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DIAPHYSEAL AND EPIPHYSEAL CONTRIBUTIONS TO CLAVICULAR LENGTH- A RELATIVE STUDY IN HUMAN FOETUSES

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ABSTRACT

Clavicle gains early strength to support the developing upper limbs of the foetus earliest to provide them easy movements.This is acquired by intramembranous ossification by two primary centres.60 clavicles were obtained from 30 human fetuses from the Department of Anatomy,JNMC,AMU,Aligarh.Foetuses were divided into 5 groups on the basis of gestational age.Total length of the clavicle was measured using Vernier calipers and diaphyseal length was measured under radiological examination.Linear graph was prepared considering total clavicular lengths as well as diaphyseal length on +y axis and gestational age on + x axis to assess the percentage increase in diaphyseal length to the total length of clavicle or contribution of epiphysis in the growth of bone each week.In our study,total length of human foetal clavicle showed a steady growth from 14 weeks onwards throughout gestation in all age groups.However diaphyseal length increased more rapidly especially after 30 weeks of gestation to catch up with the total length of clavicle.This information will provide a valuable tool in early assessment of inborn abnormalities like cleidocranial dysostosis or IUGR.

Keywords: Human foetal clavicle,radiological study,diaphyseal length,epiphysis,length of clavicle,growth of clavicle.

INTRODUCTION

Lengths of foetal long bones have long been considered to determine gestational age[1,2] Various methods provided variable results. Moreover, radiological assessment of maturity had only been partly successful because of limitations imposed by technical problems[3,4].

Prior to the advent of ultrasonography, foetal age was estimated by radiographic demonstration of the distal femoral epiphyseal ossification centre(DFE) and the proximal tibial epiphyseal ossification centre (PTE).[5,6,7,8]

Epiphyseal ossification center and neo- natal extremity radiographs demonstrated that there was a wide range variation in the radiographic appearance of DFE and PTEi.e. three and a half week.Recently ultrasonography has been popularly used to determine gestational age of developing foetus.[10,11]

In our study, we have done the

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manual measurements of foetal clavicles which will give the most precise data than by radiography or sonography.

Intramembranous ossification with earliest appearance of primary ossification (two) centers and having no medullary cavity supports the importance of clavicle in gaining early strength so that it can support the developing upper limbs of the foetus earliest to provide them easy movements.

Numerous authors have confirmed the intramembranous nature of clavicle osteogenesis both in the developing human [12,13,14,15,16,17] and in other mammals. [18,19,20,21).]

The clavicle has an embryonic origin different from the mesenchyme that forms the osteocranium.All facial and some cranial bones develop from neural crest derived mesenchyme [22,23], while most of the calvaria develops from mesenchyme of mesodermal origin.The clavicles arise from somatopleural mesoderm.[24,25] Recently various invasive and non invasive approaches, aimed at correction of different foetal defects, have lead to the emergence of a highly promising super speciality of foetal therapy which has now further enhanced the scope of study on foetal anatomy.

MATERIALS AND METHODS

30 human fetuses were obtained from the museum, Department of anatomy,JNMC,AMU,Aligarh.Foetuses of all age groups without congenital craniovertebral anomalies eg anencephaly,spina bifida, cleidocranialdysostosis were selected for the study.The parameter used for determination of gestational age was foetal foot length.[26] For the purpose of study,fetuses were divided into 5 groups on the basis of gestational age (Table 1).

A linear cutaneous incision was made along the length of both clavicles extending from the tip of right acromion process to the tip of left acromion process.Three vertical incisions were made ,4-8 cm each depending upon the size of foetus at 3 points- right and left acromion processes and one on the jugular notch in the midline.Skin folds were reflected to expose both the clavicles. The subcutaneous fat and other soft tissues like muscles,ligaments and fascia etc were removed to clear the clavicles.

The length of the clavicle was represented by the straight distance measured from the sternal end of the clavicle to the acromial end of the clavicle with the help of Vernier calipers. Diaphyseal length of human foetal clavicle was the parameter considered on radiological examination.This was done by taking radiographs of all five groups of clavicles.Right and left clavicles placed parallel to each other and ball pins were placed vertically touching at both their ends so that their actual length can be differentiated from their diaphyseal length on the radiograph,which also helped in calculating the magnification produced by X- rays.

Magnification = (Radiographic length of clavicle/actual length of clavicle) $\times 100$.This magnification was then used to deduce the actual diaphyseal length from the diaphyseal length measured from the X-ray film (i.e. actual diaphyseal length of clavicle = radiographic diaphyseal length of clavicle/magnification $\times 100$). Results were analysed by using Student's t test.

Table-1. Division of foetuses into groups on the basis of gestational age

Groups	Gestational age (weeks)	No. of Males	No. of females	Total
I	<17	2	4	6
II	17-19	2	4	6
III	20-23	3	3	6
IV	24-28	3	3	6
V	>28	3	3	6

Total no. of foetuses = 30

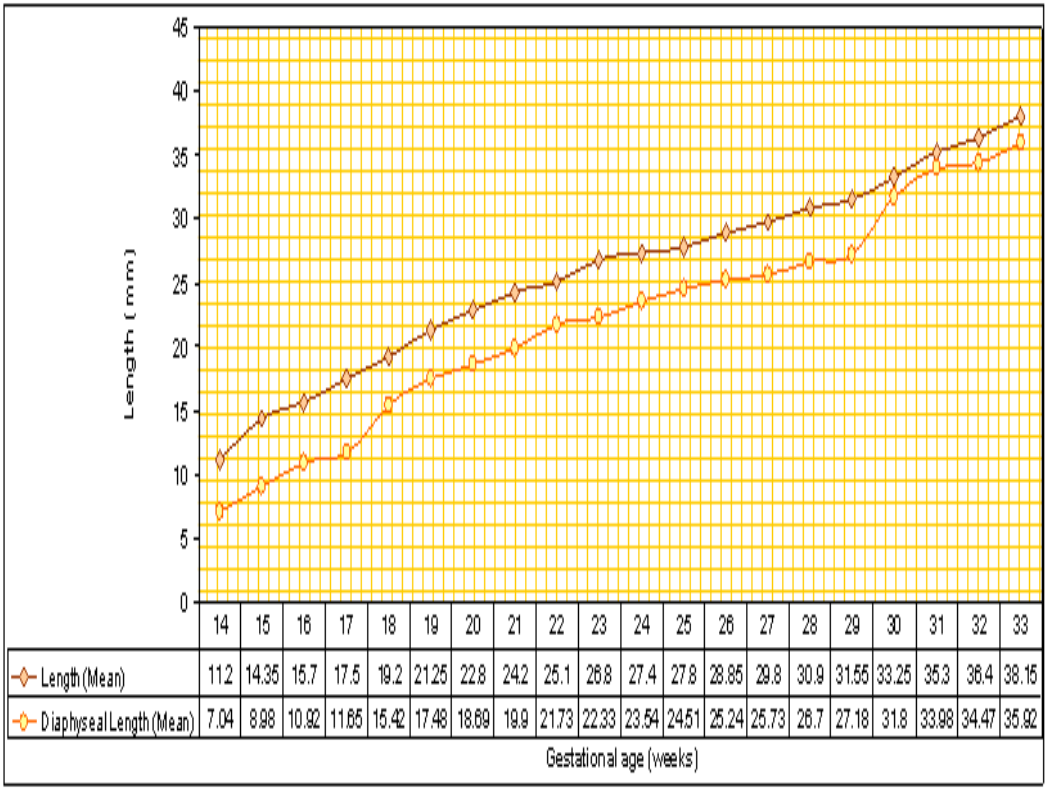

Fig.1. Diaphyseal length Vs Total length of clavicle in human fetuses

Table-2. Rate of growth in diaphyseal length of clavicle

Gestational age (weeks)	Mean Diaphyseal length (DL) of clavicle (mm)	Mean Total length (TL) of clavicle (mm)	Difference b/w TL & DL (mm)	DL as percentage of TL
14	7.04	11.20	4.16	62.86 %
15	8.98	14.35	5.37	62.58 %
16	10.92	15.70	4.78	69.55 %
17	11.65	17.50	5.85	66.57 %
18	15.42	19.20	3.78	80.31 %
19	17.48	21.25	3.77	82.26 %
20	18.69	22.80	4.11	81.97 %
21	19.90	24.20	4.30	82.23 %
22	21.73	25.10	3.37	86.57 %
23	22.33	26.80	4.47	83.32 %
24	23.54	27.40	3.86	85.91 %
25	24.51	27.80	3.29	88.17 %
26	25.24	28.85	3.61	87.49 %
27	25.73	29.80	4.07	86.34 %
28	26.70	30.90	4.20	86.41 %
29	27.18	31.55	4.37	86.15 %
30	31.80	33.25	1.45	95.64 %
31	33.98	35.30	1.32	96.26 %
32	34.47	36.40	1.93	94.70 %
33	35.92	38.15	2.23	94.15 %

OBSERVATION AND RESULTS

Table 2- Rate of growth in diaphyseal length of clavicle

Fig 1 Diaphyseal length vs total length of clavicle in human fetuses

DISCUSSION

In our study,length of human fetal clavicle showed a steady growth from 14 weeks onwards throughout gestation in all age groups.

We have performed measurements for diaphyseal length (DL) of human foetal clavicles by means of radiology.Fazekas and Kosa[27] studied the diaphyseal lengths of dried material of foetal skeletons from 3rd to 10th lunar months of pregnancy but it lacked information about foetal clavicle. In our study,we found that, from 14 to 17 weeks of IUL,DL is 65% of total length(TL).It was interesting to note that for the next 12 weeks(3 months),DL has a steady growth and remains 82% of TL.However,in the later 4 weeks (30 to 33 weeks),DL grows faster than the TL and reaches upto 95% of TL.In other words,epiphyseal thickness at both its ends continued tapering with age.

This pattern of diphyseal growth in the length of foetal clavicle can be valuable tool in early detection of hypoplasia of the bone (Eg. Cleido-cranial dysostosis).

CONCLUSION

Total length of human foetal clavicle showed a steady growth from 14 weeks onwards throughout gestation in all age groups.Epiphyseal thickness at both the ends of clavicle in human fetuses continued decreasing with age ,more rapidly in later weeks of gestation.In other words,diaphyseal length increased more rapidly especially after 30 weeks of gestation to catch up with the total length of clavicle. Any deviation from this pattern of growth can be useful for the clinicians, to access foetal well being.

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