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Estimation of crown-heel length of foetuses from its clavicle length

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Abstract:

At the discovery of foetal bones, skeletal parts or individual bone; the investigating officer will ask the forensic medical expert's opinion about; whether bone or bones belongs to human or not? If human, what is the sex, stature, age, if possible the cause of death .If the foetal bones are discovered, the problem is particularly difficult in giving the opinion. In case of criminal abortion or dead foetuses from deep soil or from otherwise dismembered, the forensic medical expert is asked to determine the age, maturuty or immaturity of foetus to establish the viability at the time of birth. Previous experts proved that foetal age length can be measured with remarkable accuracy following a study of even with a single bone. The applicability of these methods are restricted to availability of extremities (limb long bones) bones. In this present study, the methods adopted by Dr. Gy Fazekas and Kosa were used to determine the crown heel length of foetus from clavicle measurement by applying regression equation derived in present. According to Dr.Fazekes and Koas (1965-67) examinations, there is a linear correlation between the body length and intra-uterine development and growth of bones of the foetus. On this basis, the body length, consequently the age can be measured. Earlier multiplication factors were taken to estimate the body length which proved to be rough method. To get more accurate results mathematical and statistical methods are employed with calculation of regression equation and relative numbers are established with the clavicles examined. The clavicles (which shows parallel growth with those of foetus in utero and are resistant to decay) were collected and measured in dry state with the help of callipers with a sliding scale upto an accuracy of 0.1m.m.The crown heel lengths in Cms of foetuses were estimated with reasonable accuracy by applying the regression equation obtained during present study and the regression formula arrived at, in the present study is found to be fit Visakhapattanam, Andhra Pradesh.

Key words: Crown-heel length, Clavicle, dead foetuses

Introduction:

Forensic Medicine experts are asked to examine and give the opinion on the collection of bones or single bone, whether human or not; stature, age; sex of that person. When foetal bones are discovered, the problem is particularly difficult. The experience of previous workers proves that the foetal age can be determined with quite remarkable accuracy following a study of even a single bone. In the case of Criminal abortion, when, foetus was cut into pieces and recovered from outside environment, buried in soil ,water, open air for long time, and the soft parts and cartilage are decayed already, the forensic expert is asked to determine the age, maturity or immaturity of foetus to establish the viability at the time of birth. Some previous workers presented a method of calculation by means of certain formulae (Langer-1872 [1], Balthazard and Dervieux-1921 [2], Oliver and Pineau 1958 [3]) which on the basis of measurements of long bones enable the approximate determination of the age of the foetus [4]. The applicability of these methods is restricted to availability of extremities bones. It is therefore necessary to develop a method by which precise determination of foetal age could be made on the basis of bones other than those of extremities.

The relative numbers of Balthazard and Dervieux [2] were for a long time the only starting point for the determination of stature and age of the foetus on the basis of bone measurements. According to Fazekas and Kosa [5] (1965-67) examinations,

there is a linear correlation between the body length and intra-uterine development and growth of the bones of the foetus. On this basis, body length and consequently the age of the foetus can be measured from bones that show parallel growth with those of the foetus in Utero and resistant to decay. For this purpose long bones ulna, radius, femur, tibia, fibula and mandible, clavicle are appeared to be suitable. There were precise data on the measurement of foetal skeleton in the different periods of intra- uterine development. Foetal bones that have not been studied in detail and in a large sample series, may also happened to be the interest in the present study. With this purpose in mind the present study is conducted on foetal clavicle to estimate the length of and there by the age of foetuses. The clavicle is the first bone of the skeleton to ossify. Its mesenchymal primordium connected with the acromial process of the shoulder blade becomes longer towards midline, and around the middle of second lunar month, it reaches the sternal end and fuses with it. Around 6th-7th week of i.u growth, a peculiar precartilagenous centre arises in the interior of the clavicular blastoma from which the body of clavicle develops by dermal ossification. At the articular ends, secondary cartilages appear which ossify gradually. In the 3rd lunar month, the ossification of the clavicle is completed. At this stage, the clavicle can be prepared by the method elaborated below .The clavicle is well recognizable in 3rd lunar month old of foetal skeleton.

In this study an effort has been put in practice the methods adopted by Dr. Fazekas and Kosa to determine the body length of foetuses form clavicle measurements [5-16].

Earlier, multiplication factors were taken to estimate the body lengths which proved to be only a rough method. To get more accurate results, mathematical and statistical methods are employed with calculation of regression equation and relative numbers are established with clavicles of Indian origin (Visakhapattanam Andhra Pradesh).

Materials and Methods:

The examinations were performed on 50 human foetuses out of which 25 male and 25 female, deriving from different periods of pregnancy from 6th lunar month to 10th lunar months, body lengths ranged from 30cms to 53 cms. The crown heel length was measured after straightening of lower extremities and trunk without traction. Exact determination of body length was done to avoid inaccuracy in determining the relationship between bone measurements and body lengths. This was done by keeping two wooden blocks , one at the crown other at the heel. The measurements were made only on fresh foetal corpses of still born and died few hours after birth. Macerated and foetuses with abnormalities were excluded because accurate body length determination is not possible with these foetuses.

Preparation of foetal clavicle:

Removal of soft parts without injuring the bone by stripping and through cleaning was done.

Soaking in water:

The foetal bones still having adhered ligaments and parts of muscles, were placed in running tap water for 2 to 4 days. In this way the blood was dissolved and washed away the soft parts still attached to the bones. The soaking period was adjusted with the maturity of foetuses. Smaller bones required shorter soaking period.

Maceration:

The bones were kept in warm water (temp 40°C) for 1-2 days. All soft parts still attached to bones were removed after maceration.

Washing:

The bones were kept in a container filled with water, stirred thoroughly and water was discarded. This process was repeated until the bones became clear.

Desiccation:

The bones were kept in an enamel led tray and dried at room temperature.

Measurement of bone:

The measurement of bone (clavicle) was done by means of Callipers with sliding scale upto 0.1mm accuracy. The distance between the STERNAL and ACROMIAL ENDS of the bone.

Results:

Table 1: Mean Crown heel length and clavicular length in foetal corpses

	Male	Female
Mean Crown heel length in cm	46.04	42.52
Mean Clavicular length in m.m	38.88	36.08

--- t-test ---

Group	N	Mean	Std Dev	SEM
Male	25	46.04	5.276	1.055
Female	25	42.52	6.464	1.293
Difference		3.52		1.669

95% confidence interval for difference: 0.1649 to 6.875
t = 2.109 with 48 degrees of freedom; P = 0.040
There is significant association between gender and crown heel length.

Group	N	Mean	Std Dev	SEM
Male	25	38.88	4.834	0.9667
Female	25	36.08	5.251	1.05

Difference 2.804 1.427

95% confidence interval for difference: -0.06612 to 5.674
t = 1.964 with 48 degrees of freedom; P = 0.055
There is no significant association between gender and clavicular length.

Table 2: Comparision of average crown heel length and clavicular length to age in lunar months

Age in lunar months	Crown heel length in cm	Clavicular length in mm
6	30	26
6.6	32.5	28.45
7	35	29.8
7.6	38	32
8	39.78	34.1
8.6	42.43	35.1
9	44.83	37.46
9.6	47.5	39.95
10	51	43.2

Relative numbers established for estimation of foetal lengths from clavicular measurements of foetuses.

Foetal length in Cms	Clavicular measurement in m.m.	Relative numbers established
x.	A.	11.92-0.92 +/-SE 0.854

Available relative numbers for the estimation of crown heel lengths of foetuses from clavicular measurements as compared with those of present study.

Present study	Fazekas and Kosa's observations
X=A x11.92. - 0.92.	X= A x 11.94 -1.22

X= Length of the foetus in Cms
A= Clavicular measurement in. m.m

Table 3: Comparision between the original crown heel lengths and estimated crown heel lengths from clavicular measurements in m.m of the male foetuses examined in the present study.

Crown heel length Actually measured in cms	Clavicular measurements in m.m	Estimated Crown heel length in cms
38	32.2	38.2
44	36.5	43.4
39	34.8	41.3
42	34.5	41
40	34	40.4
40	34.7	41.2
43	36.6	43.5
39	32.6	38.7
46	37.5	44.6
42	35.4	42.1
42	34.8	41.3
43	34.8	41.3
40	32.5	38.6
51.5	44	52.3
52	45.2	53.7
51	44	52.3
50.5	43.2	51
52	44.4	52.8
50	41.9	49.8
49.5	40.1	47.7
52	44.5	52.9
53	46.3	55
52.5	46.3	55
50	41.2	49
49	40.1	47.7

Table 4: Comparision between the original crown heel lengths and estimated crown heel lengths from clavicular measurements in m.m of the female foetuses examined in the present study.

Crown heel length Actually measured in cms	Clavicular measurements in m.m	Estimated Crown heel length in cms
30	26	30.9
35	28.6	34
42	35	41.6
40	33.8	40.2
38	31.8	37.8
38	32	37.9
41	35.7	42.4
44	36.7	43.6
33	28.6	34
48	40.3	47.9
46	38.6	45.9
47	39.6	47.1
39	33.8	40.2
43	34.6	41.1
44	36.7	43.6
40	35.7	42.4
35	31	36.8
32	28.3	33.6
45	38.8	46.1
49	42	49.9
52.5	44	52.3
51	43.2	51
51	42.4	50.4
49.5	42.4	50.4
50	42.4	50.4

Table 5: Average clavicular measurements in m.m of present study as compared with those of the available from previous worker Dr Fazekas & Kosa

Age in lunar months	Clavicular length in mm Present work	Clavicular length in mm Fazekas&Kosa
6	26	27
6.6	28.45	28.3
7	29.8	30.3
7.6	32	31.3
8	34.1	35.6
8.6	35.1	37.2
9	37.46	37.7
9.6	39.95	42.6
10	43.2	43.8

Table 6: Comparison between the average and estimated crown heel lengths of foetuses from the average measurements of clavicle grouped according to age difference of 1/2 lunar month.

Age in lunar months	Avg. Crown heel length in cm	Avg. Clavicular length in mm	Crown heel length estimated by Regression formulae in cm
6	30	26	30.9
6.6	32.5	28.45	33.8
7	35	29.8	35.4
7.6	38	32	38.05
8	39.78	34.1	40.5
8.6	42.43	35.1	41.7
9	44.83	37.46	44.5
9.6	47.5	39.95	47.52
10	51	43.2	51.4

Discussion:

Scientific and technological aspects of forensic medicine are growing day by day. But new problems are arising and keeping pace with the advancements in the subject, the importance of study of bones was long recognised. Bones were studied in all possible aspects and methods were advised to deduce as much information and knowledge from the bones as possible. In the recent past, the study of foetal bones had aroused interest. The problem of estimation of crown heel length of foetuses with

reasonable accuracy using the foetal bones has been overcome. The experience and observations of previous workers proved that the foetal length , age can be determined with quite a remarkable accuracy following a study of even with single foetal bone. Keeping in view of the advancement in the particular field - A study of estimation of crown heel length of foetuses from measurements of clavicle, from sternal end to acromial end was carried out in the department of Forensic Medicine Andhra Medical College Visakhapattanam. The study was carried out on 50 foetuses which included equal number of female and male ones, deriving from different periods of pregnancy from 6th to 10th lunar months. Some of the foetuses were still born and the others died of a few hours after birth. The material was collected at random. The health of the parents regarding present or previous histories of any endocrine diseases, constitutional anomalies and pathological conditions of skeletal system was not taken into consideration. As the aim of the study is to know the usefulness of the foetal clavicular measurements in arriving at a reasonably accurate crown heel length estimations, with the use of material collected at random. Foetuses which had skeletal system, congenital defects were discarded because accurate body length measurement is not possible in these cases. These clavicles were collected in dry state and measurements were taken carefully.

The data thus collected was used:

1) To provide relationship between the body length and clavicular measurements.

2) To asses the reliability of the available formulae in the estimation of crown heel length from clavicle measurements of foetuses belonging to this town Visakhapattanam A.P.

From these observations, it is inferred that the measurement of clavicle is giving accurate results in estimation of crown heel length of foetuses. The available regression equation is compared with that of the present study and found fit to estimate crown heel lengths from clavicular measurements of foetuses of Indian origin in particular of Andhra Pradesh ,Visakhapattanam. The regression diagram is given in graph, and it is found they almost all the observations are very close to straight line.

Conclusions:

A study of estimation of crown heel lengths of foetuses from measurements of clavicle were made. For this study 50 foetuse were collected, out of which 25 male and 25 female. The bones were collected in dry state and measured the length between acromial and sternal ends with vernier calipers with sliding scale upto an accuracy of 0.1m.mThe new regression equation was calculated. The following conclusions were arrived at:

1) Crown -Heel length of foetuses can be estimated with reasonable accuracy with the measurement of foetal clavicle by applying the regression equation derived in present study.

2) There is no significant sex difference in the dimensions of foetal clavicle.

3) The regression formulae arrived in this study is found to befit to estimate crown heel lengths of foetuses of Indian origin in particular this zone Visakhapattanam Andhra Pradesh from clavicular measurements

4) There is correlation between the body length and clavicular measurement.

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