

Use of CT Scans in Selection of Patients for Pectus Excavatum Surgery: A Preliminary Report

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● A pectus index can be derived from dividing the transverse diameter of the chest by the anterior-posterior diameter on a simple CT scan. In a preliminary report, all patients who required operative correction for pectus excavatum had a pectus index >3.25 while matched normal controls were all <3.25 . A simple CT scan may be a useful adjunct in objective evaluation of children and teenagers for surgery of pectus excavatum.

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INDEX WORDS: Pectus excavatum; CT scans in chest disease.

AS POINTED OUT by Blickman and associates,¹ "The role of surgery in the management of patients with pectus excavatum is controversial" but experienced pediatric chest surgeons are convinced that children with severe pectus excavatum can be safely operated on with predictably normal chest wall growth and development during their pubertal growth spurt.^{2,3} Equally good data show that teenagers and young adults with marked funnel chest deformities have measurable physiologic abnormalities in pulmonary function during exercise⁴ and some patients have significant hemodynamic abnormalities as well.⁵

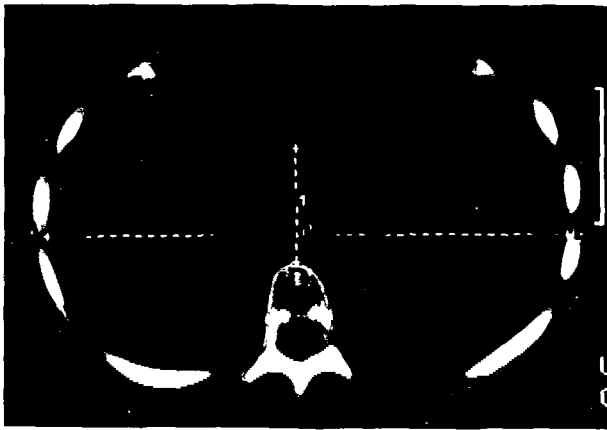


Fig 1. CT scan image with A-B (transverse diameter) and C-D (anterior-posterior diameter) indicated for calculation of pectus index (A-B/C-D).

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While awaiting the development of more sensitive techniques for measuring pulmonary and cardiac dysfunction in young children with severe chest deformities, we have traditionally selected patients for operative repair on the subjective basis of abnormal chest wall dynamics, general distortion of chest wall configuration, and caliper measurement of anterior-posterior chest diameters.⁶ These parameters have often been compared with the Welch index,⁷ which is derived from the lateral chest x-ray of patients with pectus excavatum. The purpose of this preliminary paper is to report the use of a *single CT scan* image through the deepest part of the pectus excavatum deformity as an additional new and promising measurement of chest wall deformity. It was used in 33 patients who were

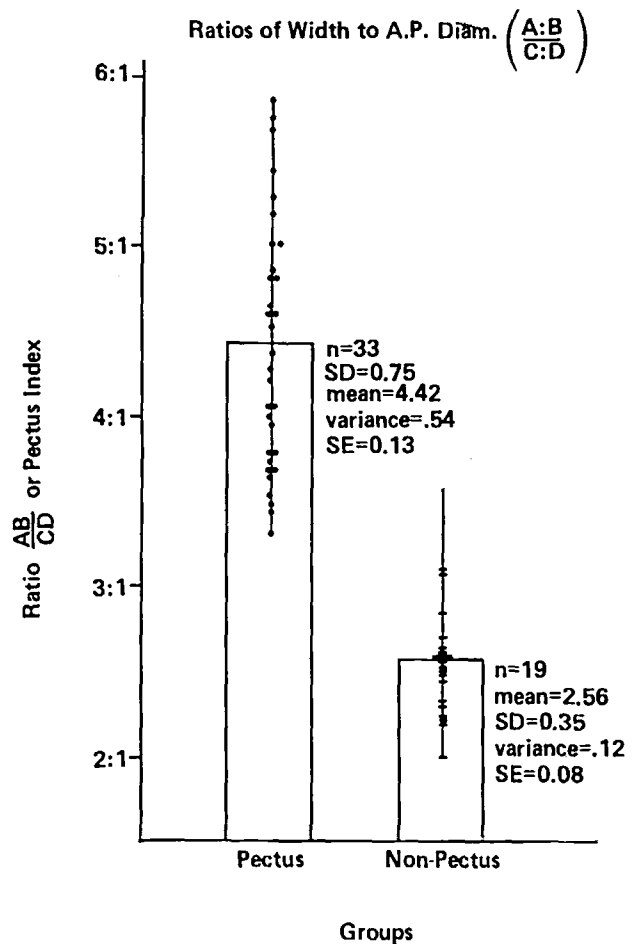


Fig 2. Comparison of pectus index scores in 33 operated pectus excavatum patients and 19 unoperated control patients.

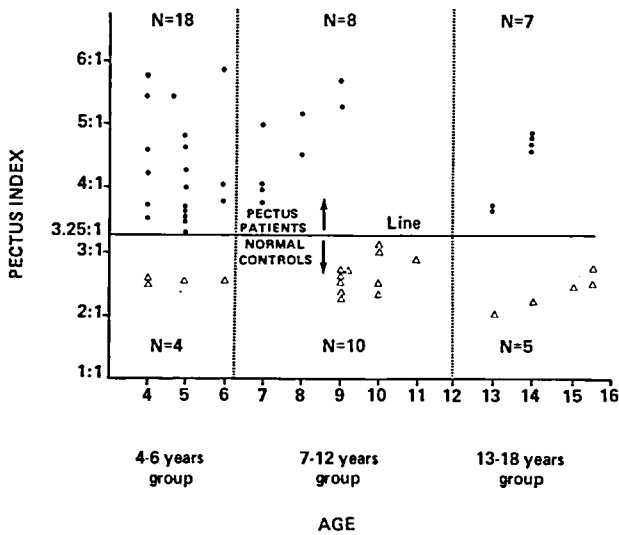


Fig 3. Comparison of pectus index scores by age groups 4 to 6 years, 7 to 12 years, and 13 to 16 years.

operated on between October 1983 and July 1985. The CT scan was used to derive an index by dividing the narrowest central diameter into the cross section diameter of the chest. This pectus index seems to separate severely deformed chests (considered marked enough to require operative repair) from the range of normal chests in a peer controlled group who were measured during the same period.

This CT scan test was used in the following way. After a decision was made by the surgeon, parents, and child to undergo operative repair, the patient had a limited CT scan performed with an image obtained at the level of the deepest part of the deformity. A typical CT scan is shown in Fig 1. The transverse diameter is measured in centimeters and labeled A-B. The anterior-posterior diameter is measured from the back of the sternum to the front of the vertebral body and labeled C-D. A-B is then divided by C-D to give a pectus index. This equation, $A-B/C-D$, is the index of the pectus excavatum deformity. The indices for 33 children and teenagers who had operative repair of their pectus excavatum abnormalities are plotted in Fig 2. These are compared with the indices of 19 age-matched controls. Because of possible variation during different growth periods, the 33 operated

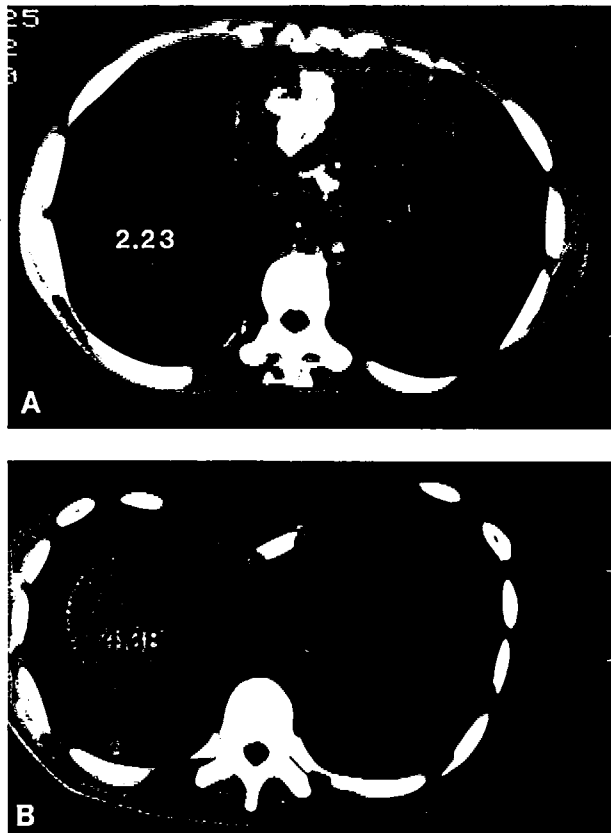


Fig 4. Young teenagers with comparative pectus indices. (A) Thirteen-year-old normal control. Pectus index = 2.23. (B) Sixteen-year-old operated pectus excavatum patient. Pectus index = 4.38.

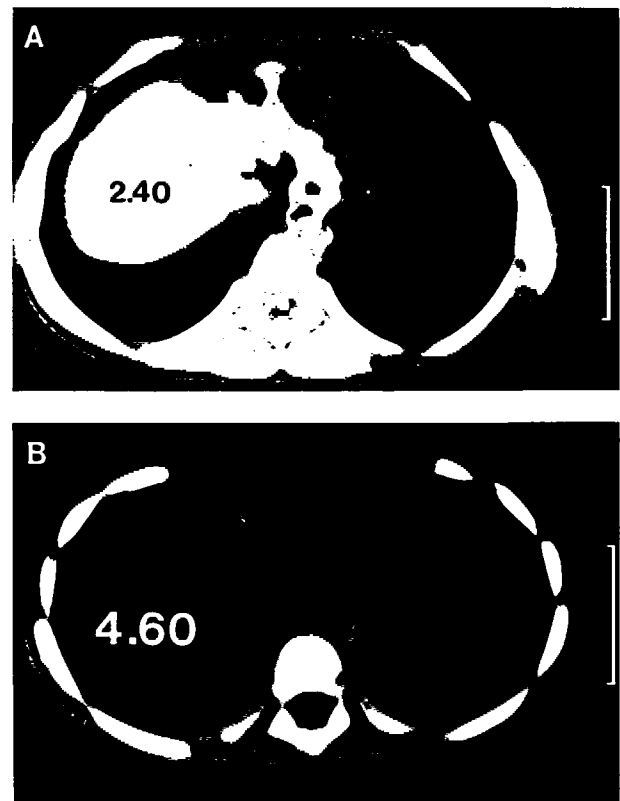


Fig 5. Pectus indices on age-matched 4-year-old children. (A) Normal control. Pectus index = 2.40. (B) Operated pectus excavatum patient. Pectus index = 4.60.

patients were compared in three age groups, ie, 4 to 6 years (18), 7 to 12 years (8), 13 to 16 years (7). These ratios are shown in Fig 3. Since the pectus indices did not differ significantly between age groups, the total operated group was then pooled and was compared with normal controls (Fig 2). All operated patients had pectus indices >3.25 and all the nonpectus control patients had indices <3.25 .

Admittedly, this index simply documents our selection bias because these patients were chosen on the basis of prior evaluation and using current state of the art methodology. Nevertheless, this technique objectively measures a subjective decision that we have been making for operative correction for more than 20 years and on more than 550 children, teenagers, and young adults.⁸ The index >3.25 clearly separates those patients who were operated on from those who were unoperated, the milder cases and normal children. We are now embarking on a prospective selection of the next 100 patients who are referred for evaluation for

pectus excavatum abnormalities. We believe there is enough merit to this pectus index to suggest its practical testing by other thoracic surgeons, both retrospectively and as a guide to recommended surgical treatment. Two matched pairs of patients and controls are shown in Fig 4A and B and Fig 5A and B to illustrate the use of the pectus index measurement.

CONCLUSION

A carefully positioned transverse CT scan of a patient with pectus excavatum deformity can be used to calculate a pectus index. Preliminary observations show that a pectus index >3.25 was present in all our operated patients. In nonoperated mild pectus patients and a control group of normal children and teenagers, the index was <3.25 in all instances. Thus, a pectus index may be a useful adjunct in the objective evaluation of children and teenagers presenting for possible surgery of pectus excavatum deformities.

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