Pectus Carinatum Repair by Minimally Invasive Procedure
New Trends About Pectus Carinatum Repair

New Trends Pectus Repair

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Introduction

The aim of this article is to show a new minimally invasive procedure for Pectus Carinatum Repair. Moreover the purpose is also to mention the recent contributions developed by experts in this realm to reduce the aggressiveness of the open and invasive techniques utilized during the last half century [1-5].

Background

Since the 1988 published article that introduced the Nuss Procedure for Pectus Excavatum correction [6], interest has emerged among surgeons dedicated to chest malformation diseases to perform the Pectus Carinatum Repair with less invasive methods.

This trend has been increased starting with the original work we showed in 2005 [7]. Through a novel technique and using an original prosthesis (Patent no. US 7,156,847 B2), this procedure corrects the pectus carinatum (p c) by means of the insertion of a compressive pre-sternal implant.

Later the results of the first 40 corrected patients were shown at the American Pediatric Surgical Association (APSA) Congress, in Phoenix, AZ USA, 2007. [8]

The original procedure has been described by Steven Rothemberg M.D.[9] as a “Reverse Nuss”. We can also schematically depict it as an “Internal Orthesis”.

The novelty takes advantage of the therapeutic experience of pre-sternal chest braces [10, 11], which correct the anterior chest wall protrusions without surgery: avoiding costo-chondral resections, sternal ostectomies, wide muscle and dermical flaps, and wide skin incisions that can provide frequent keloids. On the other hand this innovation avoids the lack of adherence to treatment which is an important factor for orthotic failure treatments.

It is known that the final favorable brace appliance result lies in systematic, continuous and progressive increases of leaning on the back and front chest.

Many factors create practical difficulties for long term application: the annoyance in having to use it many hours a day; troubles in warm weather countries and dermical damage over the protruded zones among other findings.

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The New Apparatus and Procedure

This innovation is comprised of a new technique and a new apparatus for the correction of Pectus Carinatum by minimally invasive procedure. In this technique the sternochondral region is compressed by implanting a metal bar in the pre-sternal region and securing it bilaterally to the posterolateral portion of the costal arches (Figure 1).

The target patients are children and youths suffering the Pectus Carinatum Syndrome both in the symmetric or asymmetric forms (Figure 2, 3). Adequate elasticity of the chest is a key factor required in this surgical procedure to achieve an effective molding of the chest wall. The ideal timeframe for the operation is the period of rapid body growth. The compression system acts in a way similar to that of orthodontic braces. The results considered in terms of the contour of the chest wall and their anatomical characteristic is comparable to invasive techniques. The late development of chest wall rigidity that may occur when parietal resection is performed is also avoided.

Two fixing plates are firmly implanted anchored bilaterally by pericostal stainless steel wires sutures. The link between the fixation plates and the compressive bar is with screws. The system remains implanted until ossification is achieved, and an adequate thoracic shape is obtained (Figure 4, 5). The bar is removed at a later time.

Discussion and Conclusions

Pectus Carinatum is a frequent malformation and creates many medical consults because it is difficult to hide and deeply affects personality and behaviour. The orthotic procedures are cumbersome and time-consuming and generally have poor results. The surgical procedures have shown good results since the Ravitch technique. Open techniques are aggressive and leave scars that often bring keloids. This new method has the following advantages: no extensive incisions, no need for long muscle flaps, no resection of chondral or costal arches; no sternal section. This technique does not affect breathing mechanisms by avoiding the post-surgical rigidity created by extensive resections in the thoracic wall. This method brings about very good thoracic correction results. It is a new procedure similar to Nuss´ method for Pectus Excavatum repair but the reverse. Moreover, the apparatus is useful to correct Pectus Excavatum.

The aligned holes at both tips of the new designed bar let the surgeon apply progressive pressure at both sides finding the best possible thoracic shape. The threaded holes along the groove of the fixation plate make this useful manoeuvre easy and safe.

This technique has been inspired by the Nuss Procedure. However, this procedure has important differences. The extra thoracic, pre-sternal position of the implant decreases the risks of serious operative accidents and makes thoracoscopy unnecessary. Early discharge, rapid return to activity and freedom from positional restrictions, no need for long periods of avoiding rotation or displacement of the implant are the principal achievements of the innovation.

Asymmetric conditions are not a technical barrier with this minimally invasive technique. The pressure on the sternum and the protruded region of the chondrosternal junctions is transferred through the costal arches to a fixed point (the vertebral backbone); thus, the asymmetries are corrected. Tolerance of the implant was good especially in young patients younger than 14 years.

Novelties about Pectus Carinatum Techniques (Less Invasive Procedures)

In 1997 [12] Dr. Kobayashi from Japan reported a technique by endoscopy assistance, but including cartilage resections and sternal ostectomy by means of a little pre-sternal incision.

In 2004 [13] Dr. Fonkalsrud Eric proposed a technique with minimally cartilage resections that keeps characteristics of open surgeries: wide incisions, muscle flaps, osteo-chondral resections and sternal fracture.

In 2005 [14, 15] Dr. Saxena reports a less invasive procedure for both excavatum and carinatum disease: the Willital technique also known as PLIER, (Pectus Less Invasive Extra pleural Repair).

However, the PLIER technique maintains the characteristics of the open techniques: chondro-costal resections, sternal ostectomies, etc.

In 2006 [16] Dr. Klaus Schaarschmidt published another less invasive technique similar to the Kobayashi presentation, under assisted endoscopy, but including chondral resections and sternotomies.

The Hungarian experience developed by Dr. Attila Kal-

Figure 1. Squeme of the implant

man [17] and Andras Hock [18] after they were aware of our technique in 2005 which was published in the Separ Bronconeumonology Review. Both reports are similar. The bar is implanted in intra thoracic position, and then pre-sternally and finally inserted intra-tho-

Figure 2. Patient before correction.

racicly in the opposite hemithorax.

In spite of the favorable results, in my opinion this procedure has the disadvantage of being invasive in both pleural cavities. Moreover, the implant stability depends on the wavy shape that the compressor bar adopts. For that reason, the removal of the bar may be more difficult or risky due to this particular design.

In 2008 [19] Dr. Seock Yeol Lee from Korea, reported his experience performing partial cartilage resection and pre-sternal compression with a stainless steel bar

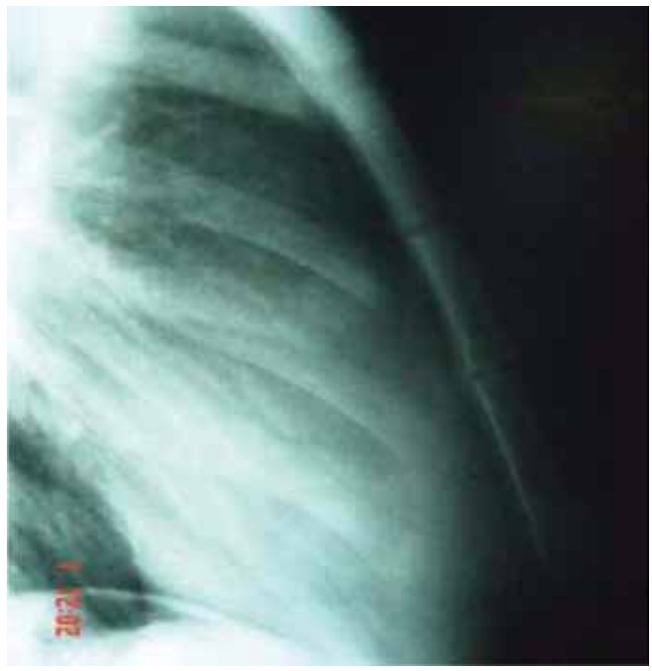

Figure 3. XRay befor correction.

in 10 patients with pectus carinatum.

In 2009 [20] Dr. Sunghoon Kim reported his experience from Children's Hospital Oakland, CA, USA. This technique was applied just in an unilateral Pectus Carinatum patient and has the disadvantage of being invasive making the cartilage resections within the thoracic cavity.

The Turkey experience was lead by Dr. Mustafa Yüksel from Istanbul [21]. He was the first surgeon to give importance to the new procedure which he found out about at the European Association for Cardio-Thoracic Surgery (EACTS) Congress in Barcelona 2005, and proceeded to apply it. Later in Buenos Aires in 2007 attending the World Federation of Associations of Pediatric Surgeons (WOFAPS) Congress showed his first experience. After 3

Figure 4. Patient after correction.

Figure 5. XRay after correction.

Pectus Carinatum repairs decided to change the Nuss Bar for a design similar to the original implant.

In 2008 [22] Dr. Patricio Varela from Chile reported two cases corrected also by means of the compressive technique but utilizing the Nuss Pectus Excavatum design. The follow up was short: 9 and 3 months respectively, but showed the disengagement of the implant in one of the two patients.

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