Pectus Excavatum
(Funnel Chest)

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Pectus excavatum
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Pectus excavatum (PE) is an abnormal development of the rib cage where the breastbone (sternum) caves in, resulting in a sunken chest wall deformity. Sometimes referred to as "funnel chest," pectus excavatum is a deformity often present at birth (congenital) that can be mild or severe.
Pectus excavatum
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What causes pectus excavatum?
The cause of pectus excavatum is not well understood. Yet, researchers believe that the deformity is caused by excessive growth of the connective tissue (cartilage) that joins the ribs to the breastbone (also known as the costochondral region), which causes an inward defect of the sternum.
Pectus excavatum

While the vast majority of pectus excavatum cases are not associated with any other condition, some disorders may include the sunken chest feature of pectus excavatum, including:

**Marfan syndrome:** A connective tissue disorder, which causes skeletal defects typically recognized by long limbs and ‘spider-like’ fingers, chest abnormalities, curvature of the spine and certain facial features including a highly arched palate, and crowded teeth.

**Rickets:** A deficiency disease occurring primarily in children, Rickets results from a lack of vitamin D or calcium and from insufficient exposure to sunlight, which disturbs normal bone growth.

**Scoliosis:** A curvature of the spine.
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Symptoms of pectus excavatum :-
Most patients do not have symptoms, though a minority of patients may have the following symptoms:
• Fatigue
• Shortness of breath
• Chest pain
• Fast heart rate (tachycardia)
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Pectus excavatum is a fairly common congenital deformity that accounts for approximately 90 percent of congenital wall deformities. Approximately 40 percent of pectus excavatum patients have one or more family members with the same defect. Pectus excavatum occurs more often in men than women, appearing in 1 per every 300 to 400 white male births.
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Pectus excavatum is not preventable, but the condition is treatable. In rare cases if the condition is left untreated, pectus excavatum can cause compression of the heart and lungs. In addition to pectus excavatum causing an unattractive appearance of the chest wall, the condition can also force the heart into the left chest to varying degrees, depending on the severity of the defect. The following symptoms occur:

• Trouble breathing
• Decreased exercise tolerance
• Chest pain
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Diagnosis
Before pectus excavatum can be properly treated, it must first be properly diagnosed. Thoracic surgeon and pulmonologist, will perform a complete physical exam and comprehensive blood tests to confirm the diagnosis. Several other tests may be performed, including
• Physical (stress) test
• Pulmonary function test
• Laboratory studies (blood work), such as chromosome studies or enzyme assays
• Metabolic studies
• Chest x-ray
• Computed tomography (CT) scan of the chest
• Electrocardiogram (EKG)
• Echocardiogram
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Chest X-ray – Lateral view
Pectus excavatum

Treatment
Since most patients with the deformity do not have symptoms, treatment may not be needed, or will be dependent upon the development of symptoms. Physical therapy in young patients (under the age of 18, due to most pectus deformities remaining the same after this age) may play a role in slowing the development of the chest wall deformity and may possibly reverse some of the chest wall deformity.
If pectus excavatum is compromising either the heart or lungs, surgery is recommended. significantly improves heart and blood vessel (cardiovascular) function.
Chest CT-scan showing changes in the chest cavity with compression and displacement of chest organs.
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**Surgery:**
The primary goal of pectus excavatum repair surgery is to correct the chest deformity to improve a patient’s breathing, posture and cardiac function. This is typically accomplished by removing a portion of the deformed cartilage and repositioning the breastbone. A variety of surgical procedures are available to repair pectus excavatum, including:

*Highly modified Ravitch technique*
*The Nuss Procedure*
**Pectus excavatum**

*Highly modified Ravitch technique:*
Originally completed by a long incision across the chest to resect excess cartilage, reposition rib bones, and implant a wedge bone graft to correct pectus excavatum,
The Ravitch technique has been recently modified as a less-invasive procedure.
The highly modified Ravitch technique is completed with a vertical incision in the mid-chest area to remove anterior cartilage. Two stainless-steel struts are placed across the anterior chest to support the breastbone and are wired to the appropriate ribs on each side, allowing the breast bone to be elevated. The struts are not visible from the outside and are removed after two years during a surgical procedure.
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Highly modified Ravitch technique
Pectus excavatum

*Highly modified Ravitch technique*

Planning
Pectus Excavatum

Different incisions and approach
Pectus excavatum

Modified Ravitch technique good result
Pectus excavatum

Modified Ravitch technique result
Pectus Carinatum, also called pigeon chest, is an overgrowth of the cartilage around the breast bone that causes an outward protrusion of the breast bone and ribs. Surgery to correct it or wearing a compression brace.
Good result is achieved after modified Ravich technique
Pectus excavatum

The Nuss Procedure:
Usually restricted for adolescent patients,
Video-assisted thoracoscopic surgery (VATS) technique to correct pectus excavatum.
Through two small incisions on either side of the chest, a curved steel bar (known as the Lorenz Pectus Bar) is inserted under the sternum. Individually curved for each patient, the steel bar is used to ‘pop out’ the depression and is then fixed to the ribs on either side.
A small steel, grooved plate may be used at the end of the bar to help stabilize and attach the bar to the rib. The bar is not visible from the outside and stays in place for a minimum of two years. When it is time, the bar is removed as an outpatient procedure.
A separate, small incision is made to insert a camera to allow the surgeon to visualize the chest cavity and insert tools in the remaining small incisions to complete the procedure. the best surgical approach to correct the condition is determined
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A case for double Bar Nus operation
The Nuss Procedure

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The Nuss Procedure

The Lorenz Pectus Bar
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The Nuss Procedure

Long curved clamp advanced across mediastinum deep to sternum.

Convex Lorenz Pectus Bar guided into the sub-sternal tunnel, using umbilical tape to keep it on track.

When the Lorenz Pectus Bar is in place it is turned over to raise the sternum using the Lorenz Flipper.
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Post op chest x-ray
AP and lateral views
Single & double
Lorenz Pectus Bar

The Nuss Procedure
The benefits of pectus excavatum surgical repair
As compared with traditional surgery, patients who undergo laparoscopic or minimally invasive surgery to repair pectus excavatum, such as VATS with the Nuss Procedure, may experience:
• Decreased postoperative pain
• Shorter hospital stay
• More rapid recovery and return to normal function and duties
Other possible benefits include reduced risk of infection and less bleeding.

The highly modified Ravitch technique offers:
• Shortened hospital stay following the procedure, rarely exceeding five days
• Decreased postoperative pain
• Reduced risk of complications
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Risks of surgical repair of pectus excavatum
The surgical repair of pectus excavatum, like other extensive surgical procedures, presents risks. While both the Nuss procedure and the highly modified Ravitch technique are safe and effective procedures, complications can occur.

Possible complications from surgical repair of pectus excavatum include:
- Pneumothorax
- Bleeding
- Pleural effusion
- Infection
- Bar displacement
- Pectus excavatum recurrence (due to having the surgical correction completed too early prior to puberty and/or not leaving the strut or bar in place for a long enough period).
- Recurrence is less likely after the Ravitch procedure.