas all correspondence values above these limits are indicative of male sex.

4. The mandibular canine crown width has been found to permit maximum percentage of accuracy in establishing sex identity in females.

5. In males, the maxillary canine crown length has been found to permit maximum percentage of accuracy in establishing sex identity.

To summarise, the facts and findings of the present work-

• The mean value of mandibular canine crown width for male is 7.27 mm ranging 7.18 - 7.36 mm with S.D. of 0.50.

• The mean value of mandibular canine crown width for female is 6.68 mm ranging 6.54 - 6.82 mm with S.D. of 0.54.

• The mean value of mandibular canine crown length for male is 10.04 mm ranging 9.55 - 10.48 mm with S.D. of 0.86.

• The mean value of mandibular canine crown length for female is 9.23 mm ranging 8.30 - 9.78 mm with S.D. of 1.11.

• The mean value of mandibular canine separation width for male is 25.63 mm ranging 25.2 - 27.1 mm with S.D. of 1.64.

• The mean value of mandibular canine separation width for female is 25.5 mm ranging 24.76 - 26.07 mm with S.D. of 1.68.

• The mean value of maxillary canine crown width for male is 8.33 mm ranging 8.05 - 8.69 mm with S.D. of 0.58.

• The mean value of maxillary canine crown width for female is 7.92 mm ranging 7.46 - 8.69 mm with S.D. of 0.59.

• The mean value of maxillary canine crown length for male is 10.9 mm ranging 9.98 - 11.44 mm with S.D. of 1.13.

• The mean value of maxillary canine crown length for female is 9.54 mm ranging 8.29 - 10.35 mm with S.D. of 0.86.

• The mean value of maxillary canine separation width for male is 35.53 mm ranging 35.23 - 36.52 mm with S.D. of 2.32.

• The mean value of maxillary canine separation width for female is 34.76 mm 34.0 - 35.4 mm with S.D. of 1.82.

• In mandibular canines, establishment of sex identity is more accurate when mesio-distal crown width is considered. Next in order of accuracy are crown length and canine separation width in both sexes.

• In cases of maxillary canines, establishment of sex identity is more accurate when crown length is considered. With crown width and canine separation width, the percentage of accuracy of sex identity is found more variable in both sexes.

This method could be useful as a new reliable tool for sex identity when use of other methods are not possible or there is no definite features indicating the sex as in cases when parts of decomposed and skeletonised dead bodies are recovered after a mass disaster or exhumation and also in cases when smaller fragmented part of the body is only available for examination.

REFERENCES

1. Anderson DL, Thompson GW. Inter-relationship and sex difference of dental and skeletal measurements, J. dental research, 1973; 52: 431-438.
2. Alvesalo L. The influence of sex chromosome genes on tooth size in man, suom. Hammalaak Toin, 1971: 67: 3-54
3. Alexander AC. A study of the distribution of supra and subgingival calculus, bacterial plaque and gingival inflammation of the mouth of 400 individuals, J. periodontal, 1971; 42:21-28
4. Barrett MJ, Brown T & Macdonald MR. Dental observations on Australian aborigines, Mesiodistal crown diameter of permanent teeth, Australian dent. J, 1963; 8: 150-56
5. Barrow GV, White JR. Developmental changes of the maxillary and mandibular dental arches. Angle orthod, 1952; 22: 41-46
6. Baume LJ. Physiology of tooth migration. J. dent. 1950; 29: 123-27
7. Baker & Newman. Book of anatomy. 1962
8. Bernard Knight. Text book of forensic medicine. 1966
9. Bailey & Love. Text book of surgery. 1984
10. Boyd's Textbook of pathology. 1970
11. Cattell P. The eruption and growth of the permanent teeth. J. dental research, 1928; 8: 279-287
12. Crooke H. A description of the body of man etc. 1615: P- 743. london
13. Diemarbroeck, Isbrandus DE. Anatome corporis humani. 1979: P-816: Geneva
14. Frezzeer. Textbook of osteology.1962.
15. Goose DH. Dental measurement. In: dental anthropology (Edited by Broth well DR) pergamon press, New york. 1963.
16. Gleister. Text book of forensic medicine. 1962
17. Hunter WS. The inheritance of mesiodistal tooth diameter in twins, Ph.D. Thesis, university of michigan, S.A. 1959.
18. Iordandis P. Ann. med. Leg. 1962; 42: 237
19. Krog HW. Permanent tooth morphology- A clinical study of cause of loss. JADA, 1958; 57: 670-75
20. Krogman WM. A guide to identification of human skeletal material, F.B.I, Law enforce, Bull .B.1939; 1-29
21. Levelle CLB, Foster TD. A cross sectional study into age changes of human dental arches; Arch. oral biology, 1967; 14: 71-86
22. Peterson KB, Kogon SL. Dental identification in woodbridge disaster. J. Can.Dent.1971; Assoc 37: 275-79

23. Rao NKG, Pai ML, Rao NN, Rao TSK. Mandibular canines in establishing sex identity. Vol 8, P. 5-12
24. Sopher IM. Forensic odontology in medicolegal investigation of death. Edited by Spitz WU and Fisher RS. (Charles CT, springfield Illinois, USA)1980; 72.
25. Sillman JH. Dimensional changes of the dental arches. Am. J. Orthod. 1964; 50: 824-838.
26. Stewart TD. Evaluation of evidence from the skeleton. 1954 P- 407-450.
27. Taylor's textbook of forensic medicine. 1962 (vol I & VOL II)