

Pectus Bar

Pectus Excavatum Correction



THORACIC



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An Innovative Technique for the Correction of Pectus Excavatum

Your progress. Our promise®. A leading innovator in musculoskeletal healthcare, Zimmer Biomet provides end-to-end patient solutions.

Dr. Donald Nuss, in cooperation with Zimmer Biomet, developed a minimally invasive surgical procedure and Pectus Bar implant to remodel the chest wall over a 2 to 3 year period. The Nuss Technique, also known as the “Minimally Invasive Repair of Pectus Excavatum”(MIRPE), uses principles of minimal-access surgery and thoracoscopy combined with the proper placement of a Pectus Bar to achieve correction of Pectus Excavatum.

Pectus Excavatum is a chest disorder occurring in approximately one of every 1,000 children. This congenital deformity is characterized by a concave, “funnel” shaped chest. The inward facing sternum can apply pressure to the vital organs of the chest resulting in restricted organ growth and shortness of breath. Mildly present at birth, Pectus Excavatum usually becomes more serious throughout childhood, often magnifying considerably during the teenage years.

Using the Nuss Technique, along with the Pectus Bar, surgery to correct Pectus Excavatum is accomplished in less time and with more ease than with other techniques.

Pectus System Features

- The Pectus Bar's rounded ends and blunt edges help minimize tissue destruction during implant insertion.
- The Pectus Bar comes in a variety of lengths ranging from 7 inches (17.8 cm) to 17 inches (43.2 cm) to accommodate most Pectus Excavatum correction procedures.
- All instruments in the Pectus System are designed to increase simplicity during the Nuss Procedure.
- The Pectus System Container comes in two sizes and conveniently houses the entire range of Pectus implants and instruments.
- Specialized titanium bars and stabilizers available for patients with nickel allergies.
- Pectus-size bars available for the following:
 - Special sized bars
 - Pre-bent bars developed in accordance with patients' CT scans*

¹ Nuss D, Kelly RE, Croitoru D, Katz M., A 10 Year Study of a Minimally Invasive Technique for the Correction of Pectus Excavatum. The Journal of Pediatric Surgery, 1998; Vol 33 April, 1998: pp 545-552

*Return time varies depending on each patient. Always consult your physician before resuming any activity.

Benefits

Minimally Invasive Operation - Use of the MIRPE technique requires neither cartilage incision nor resection for correction of pectus excavatum. There is no need to make an incision in the anterior chest wall, raise pectoralis muscle flaps, resect rib cartilages, nor perform sternal osteotomy.

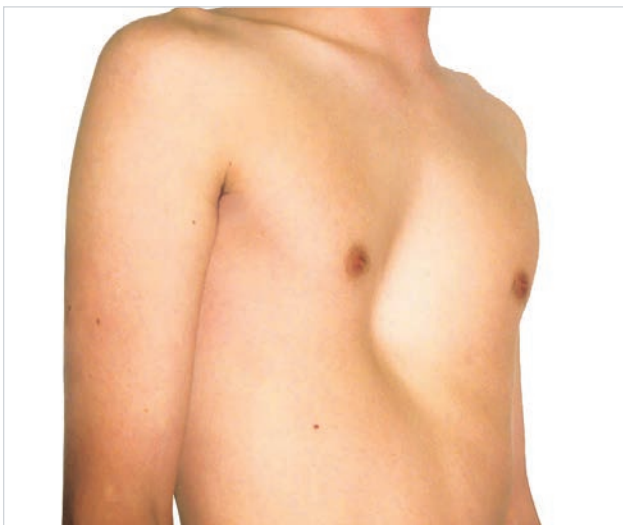
Reduces Operating Time - The procedure requires approximately 40 minutes, as opposed to the 4 to 6 hours required of a chest reconstruction.

Minimal Blood Loss - Blood loss is generally 10 to 30cc, compared to the 300cc lost with the other products and techniques.¹

Return to Regular Activity - The average time for a patient to resume daily activities, once treated with the Pectus Bar, is one month.*

Chest Correction - Using the Pectus Bar the patient can experience ease of breathing, normal chest expansion and elasticity, and proper lung and heart growth.

Excellent Long-Term Cosmetic Result - "A 10 Year Study of a Minimally Invasive Technique for the Correction of Pectus Excavatum", indicated excellent long-term results. The Journal of Pediatric Surgery, 1998; 33(4). Donald Nuss, M.B., Ch.B.; Robert E. Kelly, Jr., M.D.; Daniel P. Croitoru, M.D.; Michael E. Katz, M.D.



Severe Case of Pectus Excavatum (Pre-operative Photo).



2 year Postoperative Photo at 1 Month (After Bar Removal).

Indications and Patient Selection

Patients with pectus excavatum are considered for surgical reconstruction between the ages of 4 and 18 years when the ribs and costal cartilage are neither too malleable nor too rigid. The ideal age is between 8 and 13 years, prior to the adolescent growth period.

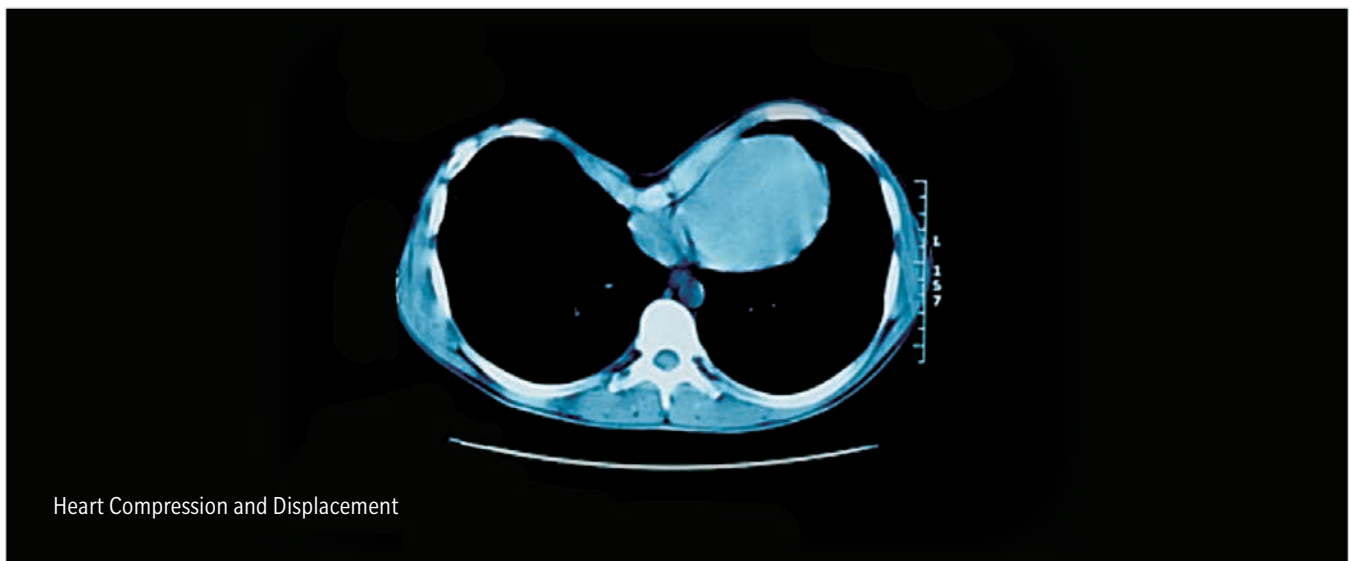
A complete physical exam and full medical history are completed for all patients to place them into either asymptomatic or symptomatic classifications based on the following criteria:

- History of progressive worsening of the pectus excavatum.
- History of the symptoms related but not limited to exercise intolerance, chest pain, and shortness of breath.
- Clinical evaluation showing severe pectus with the demonstration of cardiac displacement and pulmonary compromise.

Asymptomatic patients are given an exercise program to correct their posture and are reevaluated every six months to follow their progress. Patients will be moved into the symptomatic group as indicated by their symptoms and lack of progress.

Symptomatic patients are sent for a CT scan, pulmonary-function studies and cardiology examinations. Surgery is supported by the results of the objective criteria obtained from these exams. The criteria includes a CT index (Haller index) of 3.2 or greater, atelectasis, abnormal pulmonary function, cardiac compression, mitral valve prolapse, heart murmurs and A-V conduction delay. These patients may have other abnormalities, such as Marfan's syndrome, Ehlers-Danlos or Poland's syndrome.

Prior to the day of surgery, the patient's chest is measured to determine the length of the Pectus Bar. Proper measurement is performed utilizing a measuring tape or a Pectus Bar Template over the deepest portion of the pectus from the right midaxillary to the left midaxillary line. The length of the Pectus Bar required is 1 to 2 cm less than the measured distance because the tape measures the external diameter of the chest and the Pectus Bar traverses the internal diameter.



Heart Compression and Displacement

1.

A course of antibiotics is started at the time of surgery to prevent infection and reduce the development of pneumonia. The procedure is performed under general endotracheal anesthesia with muscle relaxation and an epidural block for both operative and postoperative pain control.

2.

During the procedure, the patient is positioned with both arms abducted at the shoulders to allow access to the lateral chest-wall. Padding under the arms and proper positioning of the arms will help prevent neurologic injury.

Patient positioned with both arms abducted



3.

The patient is draped, and the chest is marked for surgery with a sterile marking pen. The deepest portion of the pectus is marked. If the deepest point of the pectus is inferior to the sternum, then mark the lower end of the sternum. Using this point, establish a horizontal plane across the pectus region by marking the intercostal spaces at the top of the pectus ridge on both sides. Extend the horizontal plane to the lateral chest wall and mark between the anterior and midaxillary lines for transverse lateral incisions.

Patient is draped and marked for surgery

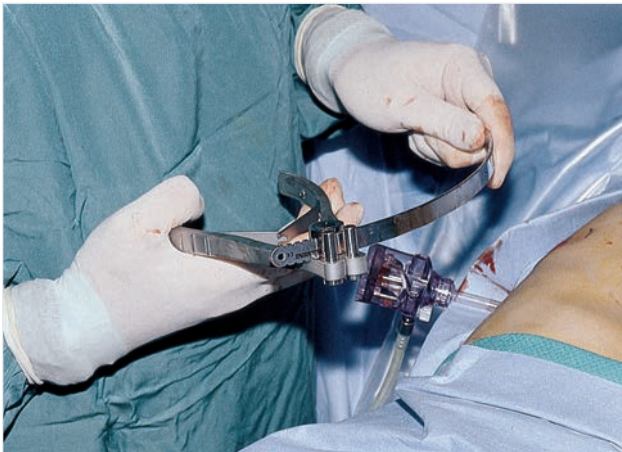




4.

The preoperative chest measurement is reconfirmed, and a Pectus Bar is selected for bending into the desired chest-wall curvature. The Pectus Bar Template can be used to visualize the shape necessary to correct the deformity. Special care should be taken in choosing the correct Pectus Bar length to maximize bar stability.

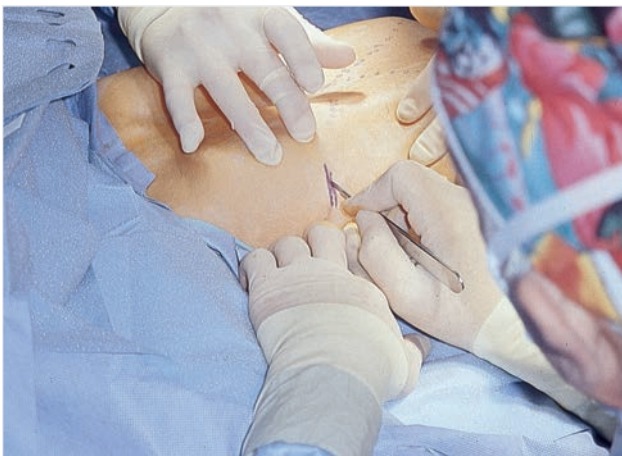
[Confirming preoperative measurements using a Pectus Bar Template](#)



5.

Using the Pectus Bender, shape the selected Pectus Bar from the center outward making small gradual bends. Position the cam on the bender at position "0" (minimum radius) then move the cam to position "1," and finally to position "2" (maximum radius). It may be necessary to exaggerate the curvature slightly to allow for the anterior chest-wall pressure and downward force of the sternum. To insure proper union between bar and stabilizer, avoid bending the lateral ends of the Pectus Bar. The selected bar is shaped for each patient Incisions being made at the predetermined marks

[The selected bar is shaped for each patient](#)



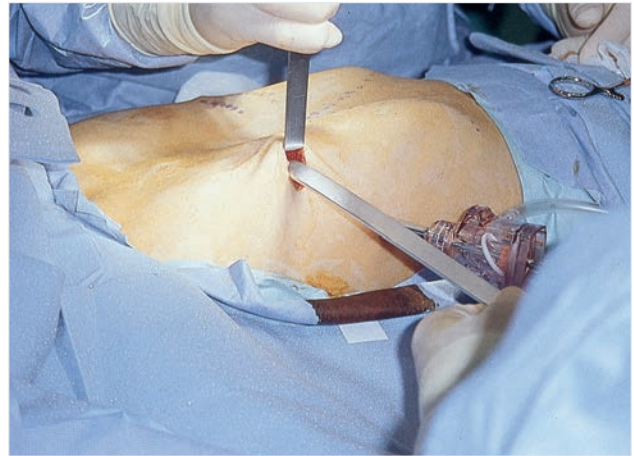
6.

Bilateral 2.5 cm transverse, thoracic incisions are made at the marks previously drawn in line with the deepest point of the depression in each lateral chest wall between the anterior and midaxillary lines. A skin tunnel is raised anteriorly from both incisions to the top of the pectus ridge at the previously selected intercostal space. The Pectus Bar enters the chest slightly medial to the top of the pectus ridge.

[Incisions being made at the predetermined marks](#)

7.

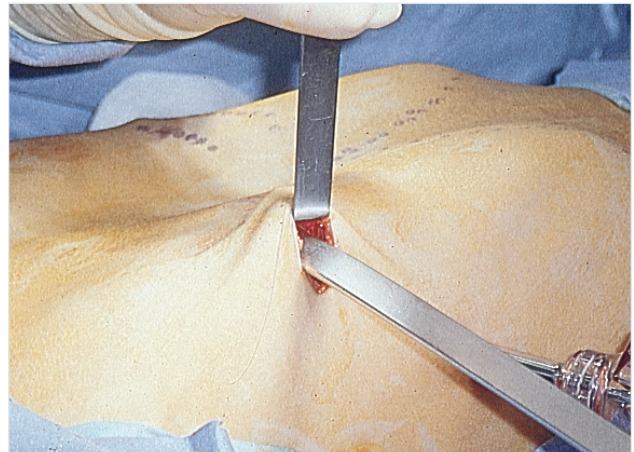
A 5mm, 0° or 30° thoracoscope is used during the procedure to visualize the chest organs. Insert the scope on the patient's right side, one to two intercostal spaces below the space which has been chosen for the Pectus Bar. The scope can be used bilaterally using the incision made on the patient's left, or a new stab incision can be made one to two intercostal spaces below the space which has been chosen. The chest is insufflated with CO2 for adequate visualization.



8.

Enter the chest from the patient's right with the proper Pectus Introducer in order to dissect a tunnel for the implant. The small introducer is for younger, smaller patients, ages 4-12. The long introducer is for older, larger patients, ages 13-18. Advancing the Pectus Bar Introducer to dissect a tunnel for the pectus bar.

[Advancing the Pectus Bar Introducer to dissect a tunnel for the pectus bar](#)

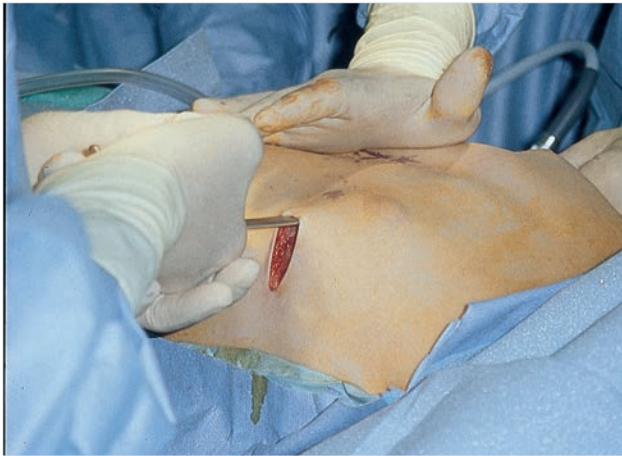


9.

The Pectus Introducer is slowly advanced across the mediastinum immediately under the sternum and is gently pushed through the intercostal space on the opposite side. The tip should face anteriorly and stay in contact with the sternum. Advance the device far enough through the opposite incision to allow for elevating the sternum and attaching of the umbilical tape.

[Introducer is advanced through the chest and the opposite incision](#)

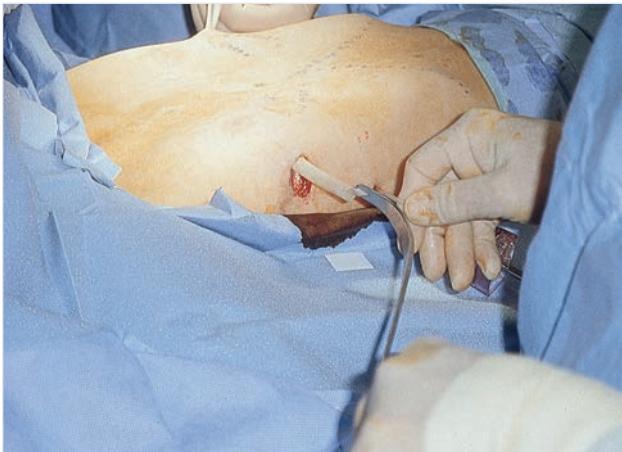




10.

Elevate the sternum by lifting the advanced introducer from both sides of the patient. Apply pressure above and below the sternum to obtain the desired curvature of the sternum. Repeat several times in order to stretch the connective tissues and correct the deformity prior to inserting the bar. Correcting the pectus excavatum by elevating the sternum with the introducer greatly facilitates initial bar rotation and improves bar stability.

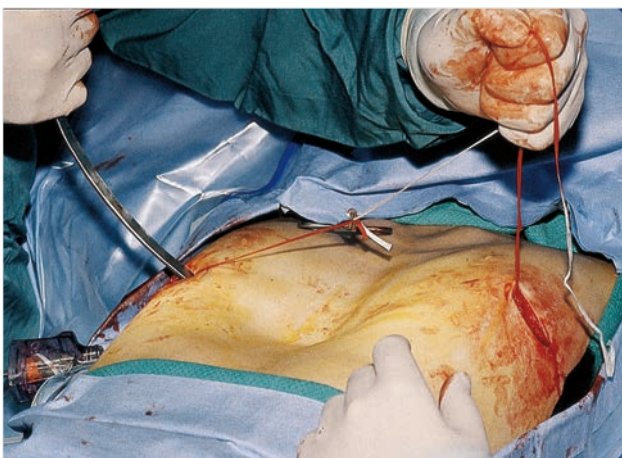
Pressure is applied to the sternum to stretch the connective tissues



11.

Two strands of umbilical tape are tied through the hole in the end of the introducer and then pulled through the tunnel by withdrawing the introducer from the patient's right side. One strand is used as a backup, while the other strand of umbilical tape is then attached to the bar and used to guide it through the tunnel.

Umbilical tape used to guide the bar



12.

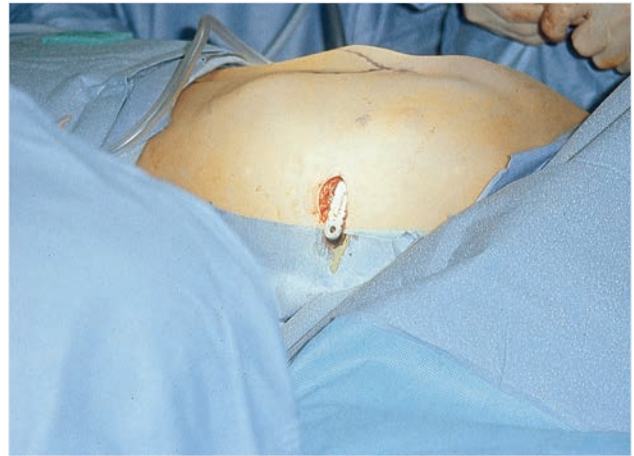
The curved Pectus Bar is pulled under the body of the sternum from the patient's right side with the convexity facing posteriorly. When the bar is in position, it is flipped with the Pectus Flipper causing the sternum and anterior chest wall to rise into the desired position.

Guiding the convex bar through the chest with the convexity facing posteriorly

13.

STABILITY OF THE BAR MUST BE DETERMINED AT THIS TIME. Such assessment will dictate the need for bar stabilization and for placement of a second bar behind the sternum. Typically, patients require one bar. Older, larger and more active patients or patients with a more severe deformity may require an additional bar to achieve proper correction and stability. If needed, a second bar is placed one or two intercostal spaces superiorly or inferiorly to the first bar.

[Pectus correction and implant stability are evaluated](#)



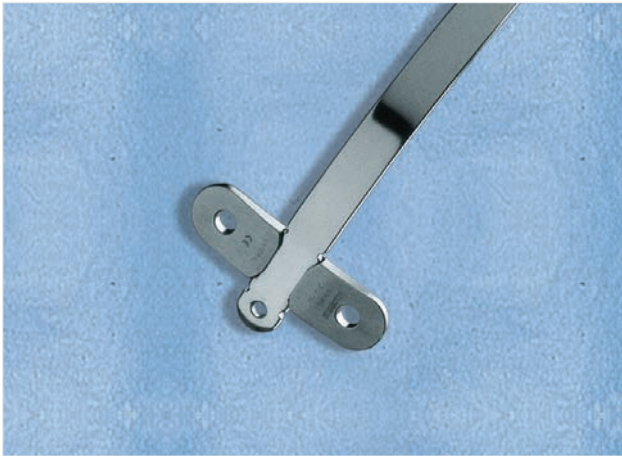
14.

A subcutaneous pocket is made posteriorly at each incision where the lateral end of the bar will be fitted with a Pectus Bar Stabilizer. One stabilizer is recommended for every bar implanted to limit rotation of the bar. Recommended patient ages for use of the stabilizers are:

- Patients 4-13 years - use one stabilizer per bar implanted
- Patients 14-18 years - use one stabilizer per bar implanted, however one may choose to use two per bar depending on the patient's pectus, muscular development, activity level (ie: sports), and the stability of the bar.

[Trial fitting a stabilizer \(01-3801\) to the implant](#)



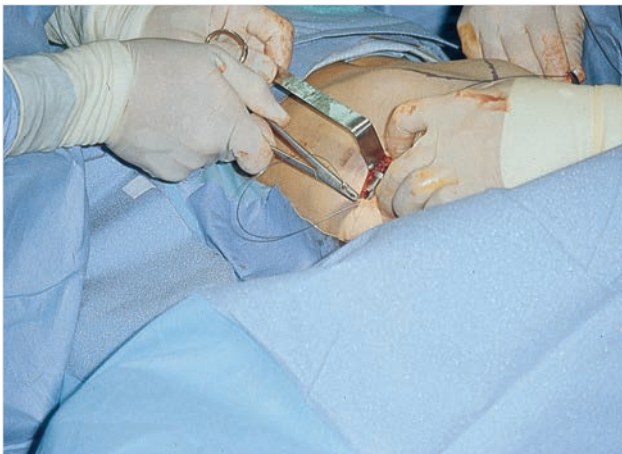


15.

An Elongated Stabilizer is chosen and fitted with the channel facing anteriorly and 1 to 2 cm of the lateral end of the bar exposed through the stabilizer. The stabilizer is then secured to the bar and sutured to the muscle after being properly fitted. The bar and stabilizer(s) should not be too anterior or posterior on the patient as this can lead to pain and tissue erosion.

- Elongated Stabilizer - Suitable for all patients in the recommended age range.

[Trial fitting a stabilizer \(01-3801\) to the implant](#)



16.

The bar and stabilizer are secured to each other and to the chest wall with multiple sutures to anchor the bar and stabilizer to the chest wall and bury the bar and stabilizer with tissue. The size and types of suture presently used are as follows:

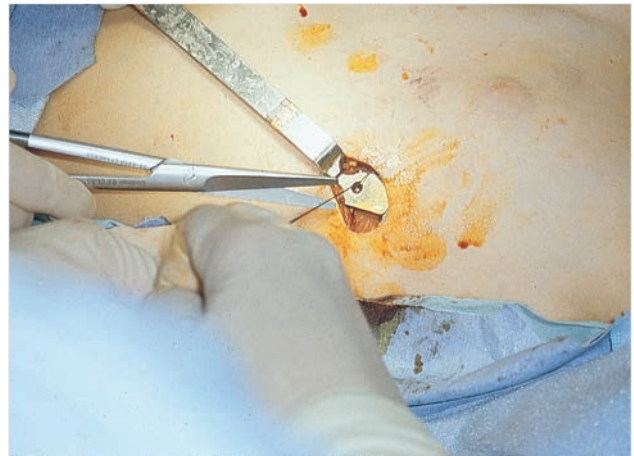
- Secure the stabilizer to the bar with a “figure-8 suture” around the junction of both devices with No. 3 cardiac wire or size “O” non-absorbable suture.
- Secure the holes in the bar and stabilizer to the chest wall muscles with size “O” absorbable or non-absorbable suture attached to a UR 6 (right-angle) needle.
- Secure muscle over the bar with “mattress sutures” using size “O” fast or slow absorbable suture attached to a large needle.
- Close the wound with a small-size, fast-absorbing suture and a dressing.

[Cardiac wire is used to “figure 8” suture both the bar and the stabilizer](#)

17.

Prior to closing the incisions, place patient in Trendelenburg's position, inflate lungs and apply positive end expiratory pressure (PEEP) of 4 to 6 cm H₂O to prevent pleural air trapping.

Suture to the chest wall muscles to anchor the device



18.

A chest radiograph should be obtained postoperatively to check for pneumothorax. The radiograph is excellent in showing final bar placement and may be obtained in the operating room or surgery-recovery area, as required.

Patient is ready for recovery



Postoperative Patient Care

Patients are kept well sedated for the first 1 to 3 days for postoperative pain management and to prevent bar displacement. Medications and therapies depend on the patient's response to pain and may include the use of an epidural catheter, intravenous morphine for breakthrough pain, patient-controlled analgesia and oral analgesia.

Postoperative patient handling by the hospital staff is important for avoiding bar displacement. Patients are discharged from the hospital when they are able to walk unassisted.

Recommended Postoperative Protocol

Day 1 Post-Op

- Out of Bed (OOB) to a chair with assistance OOB ambulation, as tolerated with assistance medical immobilization by nursing staff, as required eggcrate mattress (as indicated)
- NO chest or waist bending
- NO twisting
- NO LOG ROLLING
- Deep breathing and incentive spirometry every hour while awake

Day 2 Post-Op

- OOB to a chair with assistance
- OOB ambulation, as tolerated with assistance supine with hip flexion
- NO chest or waist bending
- NO twisting
- NO LOG ROLLING
- Deep breathing and incentive spirometry every hour while awake

Day 3 Post-Op through Discharge Day

- OOB ambulation with minimal assistance supine with hip flexion
- NO chest or waist bending
- NO twisting
- NO LOG ROLLING
- Deep breathing and incentive spirometry every hour while awake

Once discharged, the patient should maintain good posture and limit activity for the first month, with regular activity permitted after 4 to 6 weeks. The following guidelines have been developed to assist the patient's return to regular activity and reduce the risk of bar displacement:

- Walking should be done frequently

- Deep-breathing exercises performed twice a day, every morning and evening
- Patient can bathe and/or shower after five (5) days
- No waist bending, twisting or log rolling for first four (4) weeks at home
- Patient should keep a straight back with no slouching for the first month
- No heavy lifting for the two (2) months following surgery
- No sports for the first three (3) months following surgery

The implant remains in the patient for a minimum of two years. Should the patient require emergency medical attention during this period, the following recommendations will apply:

- MedicAlert® identification is recommended
- MRI of the chest or upper abdomen can be performed*
- Cardiac defibrillation, if necessary, is performed with anterior/posterior paddle placement to deliver electrical charge to the heart

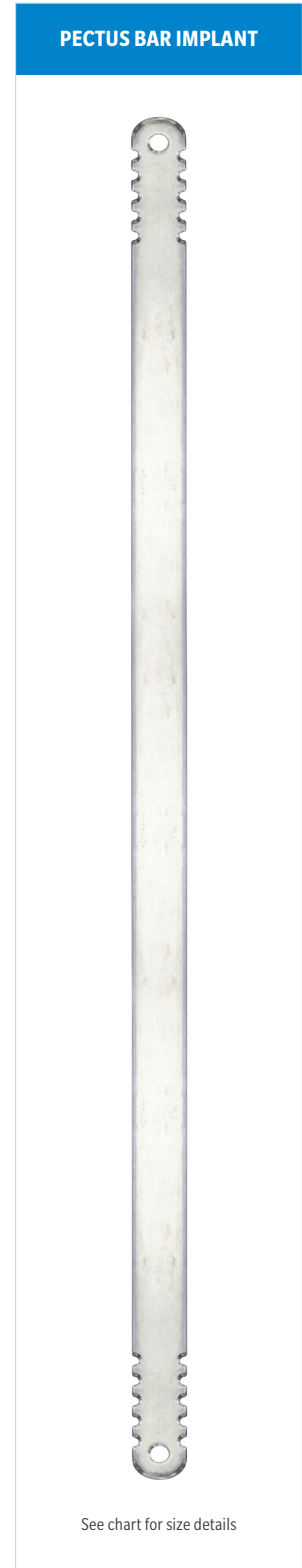
The patient should visit the doctor at regular intervals for evaluation of the chest wall. The implant is removed when the chest wall is deemed strong enough to support the sternum. Generally, the bar will remain implanted for a minimum of 2 years, and up to a maximum of 3 years.

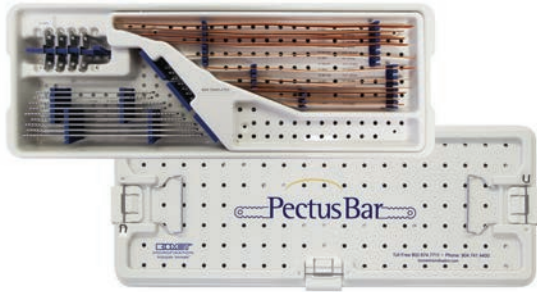
Bar Removal

1. Surgery for removal of the support bar(s) and stabilizer(s) is performed under general anesthesia as an outpatient procedure. The patient is in the supine position with the arms abducted. Incisions are made in the same locations as during the implantation.
2. The incision will allow access to the lateral tip of the support bar for removal of all stabilizers and any remaining sutures. The support bar is removed by pulling the bar through one incision while rolling the patient to the opposite side.
3. The incisions are closed with absorbable sutures, and a postoperative chest radiograph is recommended.

Pectus Bar Implant Ordering Information

SIZE IN INCHES	SIZE IN CM	PART #	TEMPLATE PART #
7	17.8	01-3707	01-3807
7.5	19.1	01-3707-05	01-3807-05
8	20.3	01-3708	01-3808
8.5	21.6	01-3708-05	01-3808-05
9	22.9	01-3709	01-3809
9.5	24.1	01-3709-05	01-3809-05
10	25.4	01-3710	01-3810
10.5	26.7	01-3710-05	01-3810-05
11	27.9	01-3711	01-3811
11.5	29.2	01-3711-05	01-3811-05
12	30.5	01-3712	01-3812
12.5	31.8	01-3712-05	01-3812-05
13	33.0	01-3713	01-3813
13.5	34.3	01-3713-05	01-3813-05
14	35.6	01-3714	01-3814
14.5	36.8	01-3714-05	01-3814-05
15	38.1	01-3715	01-3815
15.5	39.4	01-3715-05	01-3815-05
16	40.6	01-3716	01-3816
16.5	41.9	01-3716-05	01-3816-05
17	43.2	01-3717	01-3817





Standard Container
01-3920

X-Long Container
01-3925



Elongated Pectus Stabilizer
01-3801



Pectus Bender
01-3905



Pectus Bender X-Long
01-3907



Pectus Bender
01-3906



Pectus Flipper
01-3900



Pectus Removal
Benders, Pair
01-3911

Pectus Introducer



Small (18.8")
01-3909
Large (20")
01-3908
X-large (22.4")
01-3908X



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For more information on Pectus Bar and other thoracic solutions, please contact us at:

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