A Brief Historical Review of
The Challenges of Treating Pectus Excavatum and Carinatum.

Donald Nuss FRCS(C), FACS, FAAP
Professor Surgery, Emeritus.

2016

Conflict of Interest

- Grant support for research studies: CHS Foundation, Norfolk Foundation, Lorenz Surgical, Biomet Microfixation, Al-Rashid Foundation.
- Travel support: too numerous to list here.
- Royalties for the bar: Lorenz Surgical, Biomet Microfixation.
- Speaking honoraria: too numerous to list here.
Brief Historical Review

3,000 BC-1500 AD:  
No mention of Chest wall deformities: 4,500 years

1500-1900:  
?
Johani Bauhinus’ Case Report:
Oberservationum Medicarim. Liver II, Observ. 264,
Francfurti 1595, S 507 – Joh Bauhinus (420 years ago)

Congenital posterior displacement of the sternum and ribs causing difficulty with breathing.

My father showed me a boy 7 years of age, among the Nobles of Andalusia who was born with the sternum and ribs being bent back to the internal part of the chest and abdomen, so that a large cavity appeared there. It seems as though the diaphragmatic ligaments are pulling these parts inward. From birth the patient has labored with this defect, having difficulty breathing and chronic irritating cough. Now he labors very seriously, such that he seems to be in danger of suffocation because of viscid sputum. The mistress of Andalusia states that she has another grandson much younger born by the same daughter who is affected by the same defect.


250 years after Bauhinus:
The Discovery of Inhalational Anesthesia. 1846.
For the next 70 years anesthesia was administered by face mask. Thoracic Surgery remained off limits until the 1920’s when a single widebored tube became available for intubation. A cuffed tube only became available in 1932.

In 1904 Professor Mikulicz sent his resident, Sauerbruch, into the lab to find a way to operate on all the pulmonary TB patients. A fork in the road and he chose the wrong fork!
"Iron Lung used during the Poliomyelitis Epidemic 1953

3000 BC-1500 AD: No progress
1900-1950: ?
Meyer’s One Case Report in 1911: (105 years ago).
Result: “unsatisfactory”.

Diagram illustrating operation performed by Meyer, 1911.
Black area represents costal cartilages which were resected.

First Partial Costal Cartilage Resection and Sternal Osteotomy
Sauerbruch F. D Zeitschr Chir. 234:760,1931

Fig 17. Diagram illustrating partial resection of costal cartilages, sternal osteotomy and external traction by Sauerbruch, 1931.

Now (21st century) sometimes referred to as a modified open or modified Ravitch procedure.
External Traction 1920-40

- Costochondral incision or resection, sternal osteotomy AND EXTERNAL TRACTION

Sauerbruch (1931);

HISTORICAL PERSPECTIVE 1939

Ochsner and Debakey:
Report of a case and review of the world literature.
More than 20 different techniques.
J. Thor. Surg,
Vol 8, June 1939.
Brief Historical Review

1500-1900:

1900-1950:
First attempt at surgical repair-1911 Meyer-105 years ago after 5,000 years.
Endo-tracheal intubation became available.
Development of the partial costal cartilage resection technique-1931 Sauерbruch.
External traction for sternal support.
Numerous other techniques were also developed.

1950-2000:
?

Ravitch: “The paradoxical depression of the sternum during inspiration suggests that the problem is a short central tendon of the diaphragm and in order to do away with external traction, all the deformed cartilages need to be removed. The intercostal structures are transected so that the sternum is free”.

THE OPERATIVE TREATMENT OF PECTUS EXCAVATUM*
Mark M. Ravitch, M.D.
Baltimore, Md.

From the Department of Surgery, the Johns Hopkins University and the Johns Hopkins Hospital, Baltimore, Maryland.

The operation for pectus excavatum was put in proper perspective by the detailed review of Ochsner and DeBakey1 in 1939 and by the series of patients presented by Lincoln Brown2 in the following year. Since the recent publications of Sweet3 and of Lester4 with their modifications of previous techniques, pectus excavatum has been established even more firmly as a congenital deformity amenable to surgical correction.
Complete resection of the costal cartilages on both sides, oblique transection of the 2nd cartilage on each side, mobilisation and isolation of the sternum and wedge osteotomy.

"Experience has demonstrated the ease and safety with which the operation can be performed, even in infants."

75 patients, 86% before school age

Welch KJ. SATISFACTORY SURGICAL CORRECTION OF PECTUS EXCAVATUM DEFORMITY IN CHILDHOOD. J Thoracic Surg, 1958 36(5), pages 697-713

"The ideal age for operation is between 2 and 5 years, for boys and girls.
The most favorable results are obtained in the younger patients."

Internal Fixation solved the problem of recurrence by preventing the sternum from sinking into the chest but wide resection remained the procedure of choice for both pectus excavatum and carinatum.
In 1979 and for many more years the standard approach for pectus carinatum repair was still the Ravitch technique.


In 1990, Pena drew attention to the danger of asphyxiating chondrodystrophy in young children and proved his hypothesis in an experimental study on baby rabbits.

Conclusion: “It appears necessary to develop alternative techniques that avoid the removal of costal cartilages and to re-evaluate the optimal age for repair of these malformations.”
A 10-year review of a minimally invasive technique for the correction of pectus excavatum.

Nuss D, Kelly REJr, Croitoru DP, Katz M:


A paradigm shift.
Brief Historical Review

1595-1900:

1900-1950:
First attempt at surgical repair - 1911 Meyer
Development of partial costal cartilage resection - 1929 Sauerbruch.
External traction for sternal support.

1950-2000:
Wide resection of all costal cartilages and sternal isolation - 1949 Ravitch.
Internal sternal support - Adkins Bar 1961.
Dynamic Carinatum Compression - 1979 Haje.

2000-2016:
?

PEDIATRIC NOTES by Sydney S. Gellis M.D., Editor:

THE WEEKLY PEDIATRIC COMMENTARY 1996;20;99-10

“It has been evident for a long time that far too many young children have had surgery for pectus excavatum.”

“I have stormed for years against surgeons who have published large series. The operation is worse than the disease.” 1998;22:184
45 patients were referred to our chest clinic in ten years.

1987-1997

2012: 1463 patients—median age 15 years

Age at Primary Surgery

Median Age at Surgery: 15 years, ranging from 1 to 31 years

Data collected through 1/1/2012

n=1463
Number of articles on Pectus Excavatum. (PubMed)

- 1980-1989: 311
- 1990-1999: 304
- 2000-2009: 601
- In 1998 only 11 articles on Pectus Excavatum found on Pub Med world wide.
- In 2013 there were 163 articles on Pectus Exc. found on Pub Med world wide.

Klobe’s vacuum bell for pectus excavatum: Micha Bahr presented a resident paper on the subject at 1st Ped Surg World Congress in 2003


Ferro and Fraire: Dynamic compression system 2008
They were the first to measure the pressure required to correct carinatum.

Combined Procedure: Operative innovation..

Are there situations where combined procedures are necessary or helpful? Yes! These can be open or closed.

We have used this combined procedure in several older patients who had a rigid chest, with a good result.
Operative innovation to the “Nuss” procedure for pectus excavatum
Al-Assiri A, Kravarusic D, Wong V, Dicken B, Milbrandt K, Sigalet D.

Magnetic mini-mover procedure for pectus excavatum III:
safety and efficacy in a Food and Drug Administration-sponsored clinical trial.
Pectus Up Bardaji Procedure.

Brief Historical Review

1500-1900:

1900-1950:
First attempt at surgical repair-1911 Meyer
Development of partial costal cartilage resection-1929 Sauerbruch.
External traction for sternal support.

1950-2000:
Wide resection of all costal cartilages and sternal isolation 1949 Ravitch.
Internal sternal support-Adkins Bar 1961.
Dynamic Carinatum Compression-1979 Haje.

2000-2016:
Vacuum Bell-Klobe 2005
Carinatum pressure brace (Ferro & Fraire) 2008
Abramson Procedure 2008
Combined Procedure 2009
Magnetic Minimover Procedure (Harrison).
Pectus Up Procedure.
Challenges we faced when performing the Minimally Invasive Procedure.

1. Bar length, strength, configuration and number.

1987: Malleable Rectangular Titanium Bar was too soft and was the wrong shape.

Bar Insertion
In 1993 in conjunction with Walter Lorenz Surgical the bar was completely redesigned, new material was used which was much stronger and it had rounded ends. This bar required special instruments in order to bend and mold it into the correct configuration.

This bar required special instruments in order to bend and mold it into the correct configuration as shown here. This was the first time that instruments were specially created for the Minimally Invasive Procedure.
With the change of the incisions from anterior chest wall to lateral chest wall, we had to re-evaluate the length of the bar. We concluded that subtracting 1 inch or 2 cm from the measurement taken from right to left axillary line gave the correct length, since the bar takes a shorter course than the tape measure.

Measure from Right to Left Mid Axillary and subtract 1 inch or 2 cm.

Patient is measured in the clinic so that there is enough time to order the correct length bar.
Initially we tended to make the bar too long.

Bar needs to be 2cm shorter than measurement! Because it takes a shorter course than the tape measure.

Dr. Pilegaard has advocated using an even shorter bar.
Pilegaard’s Short bar technique: note position of the stabiliser.

Dr. Pilegaard operates mostly on older patients >16yrs or older, and he has changed his technique to a slightly longer and eccentrically placed bar to prevent it from sinking into the chest. The short bar should not be used in young patients who are still growing.

Minimally Invasive Procedure Statistics
No of Bars for Primary Surgical Patients 2005

<table>
<thead>
<tr>
<th>NUMBER OF BARS</th>
<th>1 bars</th>
<th>2 bars</th>
<th>3 bars</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>521</td>
<td>169</td>
<td>4</td>
</tr>
<tr>
<td>%</td>
<td>75%</td>
<td>24%</td>
<td>1%</td>
</tr>
</tbody>
</table>

LENGTH OF STAY
Median 5 days
Range 3 days – 11 days

Data collected through 01/30/05
Minimally Invasive Procedure Statistics
No of Bars for Primary Surgical Patients 2010

LENGTH OF STAY
Median 5 days
Range 3 days – 14 days
BLOOD LOSS
Median 10 cc

NUMBER OF BARS
1 bar
n = 839
68.3%
2 bars
n = 388
31.5%
3 bars
n = 4
0.3%

Data collected through 12.31.2010

Minimally Invasive Procedure Statistics
No of Bars for Primary Surgical Repair 2013

LENGTH OF STAY
Median 5 days
Range 2 – 14 days
BLOOD LOSS
Median 10 ml

NUMBER OF BARS
1 bar
n = 1061
61%
2 bars
n = 667
38.3%
3 bars
n = 9
0.5%

Data collected through 12/31/2013
Number of Bars for Primary Surgical Repair 2014

<table>
<thead>
<tr>
<th>LENGTH OF STAY</th>
<th>Median</th>
<th>5 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLOOD LOSS</td>
<td>Range</td>
<td>2 – 14 days</td>
</tr>
<tr>
<td></td>
<td>Median</td>
<td>10 ml</td>
</tr>
</tbody>
</table>

**NUMBER OF BARS**

- 1 bar: n = 1030, 60.0%
- 2 bars: n = 677, 39.5%
- 3 bars: n = 9, 0.5%

Data collected through 12/31/2014

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Long-Term Results by Length of Time Bar in Situ (Bars Removed before December 31, 2009)

Data collected through 12/31/2010

- Excellent
- Good
- Fair
- Poor
- Failed

* n=886
Challenges we faced when performing the Minimally Invasive Procedure.

1. Bar length, strength, configuration and number.
2. Lateral thoracic incisions.

The anterior chest wall incision lead to keloid formation and unsightly anterior chest wall scar.

10 y.o who is 6 years post repair.
When we moved the incisions to the lateral chest wall we had to re-define the location of the thoracic entry and exit sites.

These two slides show the relationship of the lateral thoracic incisions to the thoracostomy sites which need to be medial to the pectus ridge on each side. We received several patients from other centers in whom the bars were placed too far laterally.
We also had to re-design the configuration of the pectus bar.

Correct Configuration of the Pectus bar is very important. We also saw patients in whom the bar was too flat allowing the lung to herniate between the bar and chest wall.

Middle bar has correct configuration
Asymmetric Pectus Excavatum.


Asymmetric Bar for asymmetric pectus excavatum.

Challenges we faced when performing the Minimally Invasive Procedure.

1. Bar strength 1989, length and configuration 1992
Initially we placed mattress sutures on each side of the bar creating a soft tissue bed to hold the bar in place but that was inadequate-15% displacement rate. Metallic Stabilizer Developed 1998

Even with the stabiliser in place there was still a 5% recurrence rate and so we added PDS pericostal sutures in 2002 for a 1-2% displacement.
Bar Displacements for Primary Surgical Patients

Bar chart showing the proportion of bar displacements requiring revision and those with no revision for different stabilization methods:

- No Stabilizers: 15.3% requiring revision, 4.5% with no revision
- Stabilizers: 11.8% requiring revision, 3.4% with no revision
- Wired Stabilizers: 4.5% requiring revision, 3.4% with no revision
- Wired Stabilizers with PDS sutures: 3.4% requiring revision, 3.4% with no revision

Data collected through 12/31/2010

n=111, n=119, n=575, n=515
Bar stability is also dependent on positioning the bar under the deepest point of the depression as shown by the arrow. (There are no short ligaments pulling the sternum down)


Claw Fixator and Hinge Plate

Challenges we faced when developing the Minimally Invasive Procedure.

1. Bar strength 1989, length and configuration 1992
In 1995 when faced with a very deep pectus excavatum we used the superior tunnel technique by first creating a tunnel superiorly and leaving the bar in place before tunneling under the deepest point of the depression.

1. Superior tunnel technique: First Tunnel is under the superior sternum where it is not so deep. Leave introducer in place to keep the sternum elevated.
2. Vacuum Bell Technique: The Vacuum bell works well in young patients with a flexible chest. First used in 2005.
**Intraoperative Suction Cup Lift for Severe Pectus Excavatum.**
American College of Surgeons Congress, Video Presentation, Chicago, IL, October 12, 2009. Obermeyer R.

3. Elevating the sternum with a variety of hooks or retractors
Czech Method to elevate sternum
Courtesy of Dr. Jiri Snajdauf, Prague

TECHNICAL INNOVATION IN MINIMALLY INVASIVE REPAIR
OF THE PECTUS EXCAVATUM

Rygl M, Vyhnanek M, Kavalova L, Kuklava P, Mixa V, Snajdauf J
Department of Pediatric Surgery, Department of Anesthesiology and Reanimation
4. Uemura technique: the hook is inserted lateral to the sternum. Tedde, Ribas et al: bilateral Langenbeck retractors are used instead.

5. Park’s Crane Technique
Park’s Crane Technique with Thompson Retractor.

*Sternal Elevation significantly reduces risk of cardiac and/or pulmonary injury.*
Challenges we faced when developing the Minimally Invasive Procedure.

1. Bar strength 1989, length and configuration 1992

Thoracoscopy is essential to prevent complications. The scope may be placed on the Right, Left or Both sides. Flexible scopes are ideal.

Thoracoscopy not only minimises risks but allows one to place the bar in the ideal position under the deepest part of the depression. There are still surgeons who do not use a scope!!
Position of thoracoscope when arms are abducted. Flexible or 30° scopes give better visualisation.

Note angle of trocar, to avoid injuring diaphragm and liver.

The diaphragm and liver extend more superiorly than shown in this drawing.
Last, but not least, THE NEW POSITION ON SURGICAL TABLE, minimizes the possibility of a brachial plexus lesion; this is due to the placement of the arms of the patient along his/her body.

Some surgeons prefer left sided thoracoscopy but it is important to review the CT scan before inserting the trocar.
Tunneling – keep the tip in view at all times. Dissect from undersurface of sternum downwards. Do not push the introducer forwards.

Keep the tip in view until you can see across the mediastinum. Advantage of Co2 insufflation is no capillary bleeding.
5. Leave the first introducer in place while doing the 2\textsuperscript{nd} tunnel. Note the 2cm distance between the sternum and the pericardium.

Challenges we faced when developing the Minimally Invasive Procedure.

Up until 1997 we used the Original Instruments, only the bar was re-designed.

Original Instruments

“New introducers” greatly facilitate tunneling and permit sternal elevation after tunneling.

Sternal elevation corrects the deformity before bar insertion and decreases the amount of pressure on the bar.
“New introducers” permit sternal elevation

Sternal elevation corrects the deformity before bar insertion and decreases the amount of pressure on the bar.

Sternal elevation was not possible with the original instruments.
Sternal elevation using the “new introducer”: is very important for bar stability and for molding the anterior chest wall.

Bar Flippers
Challenges we faced when developing the Minimally Invasive Procedure.

1. Bar strength 1989, length and configuration 1992
8. Analgesia: Pre-empt the pain cascade, Narcotic PCA pump, NSAIDS, muscle relaxants. Epidural was used from 1994 to 2010.

Pre-empt the pain cascade before the patient wakes up.

• Start Toradol (NSAID) after induction of anesthesia.
• Start Narcotic (Morphine, Fentanyl, Methadone etc) in the O.R. while closing the incisions, via PCA pump before the patient wakes up.
• Continue with Toradol- requires high IV rate and H2 blockers.
• Narcan, Benadryl, Phenergan and Docusate should be ordered.
• Continue with antibiotics for 24-48 hours.
• Beware of:
  Oversedation.
  Respiratory depression.
  Nausea/Vomiting.
  Hypotension.
  Low urine output— inappropriate ADH secretion.
Post-Operative Pain Management

First Week:

- Narcotic via PCA Pump 48 hours for continuous infusion.
- Ketorolac IV for 48 hours then switch to oral NSAID (? H2 Blockers, High Fluid Load)
- Diazepam (Valium) 2-3mg IV q6h or Robaxin.
- Vigorous pulmonary toilet (Incentive Spirometer, Acapella or Flutter Valve – VIP to prevent pneumonia).
- Patient must sleep on his/her back.
- Discontinue antibiotics when temp is normal.
- Discontinue bladder catheter day 1.
- Switch to oral pain meds day 2-3 and disch day 4-5

Post-Op Day 1

No pain, no nausea, no vomiting
Challenges we faced when developing the Minimally Invasive Procedure.

1. Bar strength 1989, length and configuration 1992

Post-operative Management (cont.)

Week Two to Six:
- Wean off pain medication
- Encourage walking
- Encourage deep breathing exercises BID
- Return to school +/- 3 weeks
- No sports for 6 weeks
- Check patient in 3 to 6 weeks: bar position, compliance with exercises, instructions, etc
Post-Operative Management (cont.)

After six weeks:
- Patient should be off all pain medication-if not, why?
- Slowly resume normal activities
- Breathing and posture exercises twice a day
- Aerobic sports-soccer, basketball, swimming
- Check-up at 6 mo, 12 mo, 24 mo and 36 months
- Bar Removal at approximately 36 months

Long Term Follow-up: normal chest expansion with respiration

Age 10

It is not enough just to do the repair!
Compare the exercise program for post-op cardiac surgery, orthopedic surgery, etc
It is Essential to Receive Proper Training and to Develop A Center Of Excellence: A Well Trained Multidisciplinary Team Markedly Decreases The Complication Rate.

- Surgeons.
- Anesthesiologists.
- Pectus Program Director & Coordinator.
- Nursing Teams-Pre-op Clinic, O-R, In-Patient.
- Pain management Team.
- Respiratory Therapy Team.
- Physical Therapy Team.
- Child Life Team.

Numerous surgical centers have done over 2000 cases.

Summary of Present Treatment Options.

Before 1998 there was only one option: wide resection. In the last 18 years we have developed the following options:

Pectus Excavatum:
1. Vacuum Bell. (Non-invasive).
2. Closed or minimally invasive bar procedure.
3. Open minimal resection procedure.
4. Combined minimally invasive procedure
5. Experimental procedures. H and B.

Pectus Carinatum:
1. Bracing: Haje, Ferro, etc
2. Abramson procedure
3. Open minimal resection procedure.
After 105 years of surgical innovation we have a New Challenge.

Convincing primary care doctors, governments and insurance companies that chest wall deformities require repair for both psychological and medical reasons.

This patient's social development would be severely compromised and he would become a social outcast if his cleft lip were not repaired. However, surgical repair is routinely approved. We need to have the same routine approval for chest wall deformities. Unfortunately, that is not what happens in many centers.
Subject: STAKEHOLDER TESTING: Draft policy proposition for a Surgical procedure to correct pectus chest deformity (Adults and Children) (B10X01)
Date: 2015-11-24 17:02
From: "clinicalpolicies ENGLAND (NHS ENGLAND)" <england.clinicalpolicies@nhs.net>
To: Undisclosed recipients:

Dear Stakeholders and Clinical Reference Group members,

We are writing to request your views on a clinical commissioning policy, which is being developed by the Clinical Effectiveness Team at NHS England.

A policy proposition has been put forward for NHS England to commission a surgical procedure to correct pectus chest deformity (Adults and Children). A draft clinical commissioning policy and evidence review is attached.

As a stakeholder, we wish to hear your views on this proposal, before it is considered further by NHS England and, if approved, what level of public consultation would be most appropriate. In particular, we are keen to 'sense check' the draft policy proposition to determine whether any amendments to the policy proposition are required and if the evidence gathered is fit for purpose. If you are aware of additional evidence, please provide us with full reference details; journal and date.

A short guide to this testing process is attached, setting out in greater detail the areas on which we would like to hear your views. A standard response form for the policy proposition is also attached to this email - please note that in order for these responses to be processed we can only accept responses that are submitted using this form.

Please could you ensure all responses are submitted no later than 18:00 Tuesday 1 December 2015 to the following email address england.clinicalpolicies@nhs.net and quote this reference: B10X01.

Please note that this testing process does not seek to pre-empt or replicate the full public consultation on approved proposals that will follow later this year.

Yours sincerely,

NHS England Clinical Effectiveness Team

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Why should we care what the Insurance Companies think?
Well! The British Health System will no longer allow nor pay for Pectus Repair in their system.

- On Feb 13, 2016, at 4:41 AM, Davis, Carl <Carl.Davis@ggc.scot.nhs.uk> wrote:

  Dear all
  Pectus surgery in England is facing a crisis.
  Please support those who would benefit from this surgery and don't let NHS management destroy the service.

  Thank you
  Carl Davis
Dear Margaret,

The NHS is about to ban all pectus surgery!! We need to defend it for the NHS. Are you able to send this E-mail out to everyone you know with an interest in pectus surgery so we can get as many stakeholders together as possible to defend the 80 people per year who get pectus surgery!!

Joel Dunning

(Dr Kornaszewska is chief of thoracic surgery in Cardiff, Wales.)

PEDIATRIC NOTES by Sydney S. Gellis M.D., Editor:

THE WEEKLY PEDIATRIC COMMENTARY 1996;20;99-10

“It has been evident for a long time that far too many young children have had surgery for pectus excavatum.”

“I have stormed for years against surgeons who have published large series. The operation is worse than the disease.” 1998;22:184
Subject: Re: [CWIG] 25 days to save Pectus Surgery in the UK - We need your help!
To: "Robert M.D. Kelly" <Robert.Kelly@chkd.org Cc: "Sridhar Rathinam, etc

Date: Tuesday, February 23, 2016, 5:25 PM

Dear CWIG members:

The Board of the Brazilian Society of Thoracic Surgery (SBCT) decided to forward to all its 630 members the notice about the “non-routine commissioning” position that NHS England has about pectus surgery encouraging them to answer the Online Survey. Trying to overcome the language barrier we included a detailed road map of the NHS site and a model of the questionnaire answered. The address of the CTS net page was added also.

We hope Brazilian thoracic surgeons will participate helping to save pectus surgery.

Chest configuration is a Masculine Indicator in our society. Male pectus excavatum patients have a very poor body image and often have suicidal ideation.

A very happy winner of the Mr Universe contest. A very depressed pectus patient.
An example of poor social development and adjustment in a Pectus Patient with catastrophic results:

“I am a 36-year-old male living in the Boston area. I have been living with PE my entire life. It has been a terrible problem for as long as I can remember. I was the one child growing up who hated taking off my shirt in gym class. It has caused such emotional stress that suicide was part of my every day thinking as a teenager. I was the only one in my school who had it. I thought I was a freak. I refused to play any sports where there was any chance that I would have to take off my shirt and as a result of my PE, I never learned how to swim. I always acted as though I was not interested in playing sport, even though I was a good athlete and was dying to play!!!! My parents always asked me why I didn’t want to go out for any sports teams like my brother and sister (they were also very good athletes and popular in school). High school was a nightmare!!!

My 20’s weren’t too much easier as I was the one guy at the beach in 90 degree temps with his shirt on. I did not look forward to summer. I have become an alcoholic and my wife has divorced me because of my anger.”

The Misery starts at a very young age because children have a natural aversion to deformities.

“I was five y.o. and sitting at a pool learning how to swim when a boy my same age turns and looks at me. He points to my chest and says ‘What’s wrong with you?’. I looked down not even knowing anything was wrong with me. He looked at me strangely, got up and went and sat on the other side of the pool. Even a child with no stereotypes, no prejudice wants to get away from me. To him I am not normal. And he is right. I am a freak, a mutant.”

At school I began to learn to try to hide myself. I was afraid of others seeing me. I would turn away and only show my back to people. However, one day Someone saw me and said right before my eyes, ‘Look at his chest! That’s Gross!’ They named me Birdchest. Always after sport practice we came back to the middle school hall and as I entered, flashing on all the computers over and over again in endless loops was the familiar word, ‘Birdchest’. All twenty hummed the truth at me. I hated myself for what I was, what I am, and what I will always be.”
Chest configuration is also a Feminine Indicator in our society. 364,000 Breast augmentations are performed in the USA every year.

A very happy winner of The Miss USA contest

Another very depressed pectus patient

16 y.o. Self Referral
Asymmetric Pectus Excavatum

Very depressed, anorexic and asocial. Pediatrician did not refer her
This 16 y.o. self referral patient was severely depressed, anorexic, asocial and withdrawn when she came to us with this asymmetric, grand canyon type excavatum, ribs sticking out and breast hypoplasia. Mother had to do all the talking because she just sat there silent and miserable because her life was so awful. She had no friends.

One year after pectus repair:
“My life is so completely different now.”
The Pediatrician never referred this 16 y.o. patient for surgical consultation.

At age 8 years his pediatrician told mother not to be concerned because it would be resolved by the time he finished puberty. But it just got worse and worse and now he has developed lobar emphysema. This is a self referral as the pediatrician did not think he needed repair.
E-mail consultation showing Chest CT of a 50 y.o. patient who was asymptomatic until age 45 and is now incapacitated and in cardiac and pulmonary failure:

Despite this patient’s very severe PE he was able to compensate until age 45 years, but now he is dying prematurely from cardiac and pulmonary failure and it may be too late to save him. Note the relationship of the very severe pectus, the heart and the left lung.

Why wasn’t he repaired at age 13? or even 5 years ago when he became symptomatic.

This is an example of untimely referral

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2015 E-mail Consultation from an Adult Pulmonologist: Dr B…

“I have a 50 year old, male patient with severe resting hypoxia (O2 saturation is only 74% on room air) and hypercapnia (CO2 is 54mmHg). PFT’s are very restrictive with FVC at 20% predicted value. Estimated pulmonary systolic pressure is 55 mmHG with reduced RV function.”

“The patient functioned well until 5 years ago, when he started to become dyspneic. But his dyspnea has become progressively worse and he is now incapacitated”.

“Except for his severe pectus excavatum, I can find no other pathology to explain his deterioration and would greatly appreciate your opinion.”
Follow up on my consultation patient one year post-op:

“I feel very good and have to go to the doctor next week for check-up!!”
(statement modified for Hippa)

This patient was incapacitated and dying before surgical repair.


42 PE patients aged 50+ years presented with fatigue, exercise intolerance, shortness of breath, palpitations, inspiratory obstruction, and chest pain which started after 40 years of life with steady progression leading to declining quality of life and incapacitation.

They were diagnosed as “unexplained cardiovascular complaints” by their doctors even though they had significant PE.

11 pts (26%) ECG showed serious conduction disturbances or arrhythmia.
9 pts (21%) ECHO showed mitral valve insufficiency, MVP and enlarged Right Heart.
Central Venous Pressure was increased by 5 cm.
Rt Cardiac Cath showed RT atrial pressure was markedly increased to 13mmHg.

11 pts underwent repair with excellent results and symptoms disappeared.
(But what happened to the other 31 patients? Were they left to die because the pulmonologists did not think the pectus excavatum was the problem?!!!!!!!!!!!!)
What is your Challenge?

Your challenge is to show that Chest Wall Deformities need to be repaired before they cause permanent physical and psychological damage.

We cannot do prospective double blind studies but we can do “before and after” cardiac and pulmonary studies and we can do “body image” studies. However, they must be scientifically well done which requires well trained staff and research grants.

If you do not have enough patients then combine with other institutions.

I would like to commend Drs Pilegaard, Jaroszewski, and Sigalet for their contribution to the pectus cardiac literature and Dr Kelly for his contribution to the pectus pulmonary literature—you will be hearing from them later in the program.

Thank you.

“Yeah! the paradigm has changed!”.  

6 months post repair.
The End.