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# Iatrogenic pectus carinatum

## A case report

**S. A. Haje**

Hospital Regional da Asa Norte, Fundação Hospitalar do Distrito Federal, Brasilia, Brazil

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**Summary.** *A boy underwent cardiac surgery when he was 27 months old; prior to that his anterior chest wall had been normal. He later developed a progressive* pectus carinatum *deformity. Thoracic surgeons are cautioned to be mindful of the sternal and costal growth plates in any surgical approach to intrathoracic structures. Special care is needed when such deformities are corrected in children and adolescents.*

**Résumé.** *Le cas presenté est celui d'un enfant de neuf ans qui avait une paroi du thorax normale avant une chirurgie cardiaque realisée a l'age de 27 mois. Plus tard il est apparu une deformation* pectus carinatum *progressive. En cas d'abord chirurgicale des structures intrathoraciques l'auteur attire l'attention sur le fait que le thorax présente des plaques de croissance sternales et costales. Il est recommandé de prendre toutes les précautions nécessaires au cours des procedures visant à la correction des déformations <pectus> chez les enfants et les adolescents.*

## Introduction

Cartilaginous growth plates, identical to the growth plates of long bones, are the structures between the bony segments of the sternum and at the costochondral junction of the costal arches [15] (Fig. 1). Consideration of the presence of these growing cartilages has implications in the treatment of pectus deformities. In the past, operation was proposed as the only treatment [25, 26], and conservative measures were condemned as ineffective [18]. Nevertheless, the results of surgical methods have been questioned [3, 4, 5, 12, 17, 19, 20, 28, 36], while successful conservative methods, based on the physiology of growing bones and cartilages, have been reported [13, 14, 15, 23, 27, 29].

This paper draws attention to the sternal and costochondral growth plates, and the importance of avoiding damage to them in thoracic surgery in children and adolescents. The case reported illustrates that a deformity may develop in a previously normal anterior chest wall if the growth plates are not taken into consideration.

## Case report

A boy, 20 months old, was first admitted to our Paediatric Emergency Service in 1986. A nonspecific bacterial pneumonia was diagnosed. No abnormality of the anterior chest wall was recorded. Congenital heart disease was suspected and an atrial septal defect was corrected at operation when he was 27 months old. There were no respiratory problems after the operation, but he developed a progressive pectus carinatum deformity. There was no family history of such deformities.

The patient was first seen by the author in 1993 when he had a severe inferior type of pectus carinatum [14, 15] with a longitudinal scar over the sternum (Fig. 2). There was no scoliosis or kyphosis.

Treatment using a dynamic chest compressor [13, 14, 15] was begun in 1994. After 3 months, there was a significant reduction of the inferior protrusion of the sternum and it was possible to take oblique tomographs of the sternum to study the

*Reprint requests to:* S. A. Haje MD, SHIS QL 12 conj 10 casa 18, Brasilia, DF 71630-305 Brazil

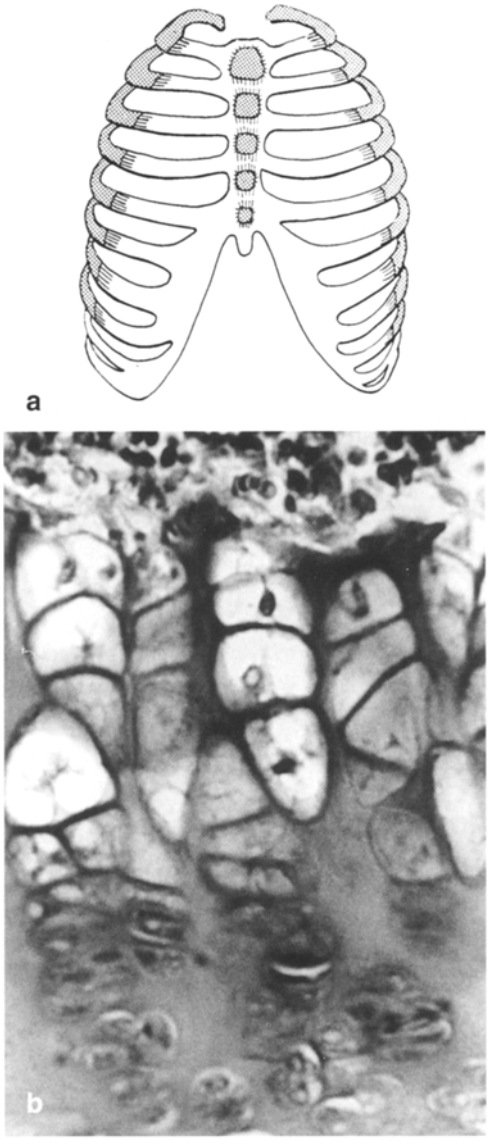


**Fig. 1.a** Diagram of the anterior chest wall of a child under one year of age. The growth plates of the sternum and costal arches are represented by shading. The bony part is dotted and the cartilage blank. **b** Shows the histological appearance of a sternal growth plate (HE ×60)

development of the bone. The findings suggested that there had been irregular closure of the sternum after the thoracotomy (Fig. 3).

## Discussion

There is confusion about the anatomy and physiology of the growing sternum, mainly in relation to suture lines [1, 2, 9, 16], which do not exist in the sternum. Repetition of this erroneous idea [8, 13, 14, 22, 31] may have created difficulties in the interpretation of the pathology in relation to orthopaedic surgery. Sutures are fibrous joints which

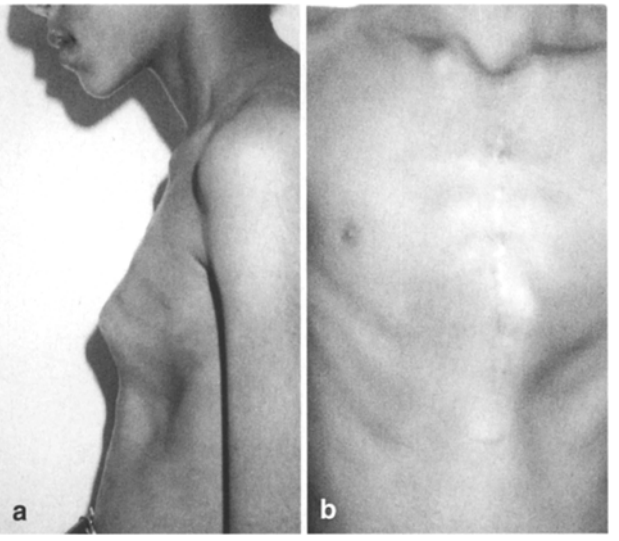


**Fig. 2.a** Iatrogenic pectus carinatum inferior from the left side. **b** Front view showing the thoracotomy scar

exist only in the skull [6, 10]. Few authors have considered the enchondral ossification of the sternum [24, 30, 35, 37] or the mechanism of growth at the costochondral junction [11, 32].

Anomalies of the sternum have been reported in children with congenital heart disease [21, 24, 34], which has also been described in association with a type of pectus carinatum with premature closure of the sternal 'sutures' (growth plates) [8, 9]. This deformity is classified by the author as pectus carinatum superior which occurs in the first years of life and in which there is usually premature closure of the sternal growth plates of congenital origin.

The type of deformity in the case presented here is pectus carinatum inferior which usually occurs in late childhood or adolescence. When the condition is idiopathic the short body of the sternum is not due to premature closure of the growth plates, but to hypoplasia of its inferior segments [14].

Scoliosis has been associated with pectus excavatum and pectus carinatum [33], and both respiratory disturbances or spinal deformities can eventually influence the growth of the sternum and ribs. None of these factors affected the development of the deformity in the case reported. The history and clinical findings suggest that the principal cause was the injury of the sternal growth plates, producing irregular closure, as a result of the operation carried out at 27 months of age.

The psychological impact of a pectus deformity can be devastating [7]. The size and contour of the chest is associated with virility in the male and beauty in the female, so it is not surprising that

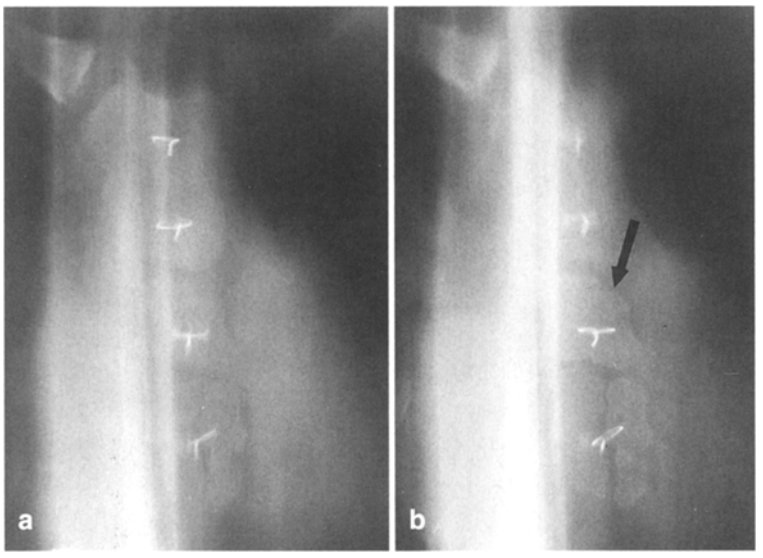


**Fig. 3a, b.** Oblique tomographs of the sternum at the age of 10 years and 2 months. In **a** the manubrium is sharper than the body of the sternum and in **b** the sternum is clearer. There are 2 wire sutures in the manubrium and 2 in the body of sternum. The body of sternum is short and almost the same length as the manubrium (the normal body of sternum is twice the length of the manubrium). A radiolucent line separates the 2 inferior segments of the body of the sternum. In **b** an arrow indicates the left part of the sternum which is inferior to the right, suggesting irregular closure after the sternotomy

those with deformities seek to hide them [25]. The most common treatment is by operation, but there are reports which discourage surgery during growth [15]. More than 40 different operative techniques have been described to deal with the excavatum deformity [20] indicating that an ideal method has not yet been discovered. Operative techniques are controversial and a perfect result is not obtained with every procedure [17]. Surgeons who recognise increasingly poor results as their patients grow older, blame the technique and seek a better one [19]. Bad results occur in children who are operated on before they are 12 years of age [28] and a poor long term outcome has been reported [7, 19] without any explanation of why these failures occur. Current surgical methods do not refer to the growth plates of the sternum and costal cartilages, and operation may produce secondary growth disturbance in addition to those that are present primarily. A conservative approach, without operation [13, 14, 15, 27], is therefore recommended for the treatment of pectus deformities during growth.

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