Ossification in the sternum as a means of assessing skeletal age

I. C. F. RIACH¹

From the Department of Radiology, Children's Hospital, Birmingham

SYNOPSIS The centres of ossification in the sternum were investigated to determine whether there was any correlation between ossification in the sternum and chronological age. But this proved to be of no value in assessing skeletal age, although it may be of use in assessing skeletal maturity for pathological or forensic purposes.

Caffey (1961) states that the number and the pattern of appearance of the ossification centres in the sternum vary considerably from child to child. He concludes that they are not reliable means of estimating skeletal age. The first ossification centre appears in the manubrium in the sixth month of intrauterine life, followed by three centres for the body of the sternum at intervals of approximately one month. They usually appear in order from above down. The foci of ossification are usually paired but may be multiple. They are divided into groups, one each side of the mid line. The manubrial centres have usually fused by birth. Fusion is complete between 6 and 12 years of age.

The aim of this investigation was to examine the sternum in stillbirths and young subjects coming to necropsy with a view to determining whether there is a correlation of any kind between ossification in the sternum and chronological age.

METHOD

It was felt that the centres of ossification in the sternum could best be demonstrated by taking radiographs of specimens excised at necropsy. Antero-posterior and lateral views were taken of each specimen on double-wrapped film at 36 in. focal film distance. The antero-posterior projections were examined, and the number, shape, and pattern of the centres recorded. The area of each centre was assessed by the method described by Riach (1966) for measuring the area of the sella turcica.

The age of each subject was noted. The clinical estimation of maturity was used in the case of stillbirths.

RESULTS

Twenty-three specimens were examined.

¹Now at Good Hope General Hospital, Sutton Coldfield.
Received for publication 24 January 1967.

PATTERN AND NUMBER OF OSSIFICATION CENTRES The pattern and number of centres varied considerably between the specimens (Fig. 1). On the whole fusion

FIG. 1. Tracings of the ossification centres made from x-ray exposures of the excised sternum in four cases of full-term stillbirths.

TABLE I

Name	Age	Remarks	Total Area (sq. mm.)
W	26 weeks		5.5
T	28 weeks		5.0
L	30 weeks		10.5
H	34 weeks		40.5
A	40 weeks		88.5
M	Full term	Twin	85.0
F	Full term	Macerated	99.0
B	Full term		112.0
O	Full term		127.0
J.S.	5 days		132.0
B	2 weeks		146.5
A.S.	2½ weeks		151.5
A.T.	3 weeks		166.5
S.G.	6 weeks	Operated C.H.D.	169.5
J.P.	6 weeks		208.0
G	2 months		225.0
P.K.	2 months		228.0
A.G.	2 months		267.0
M.B.	4 months		366.0
K.B.	1½ years		553.0
M.K.	3½ years		986.0
M.L.	4 years		1355.0
J.D.	6½ years		1890.0

FIG. 2. Total ossified area plotted against age or estimated maturity.

of the major centres did not begin till between the third and fourth year of life.

AREA OF THE OSSIFICATION CENTRES The total area of the ossification centres on the antero-posterior projection was determined in each case. The results are given in Table I. The total ossified area was plotted against age or estimated maturity (Fig. 2). These results gave a curve that rose steeply from zero at the twenty-eighth week of intrauterine life until between 1 and 2 years of age when it gradually

flattened off. The steep portion of the curve represents the period when the ossification centres are appearing and rapidly expanding. Once fusion of the centres begins and most of the sternal cartilage is ossified the curve rises less steeply.

CONCLUSIONS

The number and pattern of centres varied considerably from case to case. They were therefore of no value in assessing skeletal age.

The total area of ossification in each specimen bore a reasonable relationship to age or estimated maturity. The steep part of the curve covers the last three months of pregnancy and approximately the first year of life.

It is suggested that the total area of the sternal ossification centres may be of value in assessing skeletal maturation particularly during the period covered by the steep part of the curve, *i.e.*, from the 28th week of intrauterine life until 1 year of age.

It is impracticable to obtain satisfactory antero-posterior projections in live infants of this age even with the use of tomography. It would appear, therefore, that this means of assessing skeletal maturity is of pathological or forensic value only.

I wish to thank Dr. A. H. Cameron for his help in providing the material for this investigation and Dr. R. Astley for his advice in the preparation of this paper.

REFERENCES

- Caffey, J. (1961). *Pediatric X-Ray Diagnosis*, 4th ed. Year Book Inc., Chicago.
- Riach, I. C. F. (1966). *Brit. J. Radiol.*, 39, 241.