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Correlation study between changes in the symphyseal surface of pubic bone at autopsyand age of the individual to develop practical method for age estimation in Indian population

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ABSTRACT

Determination of age after 25 years becomes very difficult as all teeth will be erupted and ossification Centre of the bone will be fused till 25 years of the age. In all available bony changes, change in morphological surface of symphysis pubis is the most reliable between 20to 40 years of the age[1]. So we have done correlation study between changes in the symphyseal surface of pubic bone at autopsy and age of the individual in Indian population using Mckern- Stewart criteria for scoring.

Introduction

Identification is recognition of an individual by means of various physical features and biological parameters, which are unique to each individual. It may be complete (absolute) or incomplete (partial). Complete identification means the absolute fixation of individuality of person. Partial identification implies ascertainment of only some facts about the identity such as height, weight, sex etc., while other facts like name, age, and residence still not known.

Question of identification arises in every day medico-legal practice both in civil cases such as marriage, disputed sex, missing persons insurance claims, person and inheritance claims as well as in criminal cases such as persons accused of assault, rape, murder, absconding prisoners etc. The

methods of identification depend upon, available ante mortem records and the degree of preservation of body remains i.e. whether intact, decomposed, burned, fragmented, semi skeletonized or skeletonized.

Since the bones resists putrefaction and destruction by animals, skeletal remain contains an abundance of information, which can lead to the reliable determination of age, sex, race, stature of the individual.

Use of ossification centers and dentition for estimation of age is possible up to the age of about 25. After the age of 25 years, skeletal age can be assessed to within +/- 5 years by the state of cranial sutures, sternum and symphysial surface of pubic bone. Sutures tend to obliterate after mid-twenties onwards to told age but the process begins from within and shows wide individual variations.

In the available macroscopic methods the pubic symphysis is probably the best single parameter for determining age from adult population. Since pubic symphysis and its articular surfaces are well preserved by virtue of their anatomical position, the morphological changes can be easily studied even in highly decomposed and mutilated bodies for estimation of age.

It has been observed by various works that developmental and regressive changes of bones in the body are affected by various factors such as climatic, dietetic, hereditary, nutritional, sociological, racial, environmental and geographical etc. since most of these factors are different in different countries and also in different parts of India, no universal standard can be devised for estimation of age from bones. The same is true for pubic symphysis. It is therefore advisable to use figures of the particular region of India for example Delhi.

Data and observation made in western countries are not applicable to Indian population as changes in body with respect to age and development differs from place to place which is a well-established fact. As much data is not available for Indian population, the present study was undertaken. Delhi being a cosmopolitan city, study of its population has, therefore, included all important ethnic groups of the country. Anatomical characters of symphysis pubis and pubic bone had been studied for the above purpose.

Very few studieshave been conducted in this field in the city of Delhi, which has a heterogeneous community being a cosmopolitan city. The present study has been conducted to correlate between the age of the residents of Delhi andmeta- morphological changes in pubic symphysis to develop practical method for age estimation in Indian population.

Review of literature

Todd (1920) has made a substantial contribution in evaluating the role of pubic symphysis as an age indicator[2]. He called the symphyseal surface of pubis as a modified diaphyso-epiphyseal plane and expected it to show a metamorphosis as an ageing feature.

He evolved a system of assessing age from 10 stages of pubic metamorphosis.

In 1957, Mckern and Stewart worked on 450 pairs of pubic symphysis for estimation of age in males covering the age range (17-50 years)[3]. This study was based on Todd's scoring method but they selected three components, i.e. dorsal plateau, ventral rampart and symphyseal rim. Five development stages were described for each component.

Table 1. Mckern- Stewart scoring for all three components

Component I	Score	Component II	Score	Component III	Score
Dorsal margin Absent	0	Ventral Beveling Absent	0	Symphyseal rim Absent	0
Middle third	1	At superior extremity	1	Partial dorsal rim	1
Entire border	2	Extend inferiorly	2	Complete dorsal rim	2
Dorsal plateau Middle third	3	Ventral rampart Begins	3	Complete rim formation	3
Present Most of demiface	4	Extensive	4	Breakdown of rim begins	4
Complete	5	Complete	5	Rarefaction of symphyseal face	5

Mckern and Stewart noted that their system was more reliable for age period between 17 and 30 years. This method was easier and more accurate than the Todd's method because the scoring eliminated a subjective bias in interpretation of bone metamorphosis.

Glibert at al. in 1973 conducted studies on female pubic symphysis based on the formula of Mckern and Stewart[4]. This work was devoted to the development of a standard for aging female pubic symphysis for the age range 17-55 years.120 samples were collected from female individuals of known ages and parity. Besides, 60 more bones from Stewart collection were also studied. The age of samples ranged between 17 and 55 years. He established 3 components namely the dorsal demi-face, the ventral rampart and the symphyseal rim. Each component was further divided into six (0-5) stages of metamorphic change

It was observed that morphological development of females is different from that of males, and females are subject to trauma of child-birth. This may cause an individual female os pubis to appear older than it actually is. The dorsal surface of female symphysis was seen to undergo flattening at faster rate as compared to males. It was further noted that in females, the ventral (demiface) is beveled away from dorsal demiface whereas an imaginary line separated the two demi-faces in males.

They concluded that female of the same age may appear to be ten years younger based upon the ventral rampart and ten years older based upon the dorsal plateau.

Gllibert in 1973 carried out the comparison of age estimates of female pelvis obtained by the new female standard with those obtained by the male standard[5]. 15 females pelvis were aged by both the male standard and a newly developed female standard. It was found that the male standard significantly under aged females 40 years or older in the test sample, although it worked out very well for pubic between 17-40 years of age. The female standard, however, yielded results within useful limits in all age groups.

In 1979, J.M.Suchey carried out work to assess the reliability of the GllibertMckern method for aging the female os pubis[6]. He designed a study in which 23 forensic anthropologist were asked to

an age & set of 11 female pubis of known age. There was a great deal of variability in the responses of these 23 participants.

There, four and five different responses (out of a 6 scale system) were given for each component of each pubic bone. Only 51% of the assessment showed age ranges which included the known age of specimens. It was concluded that it is difficult for an observer to select the exact stage of development which is present in any of the three components using the Gllibert- Mckern method.Analysis of the errors showed that one of the main problems of the Gllibert-Mckern system was the difficulty in judging whether the ventral rampart was building up or breaking down. Same difficulty was experienced while assessing component III (the symphyseal rim).

A study by Gaurav Sharma`s demonstrated that various stages of symphysial rim were found at a later age in Indians as compared with American pubic bones examined by Mckern and Stewart[7]. This study confirms pubic symphysis as useful age indicator especially for adult male. There were no differences in the urban and rural populations to the metamorphic changes in the symphyseal surface of pubic bone.

MATERIALS AND METHODS

The study was conducted on 50 cases coming for medico-legal postmortem examination to the Department of Forensic medicine, Maulana Azad Medical College,New Delhi.

Study design

Descriptive cross-sectional study**.**

MATERIALS

Human pubic symphysis (body, part of superior ramus and part of inferior ramus of pubis) belonging to different known age groups and sexes had been used for the study .The specimens were collected from autopsies conducted by the Department of Forensic Medicine at MaulanaAzad Medical College New Delhi.

INCLUSION CRITERIA

1. The cases of known age coming for medico legal postmortem examination. Age was confirmed by

   documentary evidences.

2. Subjects above 12 years of age. According to existing literature changes in symphysial surface of pubic

   bone starts at 17 years of age, so we had taken 12 years of the age for baseline morphology of symphysial surface of pubic bone and to detect changes before 17 years of the age in our study population if any.

   EXCLUSION CRITERIA

   1. Unknown, unclaimed bodies.

   2. Cases showing fracture of limb, pelvic degenerative disease or fracture of pelvis.

   METHOD OF REMOVAL OF PUBIC SYMPHYSIS AT AUTOPSY:

The soft tissue in the suprapubicregion was displaced and cleared in order to have workable space. Soft tissue overlying pubic symphysis was retracted as far as possible. Electric bone cutting saw was used for cutting thebone. Two lateral cuts were made on the superior pubic rami about 2 inches from midlines, inferior pubic rami was cut in similar manner. Then soft tissue was separated and the specimen had been takenout from body. The specimens were further dissected to remove soft tissue without damaging underlying bone.

PROCESSING

The specimens were processed by chemical method. After proper tagging with patient's details, the specimens were placed in bath of antiformin (150 grams of sodium bicarbonate and 100 grams of bleaching powder with 1 litre of water mixed with 1 liter of 15% solution of sodium hydroxide) solution using sufficient solution to cover the specimens. For fresh tissue 1 part of antiformin to 8 to10 parts of water was used. The solution was heated just short of boiling and was maintained at this temperature. The specimens were examined from time to time to see how quickly it is being denuded. In most of the specimens additional method like burying in sand wereneeded to clean the soft tissue.

When the specimens were totally free of soft tissue then the symphyseal surface was studied for morphological changes using a hand lens. Age was precisely recorded from police records (inquest papers). The age was further verified from municipal corporation records, i.e. birth certificate, election card etc.

The Study materials were scored on the pattern as described by Mckern – Stewart.

STATISTICAL EVALUATION

We had used mean, standard deviation, and correlation test.

OBSERVATION AND RESULT

The present study comprises a total of 53 individuals in the age group of 12-75 years, residence of Delhi. All the individuals had never suffered from any disease or deformity affecting the bone during their life.

Table 2.

SCORE	MEAN AGE	S.D.
0	16.875	3.72
1	23	1.41
2	23.14	2.19
3	27.43	1.90
4	32.2	5.49
5	49.84	11.28

Table 3.

SCORE	MEAN AGE	S.D.
0	16.43	3.78
1	21.67	1.51
2	25	2.16
3	28.08	2.77
4	38.2	7.87
5	53.57	10.78

Table 4.

SCORE	MEAN AGE	S.D.
0	15.67	3.50
1	21.25	1.89
2	23.75	1.98
3	27	1.73
4	34.42	5.43
5	51.875	11

(Mean age and S.D. (Mean age and S.D. (Mean age and S.D.

for component-I) for component-II) for component-III)

Discussion

The dorsal margin begins at the mean age of 23 years in both sexes and it completes at the mean age of 23.14 years. Dorsal plateau[(figure 1, 2, 3, 4)] formation starts at the mean age of 27.43 years and it completes at the mean age of 49.84 years.



Fig. 1. 12 years, Pubic symphysis before any changes



Fig. 2. 25 Years, Dorsal plateau in upper third and ventral rampart formation in middle third and partial symphysial ring



Fig. 3. 30 Years, Dorsal plateau in upper two third, ventral rampart in upper third and partial symphyseal ring



Fig. 4. 53 years, Complete dorsal plateau, complete ventral rampart and rarefaction of symphyseal ring

Ventral bevelling appears late at the mean age of 21.25 years in both sexes and it completes at the mean age of of 23.75 years. Ventral rampart(figure 1, 2, 3, 4) formation starts at the mean age of 27 years and it completes at the mean age of 51.875 years. Symphysealrim(figure 1,2,34) formation appears early at the mean age of 21.67 years in both sexes and it completes at the mean age of 28.08 years. The rarefaction of symphysealrim starts at the mean age of 38.2 years.

CONCLUSION

1. Age can be estimated by the study of metamorphosis of os pubis based on Mckern-Stewart`s 3 component criteria to the accuracy of +/- S.D as mentioned in table 2,3 and 4.

1. For component I, II and III score-age correlation are 0.912, 0.932 and 0.95 respectively. Out of all three components, Component III is the most reliable for age

estimation.

1. Antiformin solution is not recommended for removal of soft tissue from the bone, as burial was needed in most of our specimens.

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