



# YOUR SURGICAL CONSULTANT

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## Downtown Office

901 7<sup>th</sup> Avenue, Suite 210  
Fort Worth, TX 76104

Office hours: 8 am to 5 pm weekdays

## Grapevine Office

2020 W Hwy 114 Suite 110  
Grapevine, TX 76051

Office hours: 1 pm to 5 pm Tu  
9 am to noon Th

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We at Pediatric Surgical Associates greatly appreciate our collegial relationship with referring physicians such as you. Best wishes this year to you and your families, and to the members of your staff.

**Please note: For your patients' convenience, we have opened a Grapevine office located at 2020 W Hwy 114 Suite 110, near the Baylor Grapevine Medical Center and will be available to see patients on Tuesdays from 1 to 5 pm and Thursdays from 9 am to noon.**

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## CHEST WALL DEFORMITIES

When I was in high school, I had a friend named Steve who was tall and very thin. He tended to walk with his shoulders hunched over a bit. I was shocked one day as we were changing clothes in gym class to notice that the middle of his chest was sunken in quite deeply. As far as I could tell, this condition never seemed to bother Steve or hinder his ability to participate in athletics. I know now that Steve had a pectus excavatum deformity.

The two most common types of chest wall or "pectus" (Latin: 'chest') deformities are the pectus excavatum, in which the sternum is depressed or 'excavated', and the pectus carinatum (Latin: "carina" meaning 'the keel of a ship'), in which the sternum protrudes. An occasional patient has a combination of excavatum and carinatum deformities.

### Pectus excavatum.

Intrusion deformities occur about once in 300-400 births. Males outnumber females 3 to 1. Ninety percent of cases are seen first in infancy, and spontaneous resolution is rare. Pectus excavatum tends to become symptomatic during the teen years and worsens until the skeleton has matured.

All current theories explaining the cause of pectus excavatum are inadequate. The known association with scoliosis (15%) and Marfan's syndrome suggests abnormal connective tissue, and hyperflexible costal cartilage has been found in pectus excavatum.

The defect in pectus excavatum is two-fold: 1) a posterior angulation of the sternum, usually between the 2<sup>nd</sup> and 3<sup>rd</sup> ribs, and 2) posterior angulation of the costal cartilages. Some deformities are asymmetric with the right side deeper than the left.

The severity of the deformity is estimated on CT scan by the "pectus index" (PI), the transverse diameter of the chest divided by the minimum antero-posterior diameter of the chest. A PI over 3.25 is considered abnormal. In severe cases, the sternum may nearly touch the vertebral column.

In fact, most patients with pectus excavatum are relatively asymptomatic. The cause of the chest and back pain experienced by some pectus excavatum (and many pectus carinatum) patients is probably musculoskeletal in origin, but the cause is not well understood. It is likely that the pain is related to an abnormal stress pattern placed on the costochondral and sternochondral ligaments.

Numerous attempts have been made to associate physiologic abnormalities with pectus excavatum to justify surgical repair, but results remain controversial. Nonetheless, pulmonary function testing, echocardiography, CT scanning, etc. are often employed in preoperative evaluation.

It is easy to assume that because of the deformity, pectus excavatum causes a decrease in pulmonary function. However, this cause-and-effect is difficult to prove because of the wide range of pulmonary function among healthy in-

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dividuals and because pulmonary function correlates better with physical training than with body habitus. After decades of studying pulmonary function in pectus excavatum patients, no consistent improvement has been documented following surgical repair.

Angiographic studies in patients with pectus excavatum have shown the imprint of the sternum on the anterior wall of the right ventricle. This pressure may cause deformation of the mitral valve annulus and mitral valve prolapse in as many as 65%. Echocardiography often identifies an improvement in cardiac index on exertion after operative repair. Exercise tolerance as measured by total exercise time may also be improved after repair. It is tempting to use such observations as evidence to indicate that the operative repair of pectus excavatum results in improved cardiac function, but the roles of conditioning and subjective response to surgery are difficult to assess.

The most common reason for seeking operative repair of a pectus excavatum is the desire to improve the young person's appearance. This is particularly important in younger teenagers whose body image and self esteem is affected by their appearance. We believe that appearance ought to be a significant factor in considering surgery.

The repair of pectus excavatum has evolved over the past decade. The procedure was previously performed using an open technique; the costal cartilages were removed, the sternum was transected at the point of angulation and elevated, and a support bar was placed beneath the sternum and removed after a year. In 1997, Dr. Donald Nuss reported a minimally invasive approach in which a pre-curved bar was inserted substernally through 2 small lateral incisions and left in place for 2 to 3 years. Just as orthodontic braces slowly cause bones to remodel, the bar causes the sternum and the costal cartilages to reconfigure over time.

We are adept at performing both procedures, each of which has advantages and disadvantages. The open procedure may be performed in patients as young as 7 years, and the bar may be removed after 1 year. However, the procedure takes longer, it usually results in more blood loss and it results in a larger and more cosmetically undesirable scar. The Nuss procedure is cosmetically more desirable, but the bar must remain in place for 2 to 3 years. Although the procedure is performed for symptomatic children of any age, Dr. Nuss recommends asymptomatic children be at least 12 years old. Postoperative pain, time of hospitalization, and time to return to usual activities are relatively equal.



Pectus excavatum before repair      After Nuss repair

### **Pectus carinatum.**

Pectus carinatum deformities are less common than are excavatum deformities and more varied in appearance. They are more common in boys than girls (4:1). About half of pectus carinatum deformities occur after the 11<sup>th</sup> birthday.

The cause of pectus carinatum is as poorly understood as is the cause of pectus excavatum. There is again a 15% association with scoliosis.

Most commonly there is a symmetric protrusion of the sternum (less commonly the manubrium) with associated lateral depression of the ribs. Sometimes the protrusion is asymmetrically limited to one side of the sternum.

There is, of course, no concern for physiologic effects on the lungs or heart, but pain in the chest and back, probably related to abnormal stresses on the costochondral and sternochondral ligaments may be significant.

Surgical repair of a pectus carinatum is accomplished only through an open technique since there is currently no minimally invasive procedure described. The costal cartilages are each removed, the sternum is transected at the point of angulation and swung downward, and a bar is placed beneath the sternum for support.

Recently, custom-made, external orthotic bracing has been used to correct protrusion defects. This seems to be most successful in younger patients as both they and their chest walls are more compliant. Older children are more resistant to wearing an uncomfortable brace all day for months or years; they are more likely to request surgery.

The ideal age for repairing a pectus excavatum or carinatum is between 10 and 14 years of age, although we often see children older than 14 and some younger than 10.

Gaining insurance authorization for repair of a pectus excavatum or carinatum deformity is a challenging task. Nevertheless, after listening closely to patients and their parents, we can often identify factors which will qualify the child to receive insurance approval for surgical repair. Our office is adept at dealing with third party payers in this difficult area. Surgery is generally planned for the summer because of school. However, since it may take 2 to 6 months to gain approval for the procedure, winter or spring is the best time of the year to initiate the approval process.

Hospitalization usually lasts about 5 days. We strongly advise that an epidural catheter be placed during repair of either a pectus excavatum or pectus carinatum, which will significantly reduce postoperative pain. Postoperatively, deep-breathing exercises are important as is posture training to enhance the cosmetic repair. After 6 weeks, an upper body weight-training program may be initiated which will improve the results even more. Children may return to contact sports 6 months after repair.

There are few procedures we perform for which the patient has more genuine appreciation than for the repair of a pectus excavatum or pectus carinatum deformity. A repair frequently results in a complete change in the child's outlook on life, and he or she often becomes more outgoing, more sociable, and more self-assured. It is truly gratifying to see such a marked improvement in a young person at such a crucial time in his or her life.

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**Disclaimer:** All material is intended for informational purposes only and is not intended, and should not be used, to replace medical advice offered by a qualified physician. We are always available and willing to discuss questionable conditions with you and we invite your request for our assistance.