

전공의 연수교육
흉벽질환 및 다한증

2013. 5. 25

강남세브란스병원

이 성 수

Pactis Carinatum

Pactis Excavatum

HISTORY

大韓 胸部外科學會雜誌 第1卷 第1號
Vol. 1. No. 1 Decembr, 1968

Von-Recklinghausen 氏病을 同伴한 Funnel Chest 1 治驗例

李英秀* 李榮根* 閔震植**

= Abstract =

A Case of Funnel Chest Associated with von-Recklinghausen's Disease of the Skin

Y.S .Lee.* M.D., Y. K. Lee,* M.D., J.S. Min,** M.D.

A case of funnel chest associated with von-Recklinghausen's disease of the skin, who was treated surgically under the method of sternoturn-over at the 63rd Army Hospital, Republic of Korea Army, is presented with review of the literature.

漏斗胸의 手術矯正*

盧 浚 亮*

= Abstract =

Correction of Funnel Chest: A Report of 4 Cases

Joon Ryang Rho, M.D. **

Four patients with funnel chest deformity corrected in the Department of Thoracic Surgery, Seoul National University Hospital are presented.

The first case was a 21-year old female with cyanosis, clubbed fingers and systolic murmur on the left infrascapular region on physical examination associated with agenesis of the right lung.

The deformity was of asymmetrical funnel chest, in which the left hemi-thorax was more sunken. She was corrected by the method of Funnel Costoplasty of Wada.

The second case was a three years old boy whose anterior chest wall was symmetrically deformed, and he was corrected by the method of Ravitch using Adkins strut under the sternum.

The third was a 22-year old man with symmetrical deformity, and was corrected by the method described by Shannon in 1973.

The last patient was a 22-year old man and he had dyspnea on exertion, palpitation and apical systolic murmur with symmetrical funnel chest deformity.

He was also corrected by Ravitch operation,

All of them has excellent result.

大韓胸部外科學會誌 第19卷 第4號
Vol. 19, No. 4, December, 1986

누두흉의 수술 교정*

- 8 예 보고 -

大韓胸部外科學會誌 第25卷 第12號
Vol. 25, No. 12, December, 1992

새가슴 수술치험 1례 보고

목 형 균* · 신 호 승* · 홍 기 우*

=Abstract=

The Surgical Correction for Pectus Carinatum

- One Case Report -

Hyoung Kyun Mok, M.D.*, Ho Seung Shin, M.D.*, Ki Woo Hong, M.D.*

Pectus Bar를 이용한 누두흉에서 수술적 치료

황 정 주* · 신 화 균* · 김 도 형* · 이 두 연*

대흉외지 2003;36:164-174

임상연구

Nuss 술식에 기초한 누두흉의 최소 침습 수술: 수술 수기의 개발 및 322예의 조기 성적

대흉외지 2007;40:369-375

임상연구

압박 교정기를 이용한 새가슴의 치료

이석열* · 손진성* · 전철우* · 이승진* · 이철세* · 이길노*

Treatment of Pectus Carinatum with a Compressive Brace

Seock Yeol Lee, M.D.*, Jin-Sung Son, M.D.*, Cheol-Woo Jeon, M.D.*,
Seong-Jin Lee, M.D.*, Chol-Sae Lee, M.D.*, Kihl-Rho Lee, M.D.*

*Deformities of the anterior chest wall
are widely recognized,
poorly understood and
generally neglected.*

– Charles W. Lester

Pectus Excavatum

- **Funnel chest** (congenital) involves the sternum as well as the ribs.
- Usually it is marked as a depression on the sternum.
- The degree of the depression on the sternum varies from mild to severe. In severe cases, the depression on the sternum is so deep that it involves most of the anterior chest wall.



- Pectus excavatum is a relatively common anomaly
 - occurs in about one in 300–400 live births
 - three times more frequent in males
 - often associated with connective tissue disorders, such as Marfan's disease or Ehlers-Danlos syndrome
- Symptoms
 - palpitation, exertional dyspnea, fatigue and dull precordial pain, paradoxical breathing, exercise intolerance
- The deformity is also often emotionally disturbing, especially in adolescents, who often avoid active sports and become shy and retiring.

Etiology

- heredity :about 20 to 50% of patients have a family history of pectus deformities - Williams 1872
- an overgrowth of the costal cartilages – Flesch 1873
- arrested growth of the sternum - Ebstein 1882
- various intrauterine compressive forces such as pressure by the chin, knee or elbow
- latent mediastinitis – Raubitsch
- undue traction exerted upon the sternum by the diaphragmatico-sternal ligament - Lincoln Brown 1939(1596)

Repair of PE

- Initially surgical intervention
 - only for patients with severe sternal depression
 - aimed primarily at relieving cardiac compression
 - cosmesis played a secondary role
- Deformed chest
 - a potential source of embarrassment
 - especially during adolescence and in young adulthood
 - operative correction is now recommended by most practitioners even in the absence of other symptoms
- Earlier operations - easy to perform, better results
 - at a later age :chest is less pliable and less accommodating

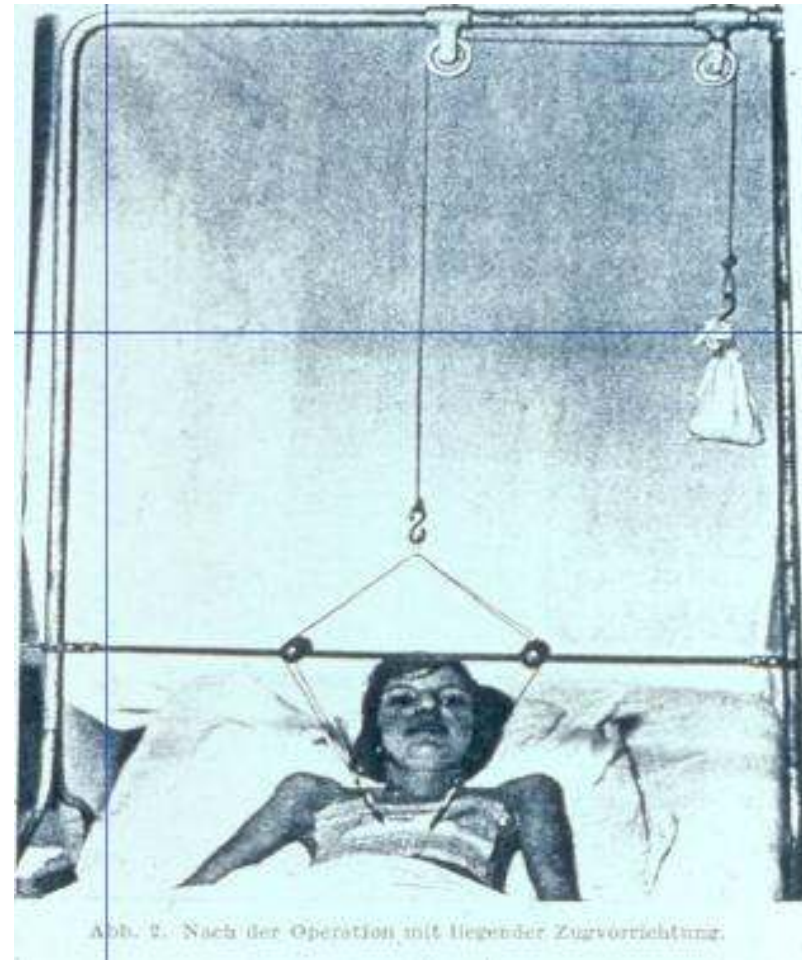
Historical period

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External Traction 1920-30

Costochondral
incision or resection,
sternal osteotomy
**AND EXTERNAL
TRACTION**
Sauerbruch (1931);



The modern era

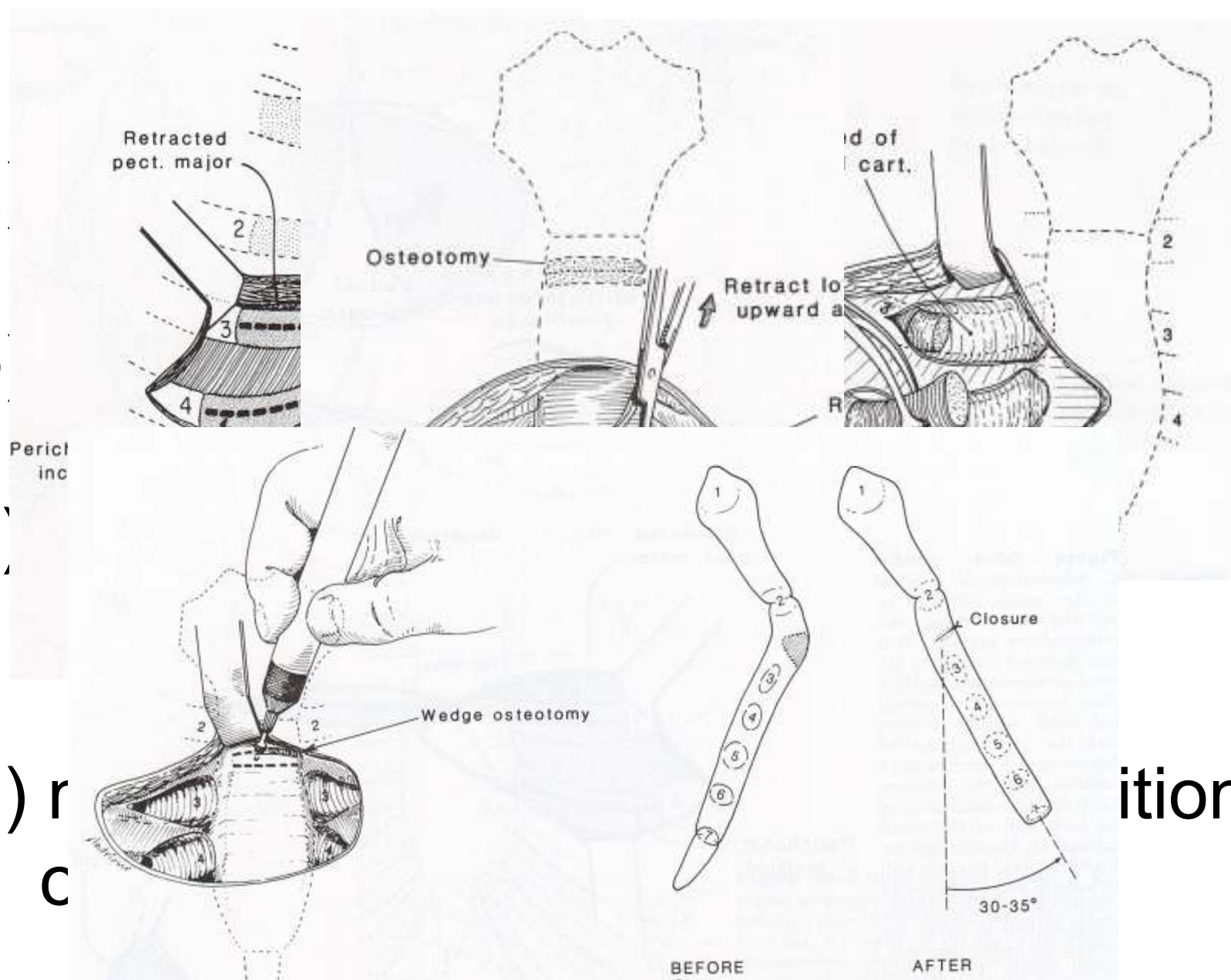
- less than satisfactory late outcomes
- corrected position of the sternum using **substernal support**
- The principles of modern pectus excavatum surgery
 - Ravitch in 1949.
 - (a) the removal of deformed cartilages,
 - (b) division of the xiphisternal articulation,
 - (c) transverse cuneiform osteotomy of the sternum at the upper level of the deformity
 - (d) maintenance of the corrected position of the sternum

(a)

(b)

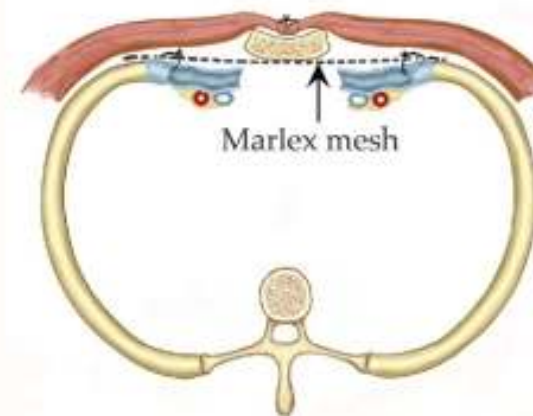
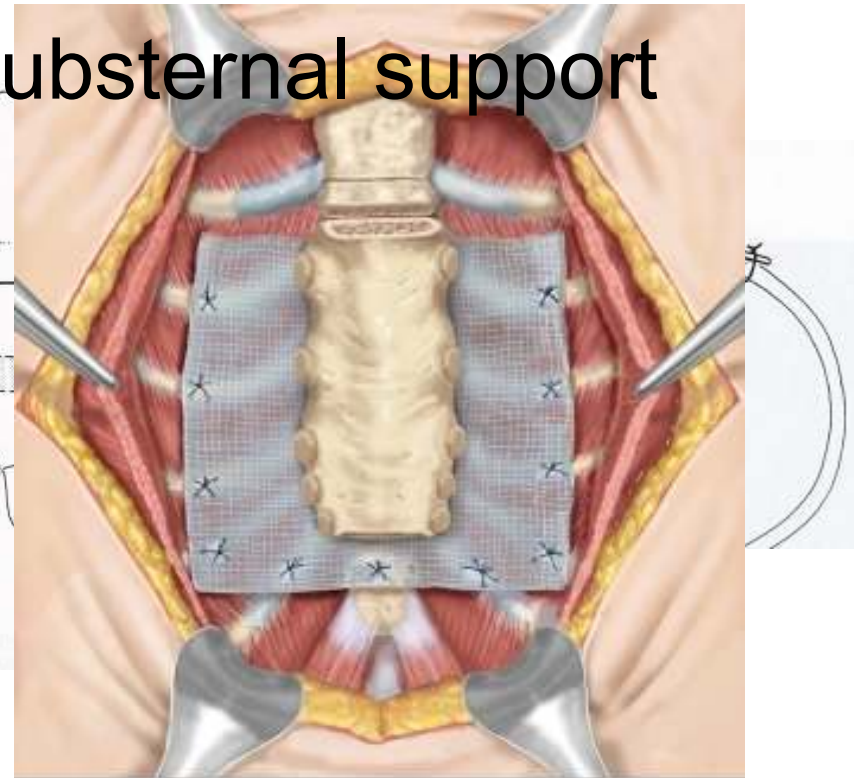
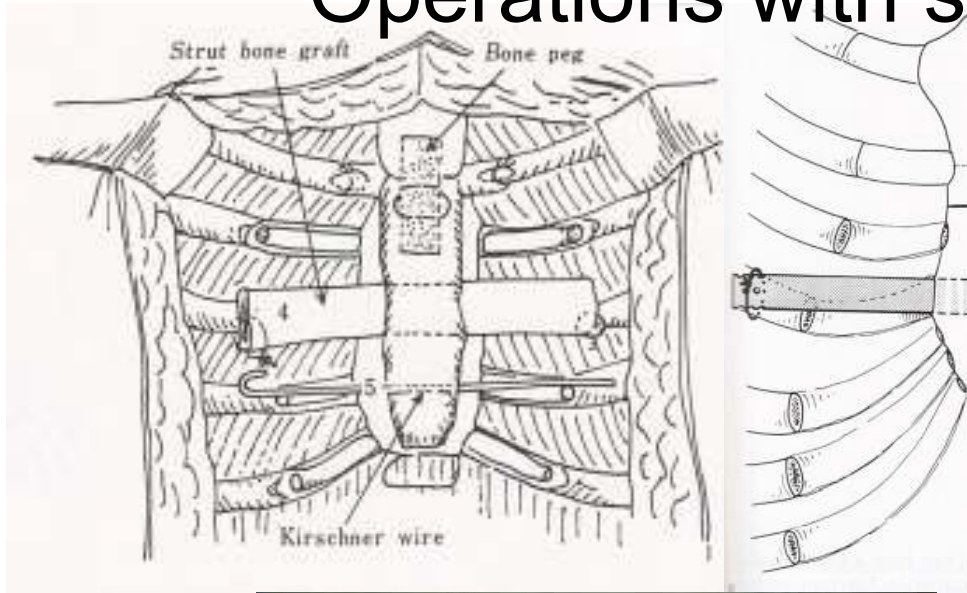
(c)

(d) r
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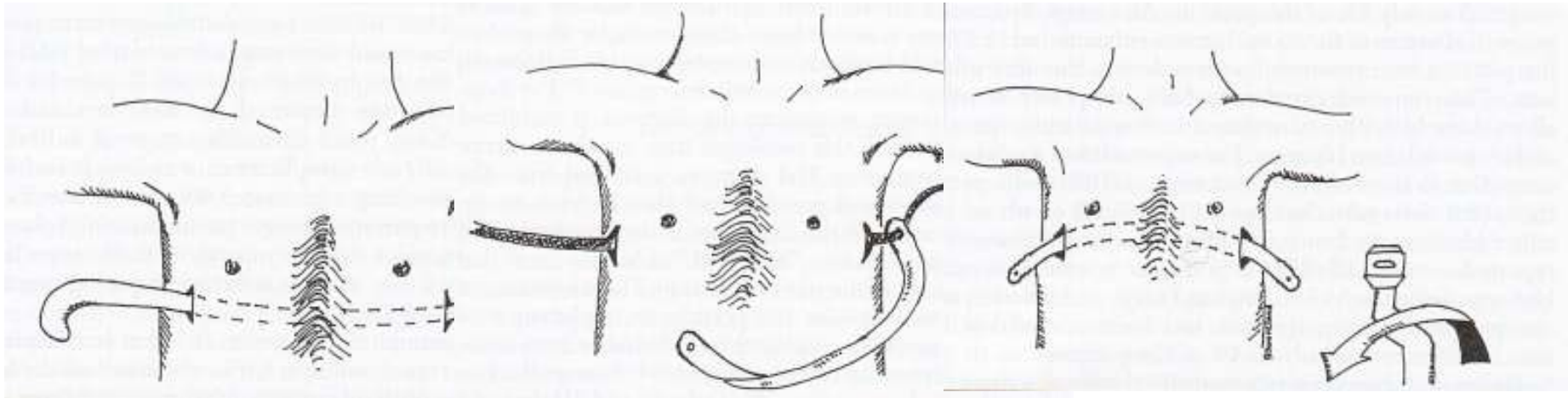
Operations with substernal support



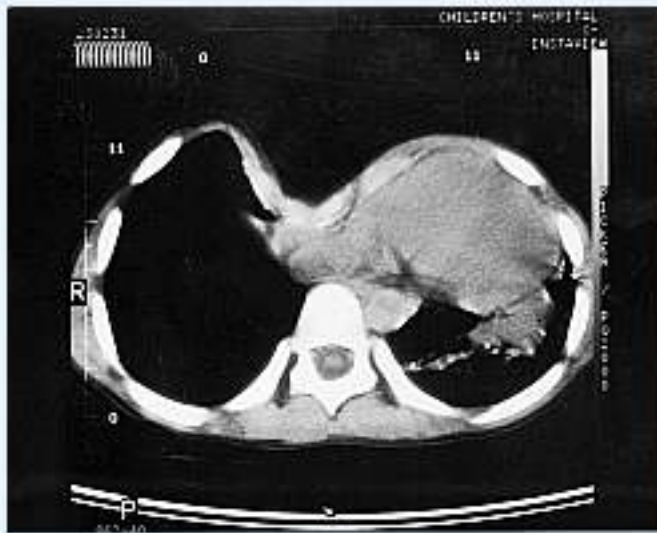
New Pectus Excavatum Surgery

- “minimally invasive repair of pectus excavatum” by Donald Nuss in 1998
- the number of patients operated for pectus excavatum has more than tripled in the last few years

Nuss procedure



Pre-operative



Post-operative



Why a new approach?

NORFOLK 1977 POST RAVITCH REPAIR

Failed rib regeneration, subcutaneous cardiac impulse



Acquired Asphyxiating Chondrodystrophy

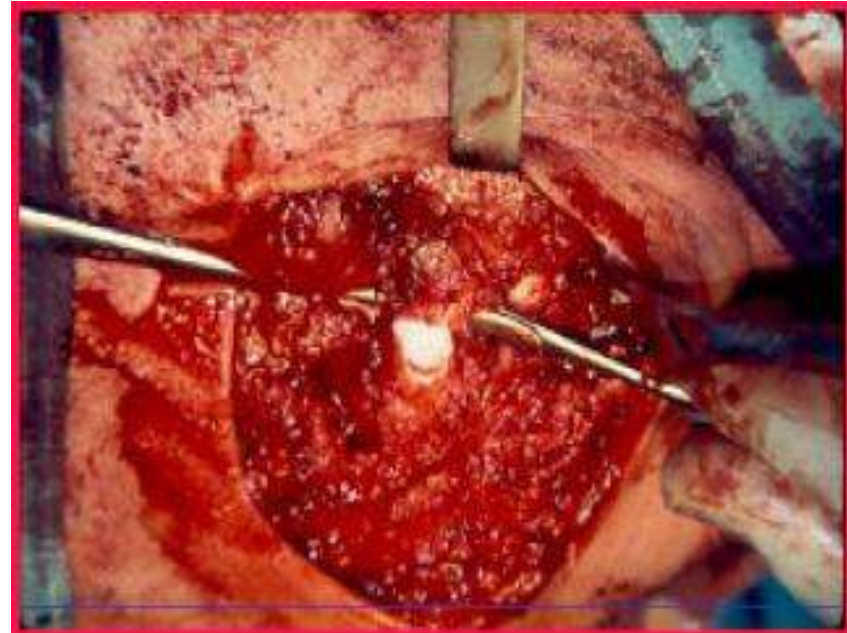
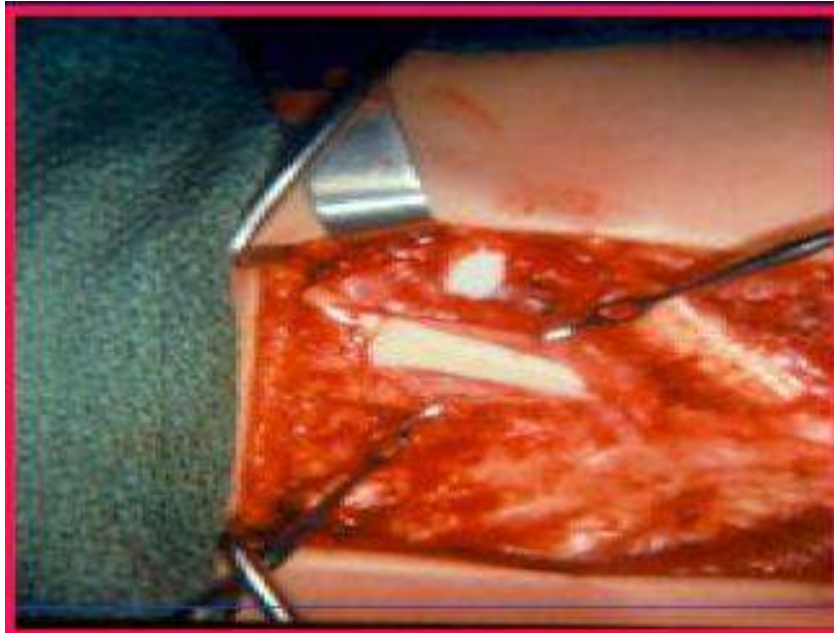


Rigid and corrugated anterior chest wall.



**Second opinion post Ravitch recurrence,
Procedure done elsewhere.**

When removing the rib cartilage it bent to a 90* angle

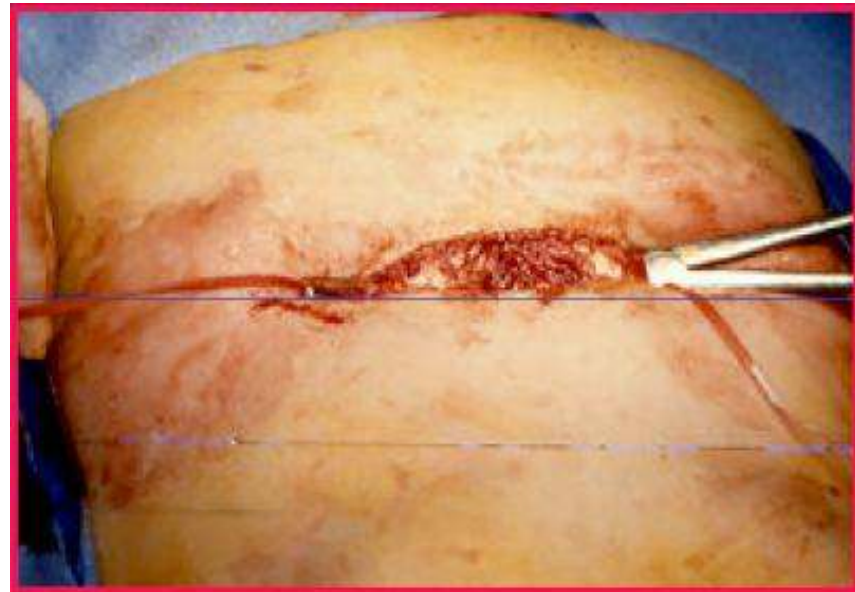
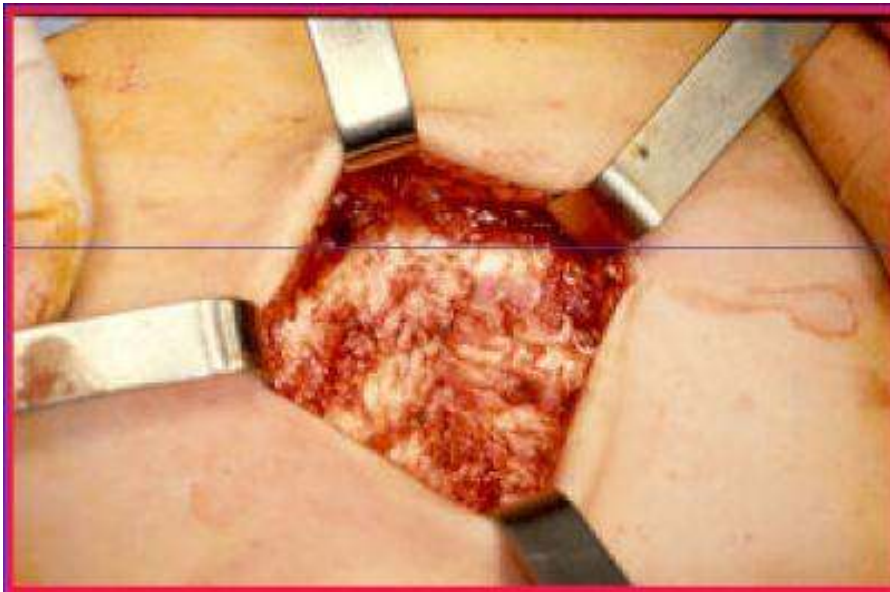


“Why are you removing it?
Can you not see how flexible it is?”

A New Idea

1987

First Minimally Invasive Pectus Procedure



Kelly clamp tunneled under the sternum

Malleable Rectangular Titanium Bar

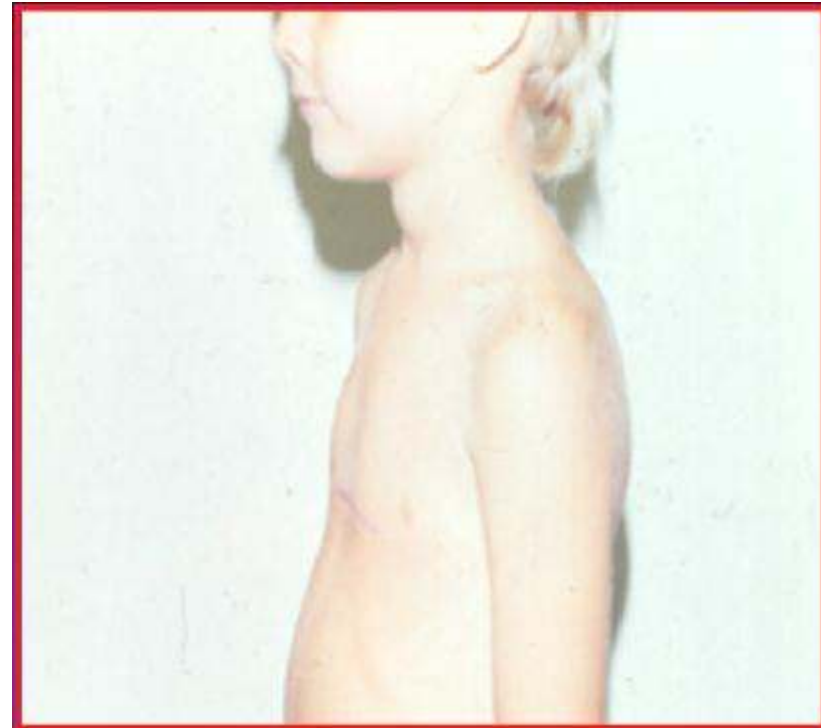


Bar Insertion

1st Patient – One month Post 1987



1st Patient – 6 months later



Conclusion: Bar is not strong enough so the initial excellent correction has not been maintained. Patient is now flat-chested.

In 1988 the manufacturer agreed to strengthen the titanium bar by making it thicker.

R.R. Long Term Follow-up



R.R Age 14



R.R. Age 18

1991 Pectus Bar withdrawn

- We can no longer supply you with the bar.
- You are the only surgeon using the special bar.
- Malpractice risk too high.
- Result: No pectus excavatum repairs for 2 years.

**New Bar designed and produced in 1993
In conjunction with Walter Lorenz Surgical
New bar is much stronger and has rounded
ends for easier insertion**

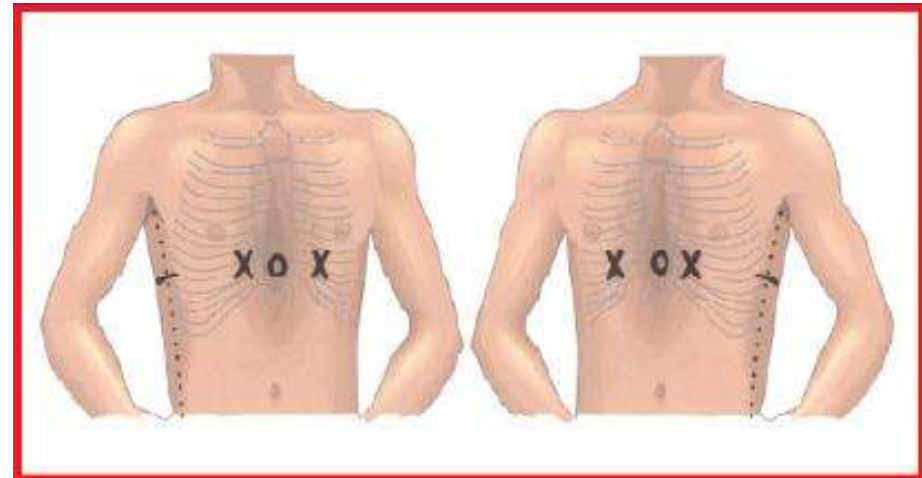


A.C age ten, 6 years post repair Keloid formation



Conclusion: Move the incision away from the anterior chest.

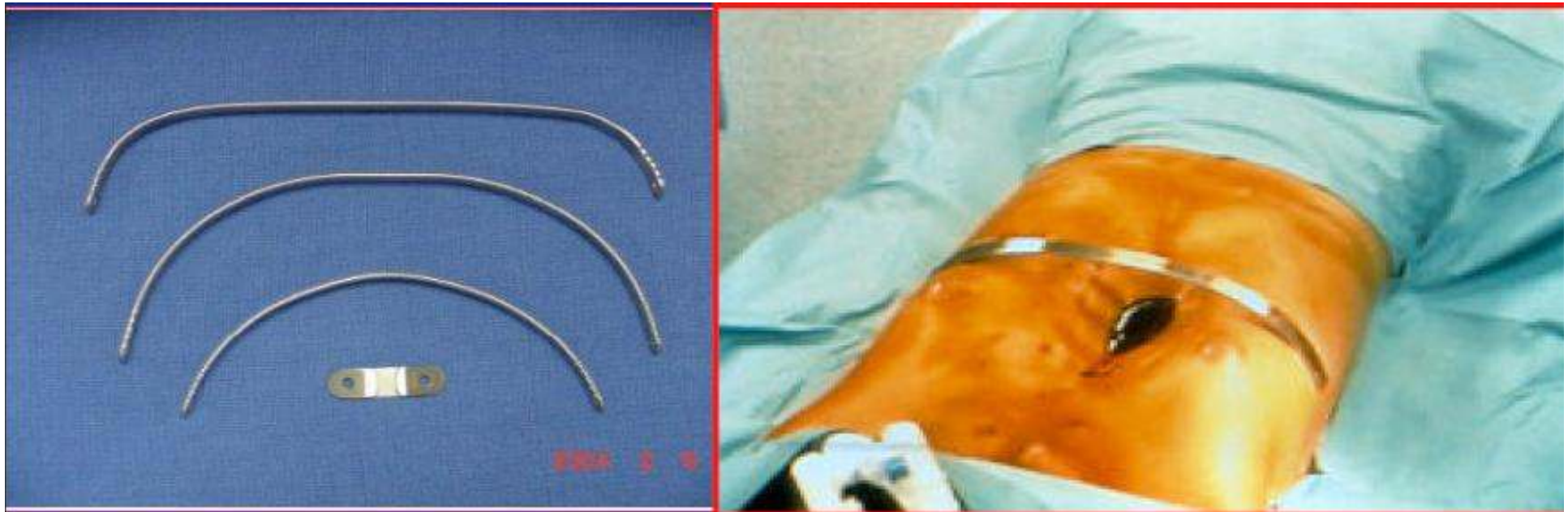
Lateral Thoracic Skin Incisions



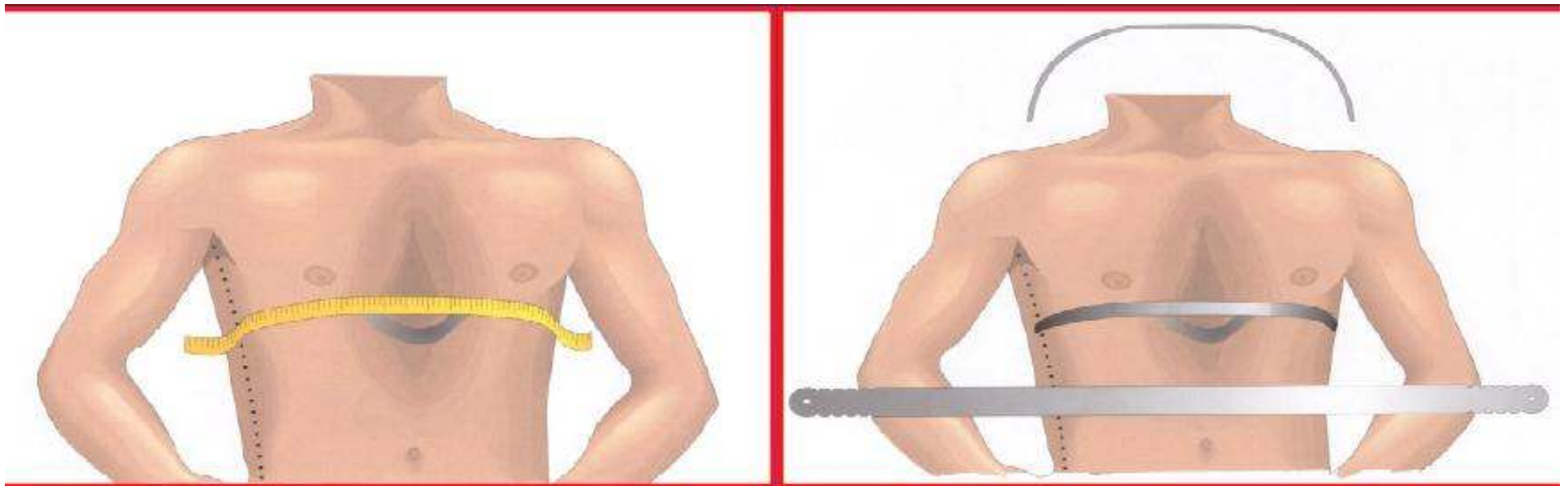
Minor overcorrection is ideal because it minimizes the risk of recurrence and decreases costal flaring



Correct Bar Configuration



How long should the bar be?

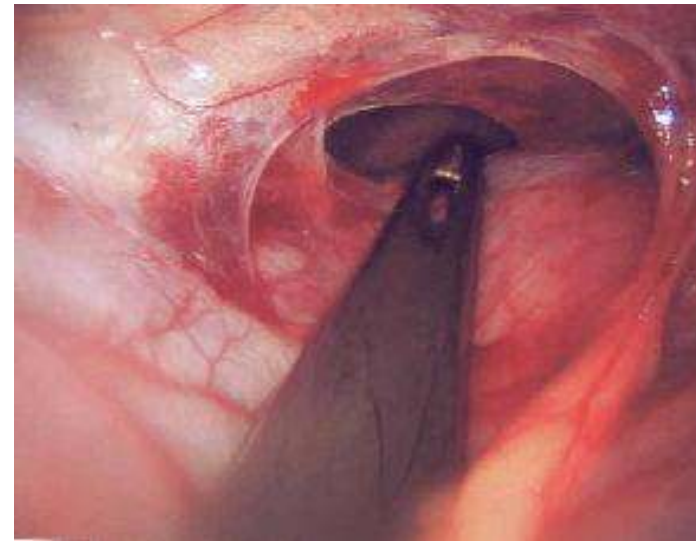
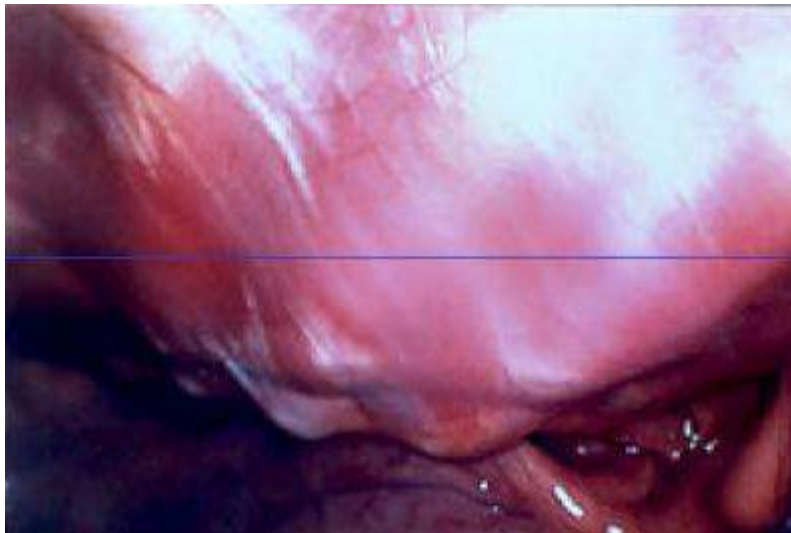


Bar needs to be 2cm shorter than measurement!

Thoracic Epidural Anesthesia started in 1994 (optional)

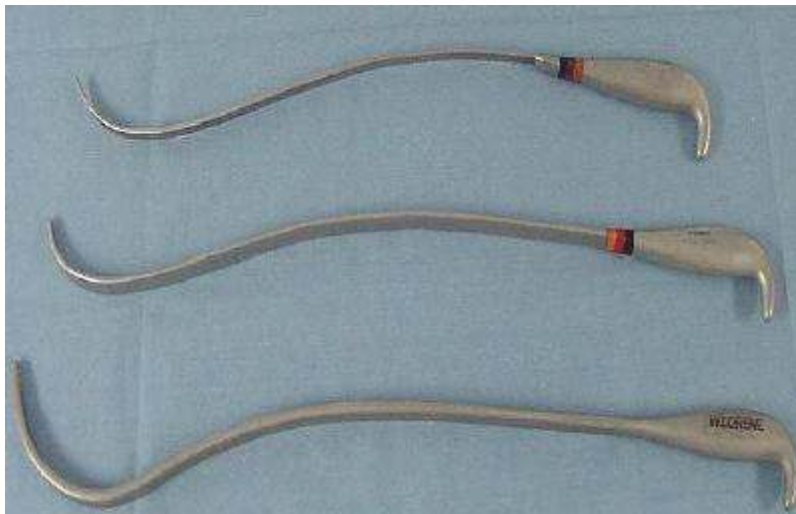
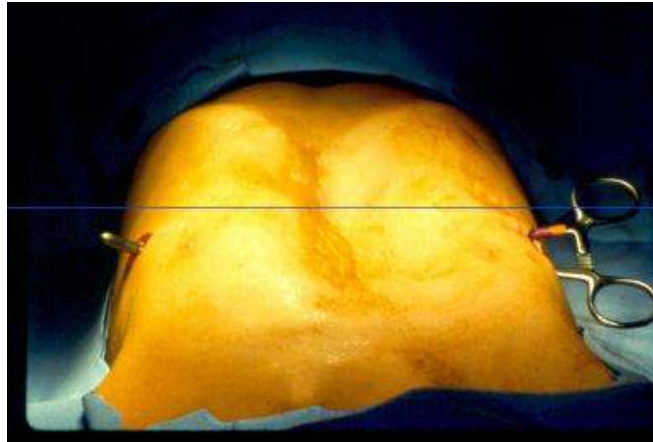


Thoracoscopy With Co2 Insufflation (1998)



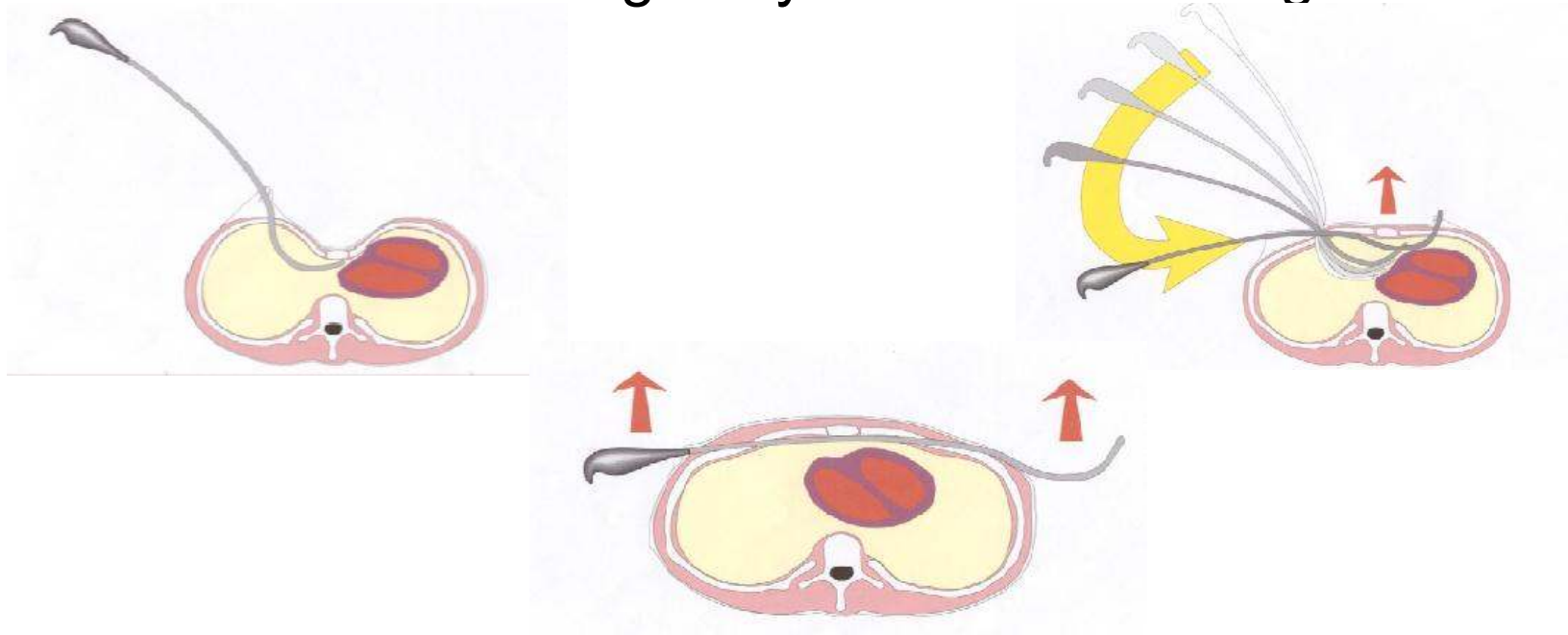
Helps with selecting bar position and makes the procedure safer.
May be inserted on the right, left or both sides.
Always keep the Tip of the Introducer in view

New Instruments



“New introducers” permit sternal elevation

Introducers greatly facilitate tunneling

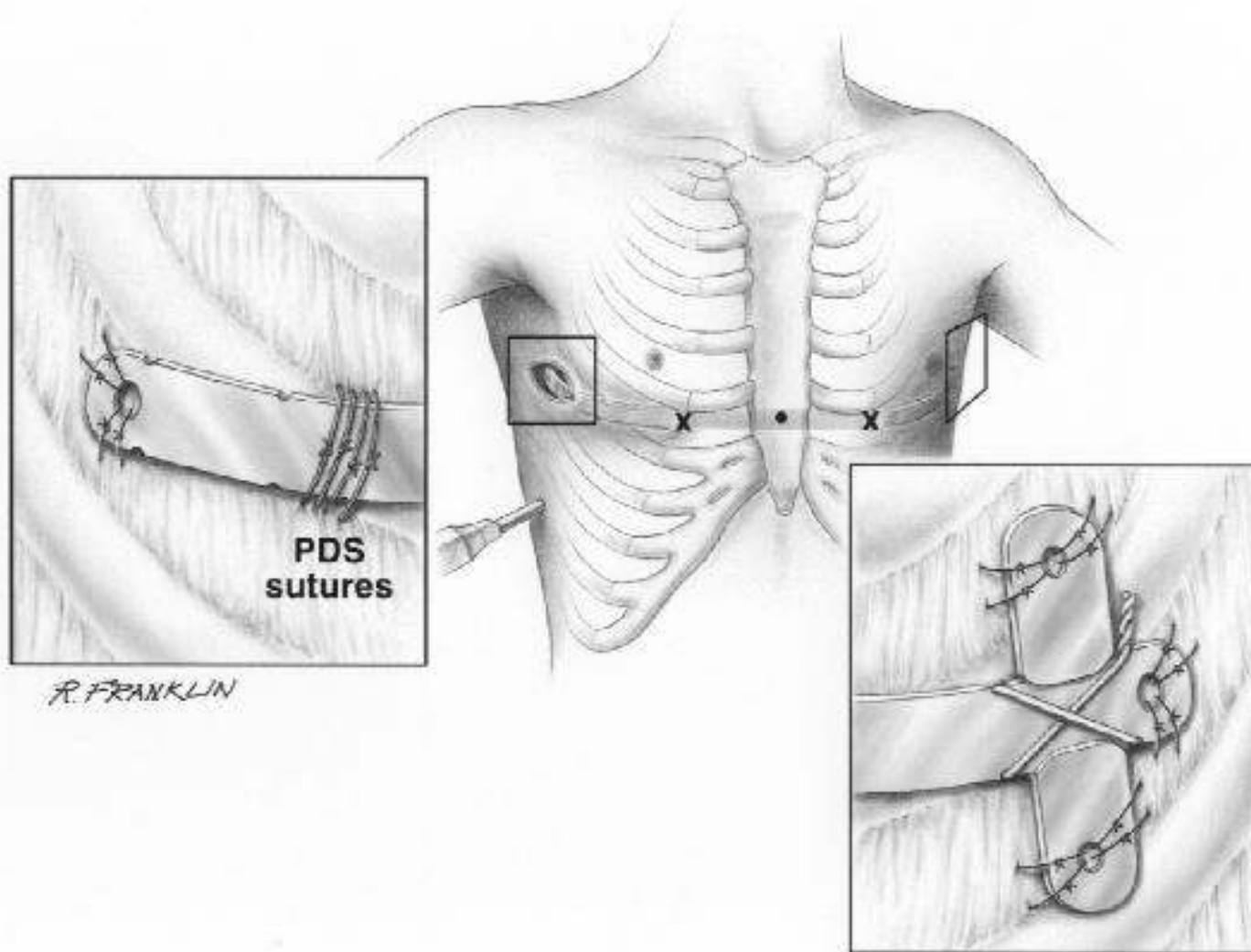


Sternal elevation corrects the deformity before bar insertion
and decreases the amount of pressure on the bar.

Bar Flippers, Metallic Stabilizer(1998)



PDS pericostal sutures 2002



Vaccum Bell



ction cup for pectus

:

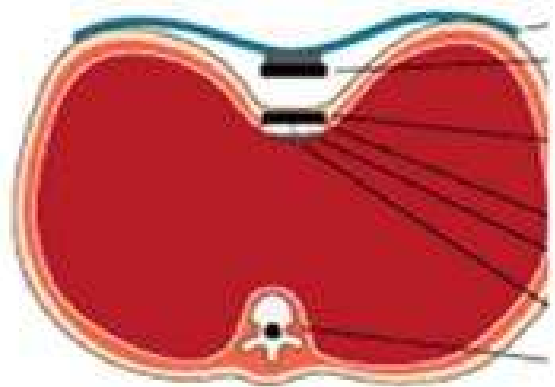
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ed out, can it



Magnetic Mini Mover Procedure (3MP)



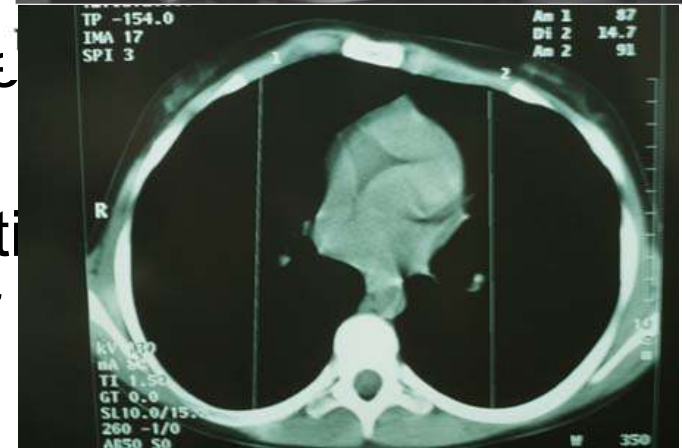
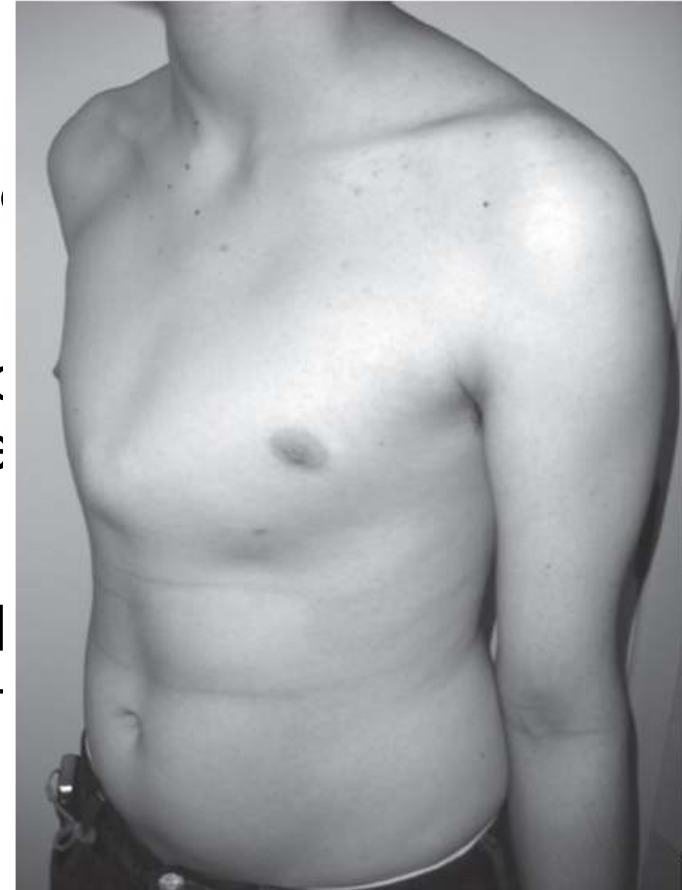
magnets to slowly reconfigure
concept to

- By adjusting
(Magnatrac),
(Magnimplant) can slowly re
chest



Pectus Carinatum

- Pectus carinatum is 16.7% of all chest wall deformities in the Boston children's hospital
- **Chondrogladiolar type** : most frequent
- anterior protrusion of the body of the sternum

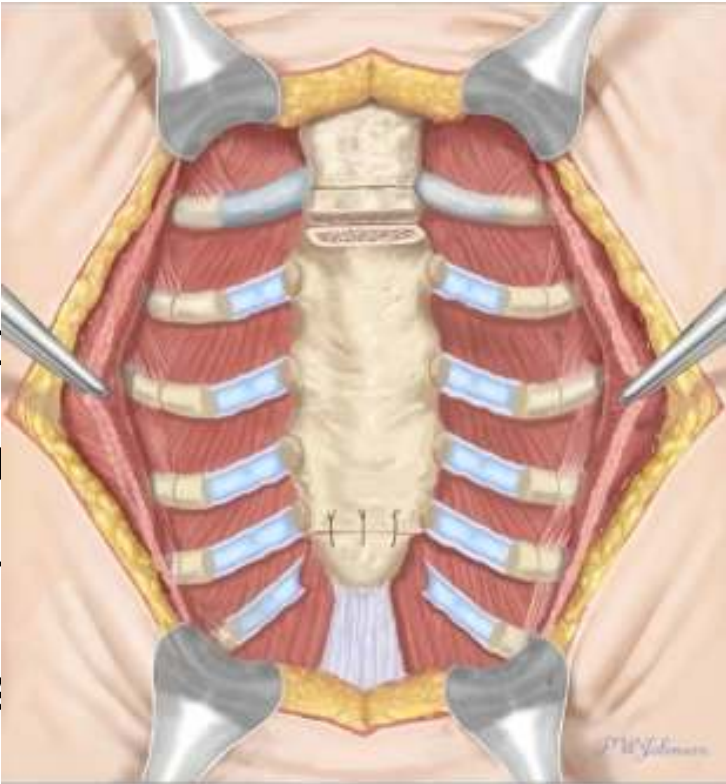


Pectus Carinatum

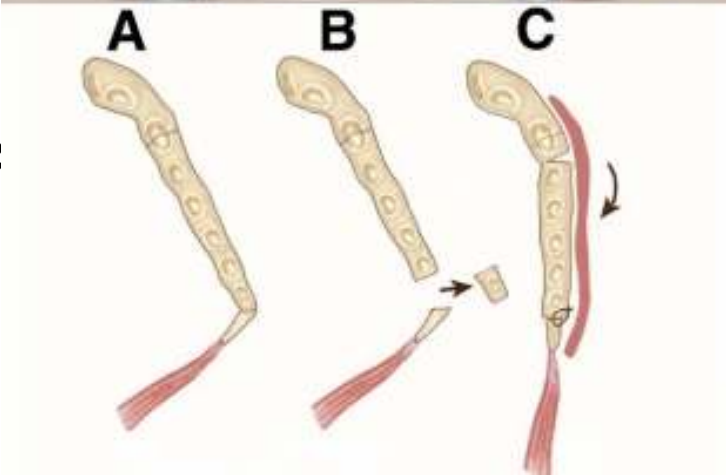
- Etiology : not clear
 - an overgrowth of the costal cartilages with forward buckling of the cartilages and anterior displacement of the sternum
 - genetic basis : 26% had a family history of chest wall deformity and 12% of scoliosis.
 - more frequent in boys than in girls - 3:1
- PC is rarely present at birth
 - deformity was not identified until after the eleventh birthday
 - deformity often progresses during early childhood particularly in the period of rapid growth at puberty.

air

- The current of often involving osteotomy and modifications
- The majority procedure first



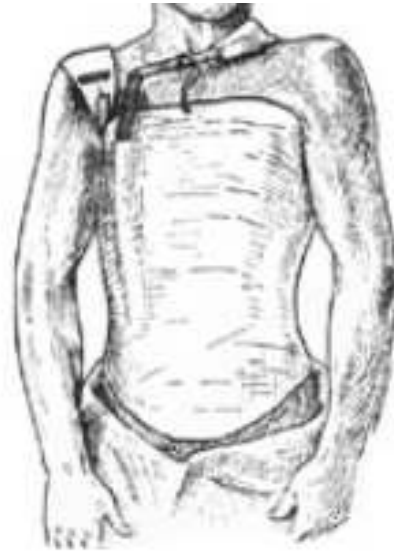
atum is surgical, plates and sternal nally invasive



ariations of the avitch.

1960s and 1970s

- Some authors reported correct posture and/or breathing



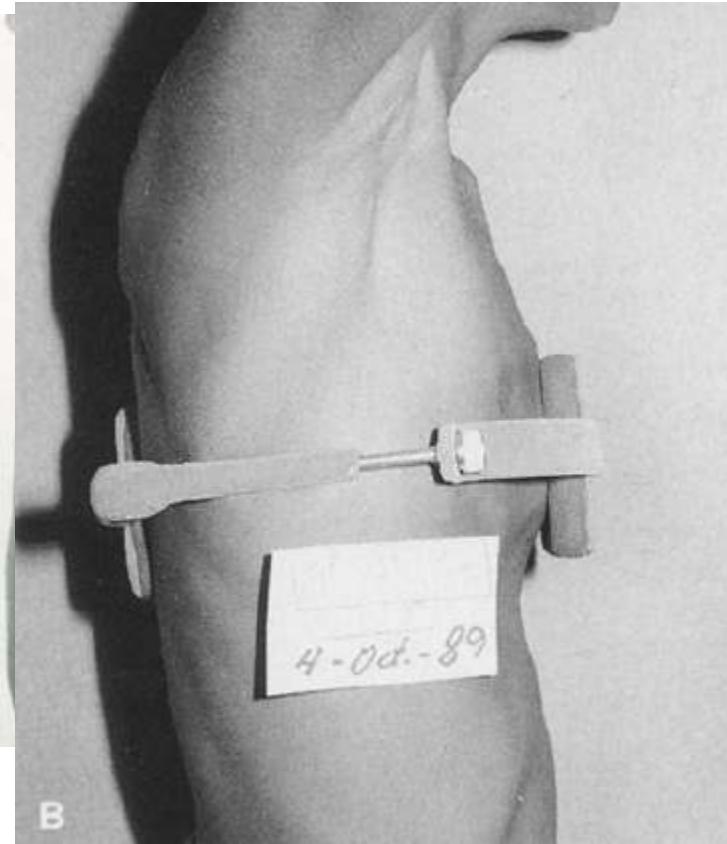
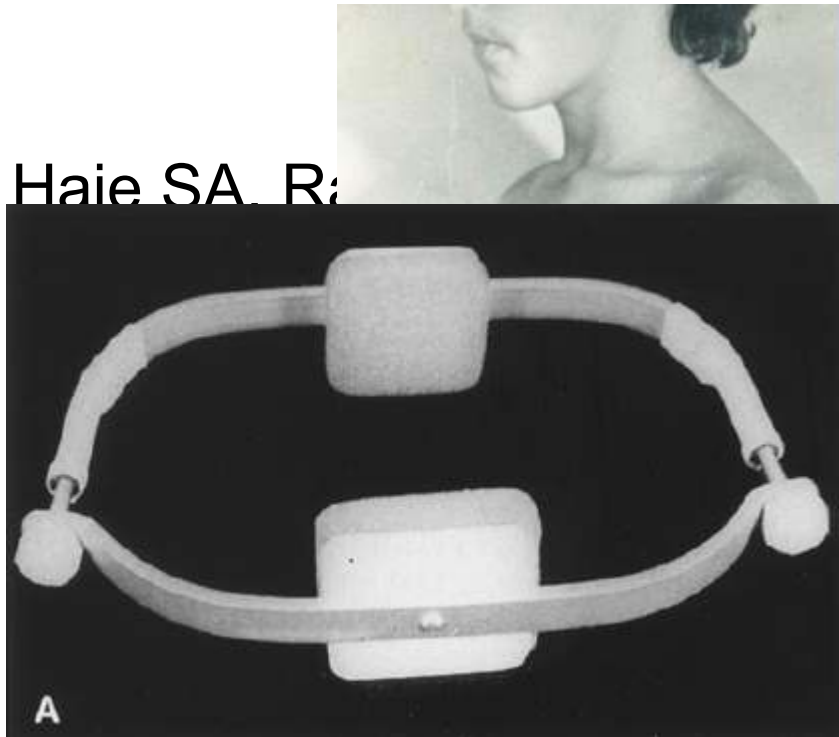
max

19



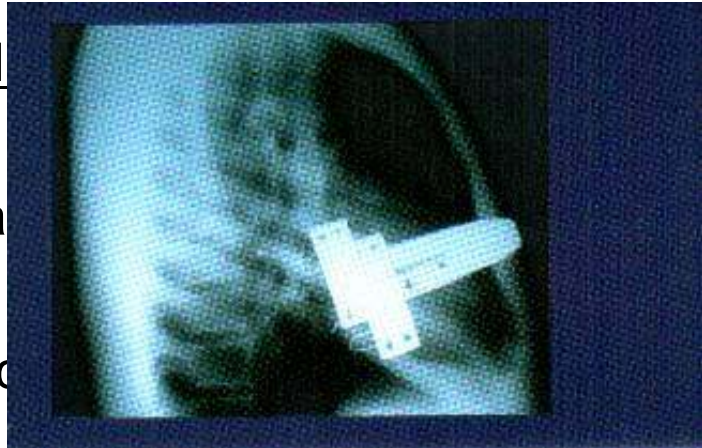
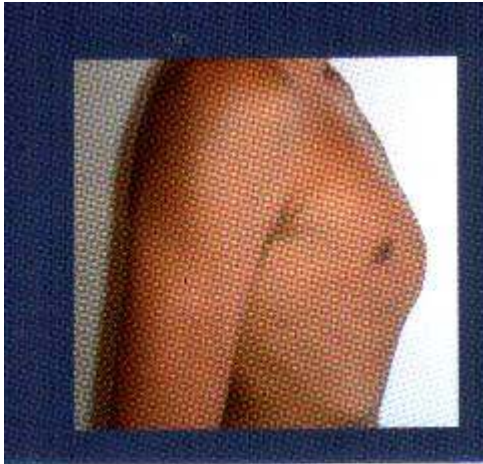
Dynamic Chest Compressor

Haie SA. R:



A Minimally Invasive Technique to Repair Pectus Carinatum. Preliminary Report

..., Arch Bronconeumol 2005; 41: 349 - 351



pectus carinatum

- chest wall wa

- intrathoracic c

the presternal region

- the strut was removed after 1 year



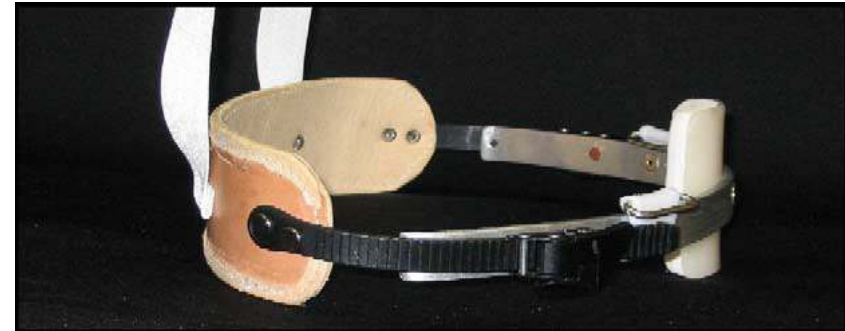


2013년 제6차 전공의 연수교육

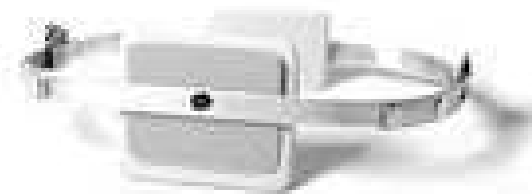




Compressive bracing for Pectus carinatum



Var ces



2013년 제6차 전공의 연수교육

Bracing of Pectus Carinatum : a Preliminary Report



Sungsoo Lee, Ho Choi, Joon-Ho Jung, Sang Ho Chung, Jinkyung Cho,
Hyungtae Kim, Sang-Hyun Lim, You-Sun Hong, Cheol Joo Lee

**Ajou University School of Medicine,
Department of Thoracic and Cardiovascular Surgery**

2013년 제6차 전공의 연수교육

Patients

- Study period : 2008. 7. – 2009. 6.
- 18 patients with pectus carinatum treated at OPD
- 1 (5.6%) females : 17 (94.4%) males
- Mean age : 12.9 (3.4 – 19) years
- Upper : Lower = 1 : 17
- Symmetric : Asymmetric = 12 : 6 (Rt > Lt)

Methods

- Manual Compressive test
- Lightweight, patient-controlled chest brace, wore for more than 20 hours per day for 6 months.
- Telephone Survey at 12 months
- Satisfaction Scores
 - 1 - no correction
 - 2 - minimal correction
 - 3 - improved
 - 4 - remarkable improvement





Results

- 13 (72.2%) patients have completed treatment (mean bracing time, 4.9 ± 1.4 months).

- There were 5 patients (27.8%) who were noncompliant for brace therapy.



- Minimal recurrence of pectus carinatum after removal of the compressive brace occurred in 5 (38.5%) of 13 patients.
- All these patients stopped wearing the compressive brace in 4 months against our advice.

Conclusions

- Compressive bracing results in a significant improvement in PC appearance in skeletally immature patients.
- However, patient compliance and diligent follow up appear to be paramount for the success of this treatment.
- We currently offer this approach as a first-line treatment, reserving surgery for patients who are noncompliant and those who fail the nonoperative modality.

**9th Annual International Nuss Pectus Excavatum and Carinatum
Lecture Series
June 23-24, 2011**

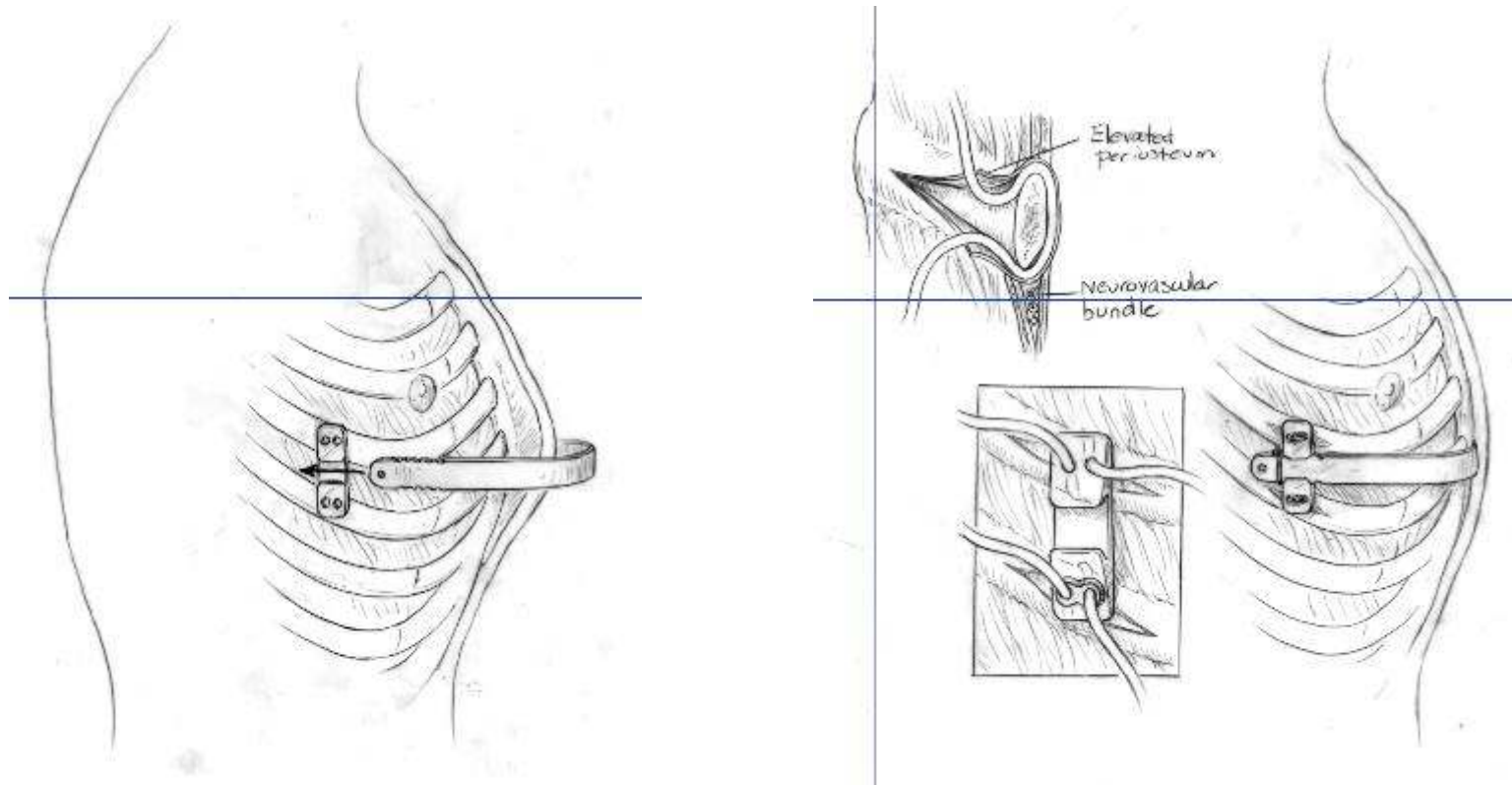


Pectus Carinatum for 1 year

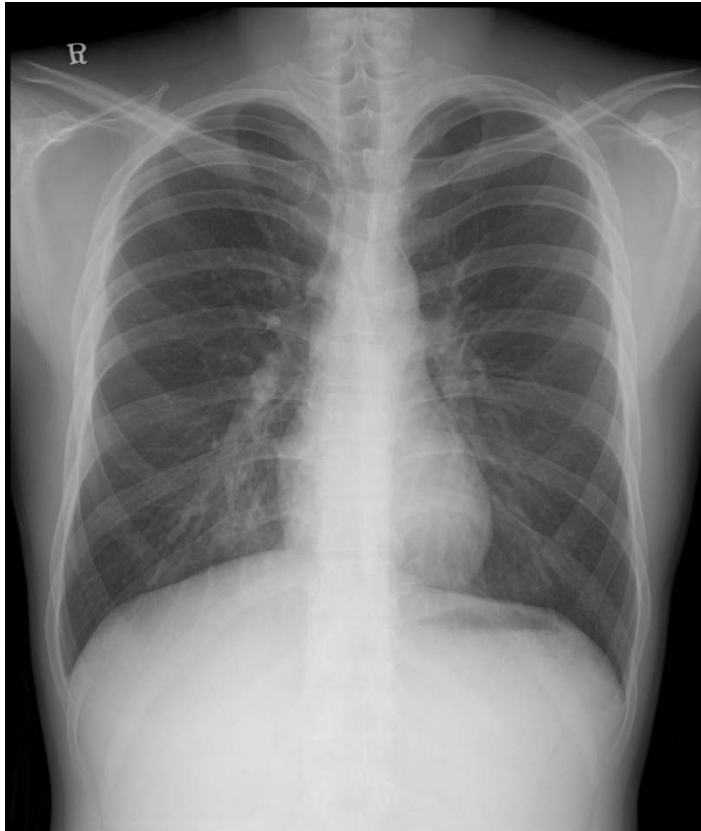
- Aug. 2010 – July 2011
- 112 patients with PC
- Brace therapy – 65 (58%)
- Later Tx (after growth) - 21명 (18%)
- Can't decide Tx - 15 (13%)
- Avoid hot summer for bracing – 9 (8%)
- Minimally invasive surgery – 2 (2%)

Minimally invasive
Pectus Carinatum Surgery

Abramson Operation



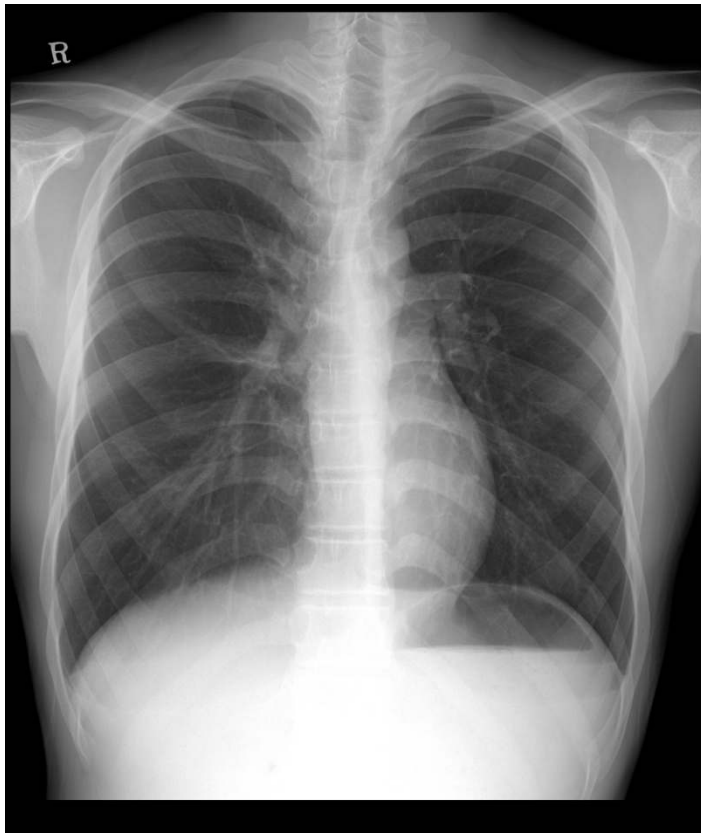
CASE.1 강 0 0 M/20



강 0 0 M/20



CASE.2 배 0 0 M/17



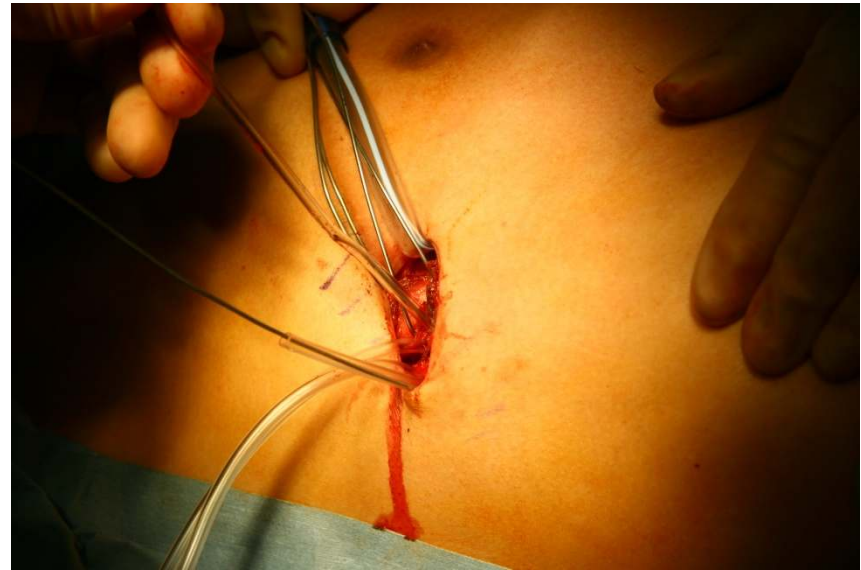
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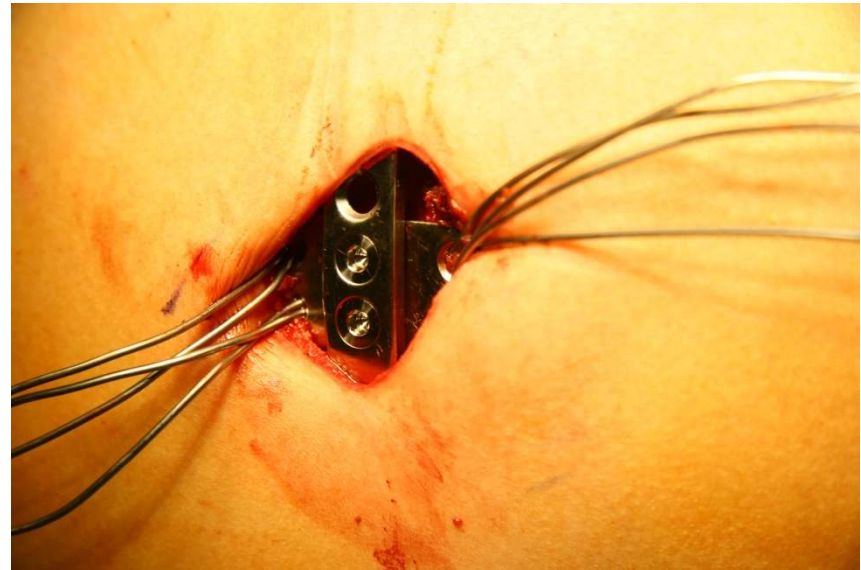
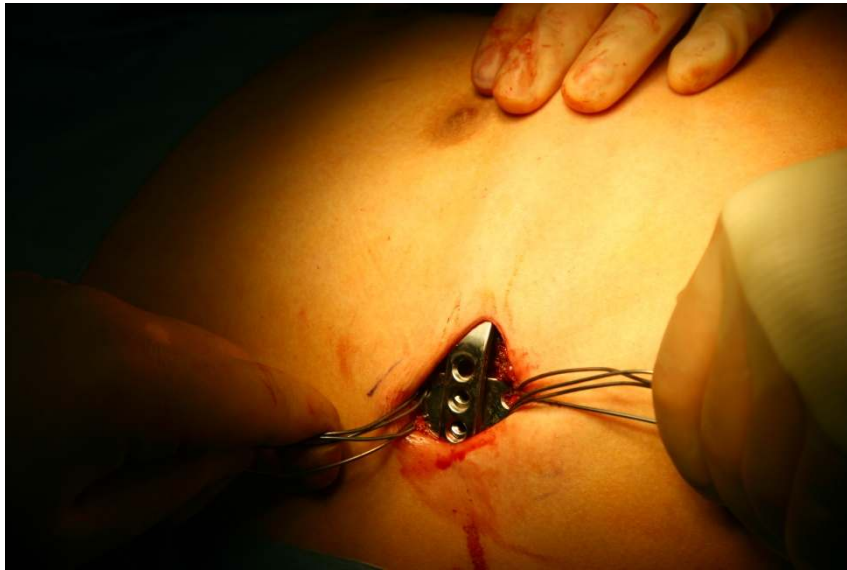
procedure



procedure



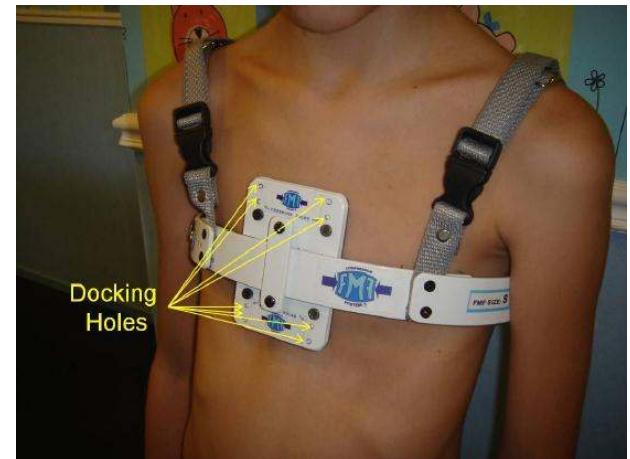
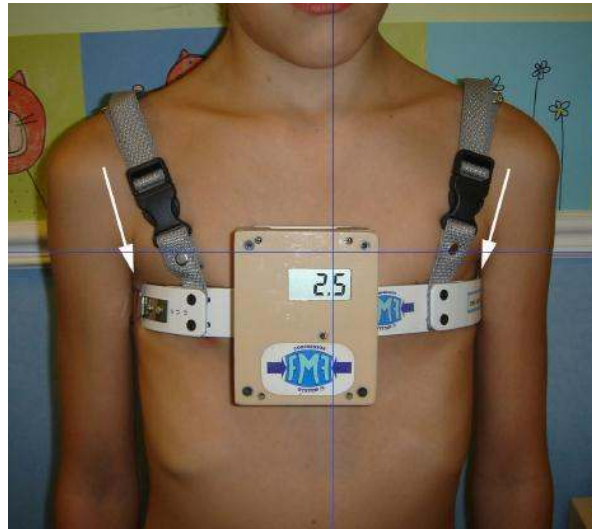
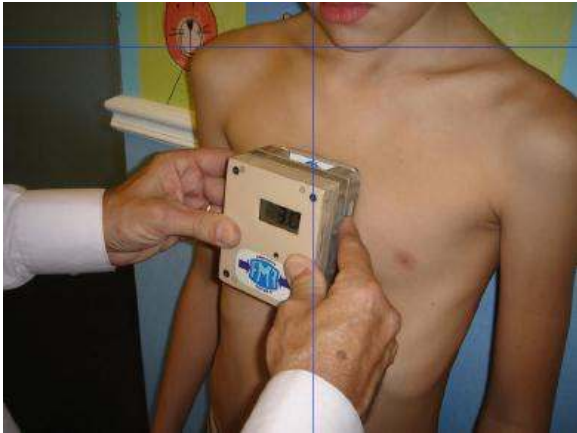
procedure



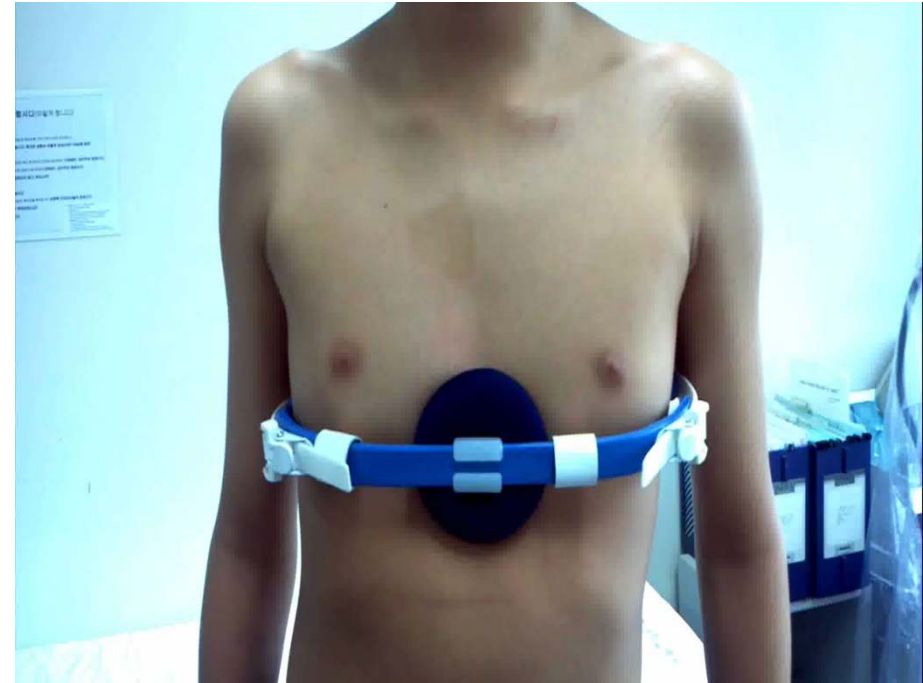
procedure



New brace



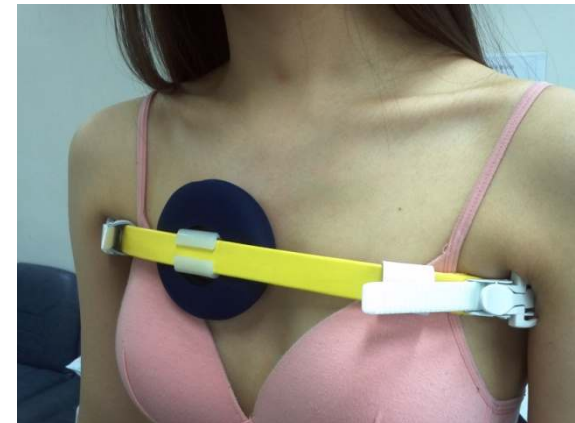
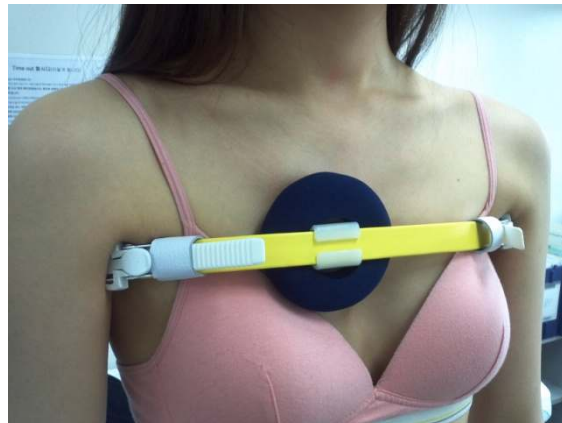
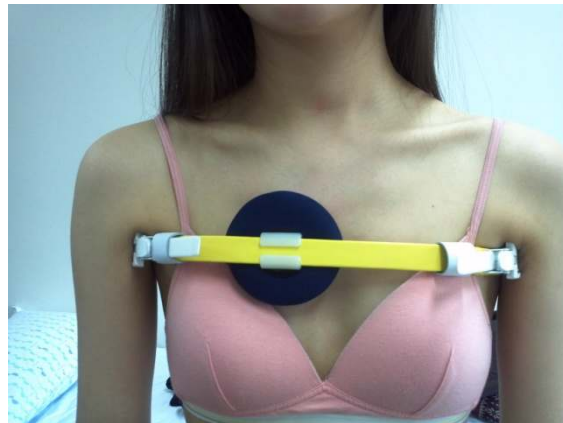
Examples of Bracing for PC



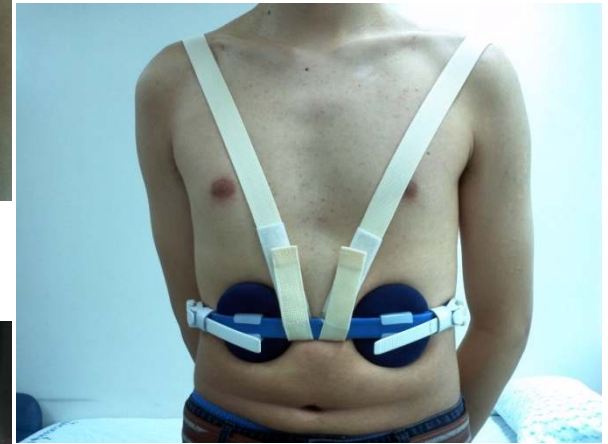
Overcorrection



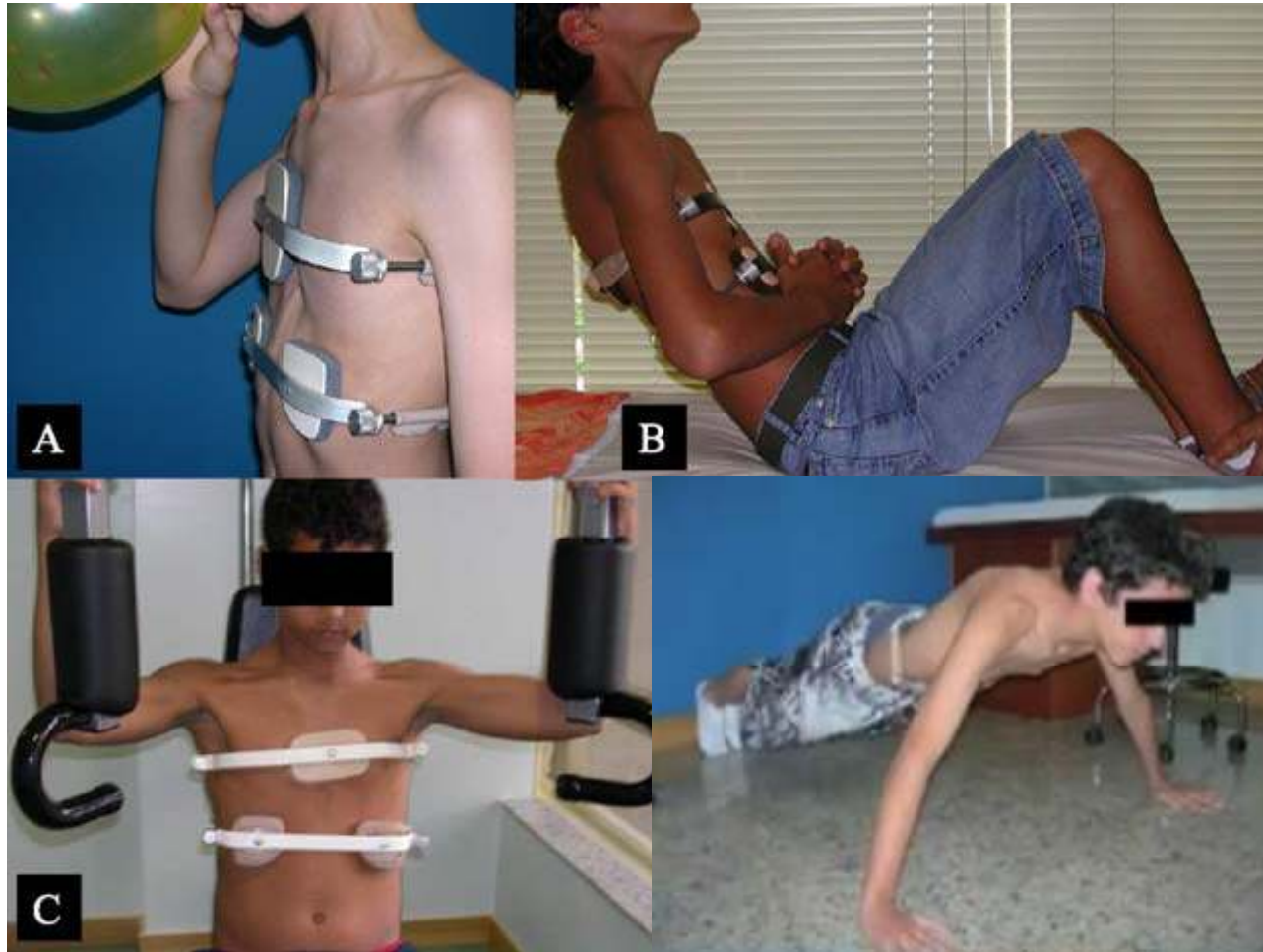
Atypical lesion



Flared rib



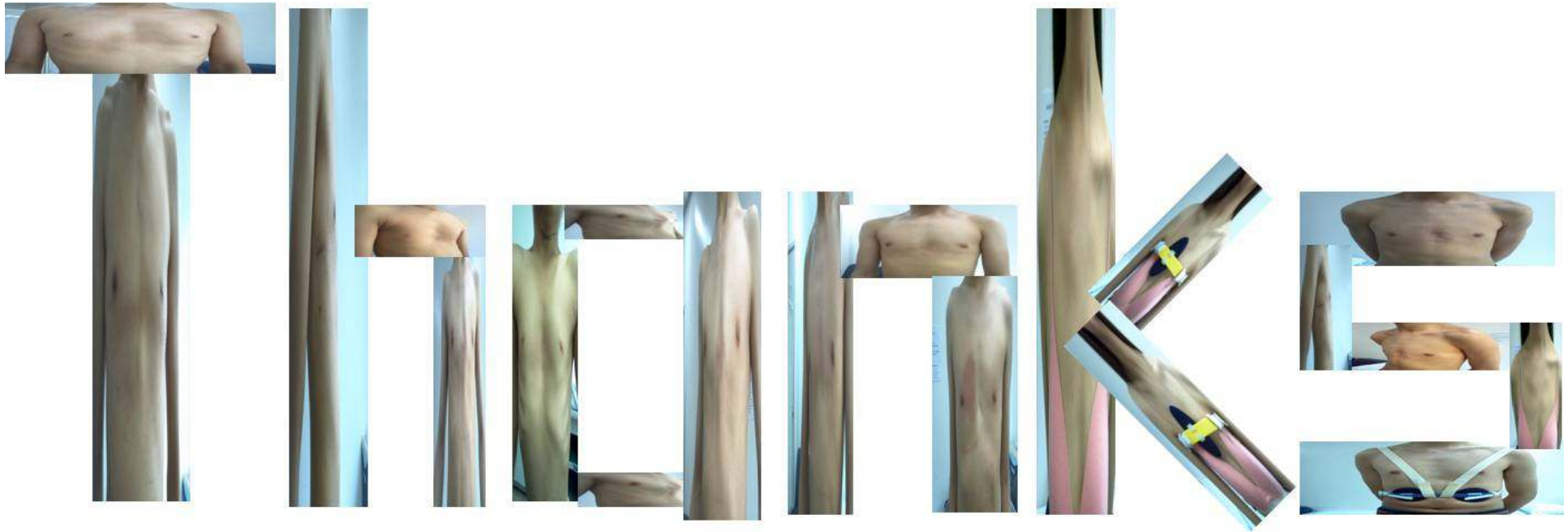
Brace with Exercise



Sydney A Haje, MD – Dynamic Remodeling

2013년 제6차 전공의 연수교육

Thank you for your attentions!



Hyperhidrosis

Hyperhidrosis

- Pathologic condition of *excessive sweating* in amounts *greater than physiologically needed for thermoregulation*

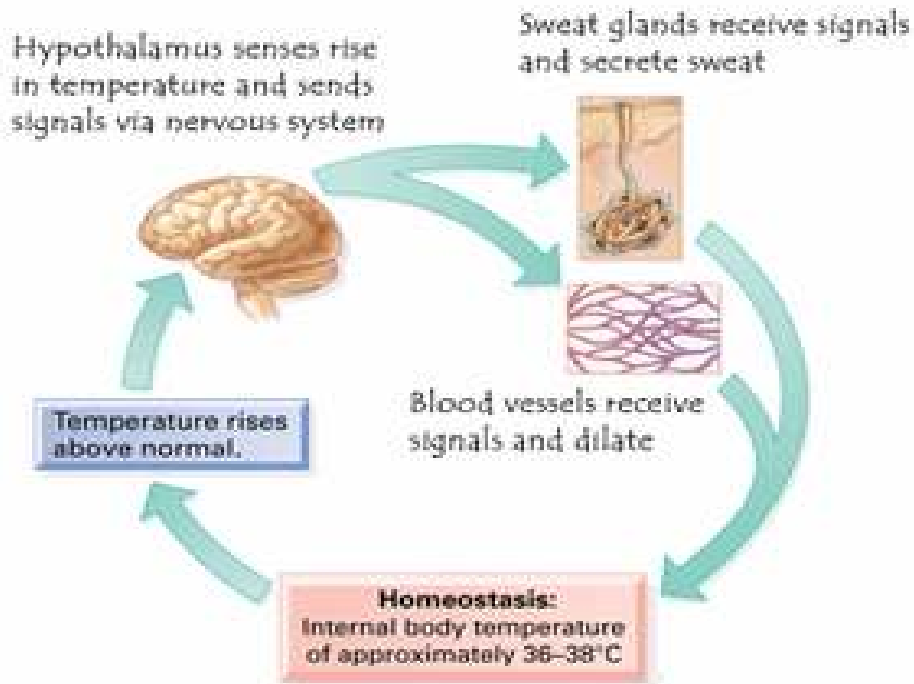


Pathogenesis

- **Eccrine sweat glands are responsible for hyperhidrosis**
 - mixture of the two [apo/eccrine] glands may play a role in axillary hyperhidrosis
- **A sympathetic signal is carried to sweat glands by cholinergic autonomic neurons**

- **Idiopathic** (
 - Sweat gland
 - Abnormal

- **Genetic con**



nally normal.

Types of hyperhidrosis

- **Focal or primary hyperhidrosis**
 - face, palms, soles, or axillae
- **Generalized sweating(secondary)**
 - Excessive heat and obesity
 - Infections, endocrine disorders, neuroendocrine tumors, malignancy, neurologic disorders, toxins, and previous spinal cord injuries
 - Present as adults and have excessive sweating that occurs both while awake and asleep

Treatment

- **Nonsurgical Treatment**

Table 2. Comparison of Therapies for Primary Hyperhidrosis

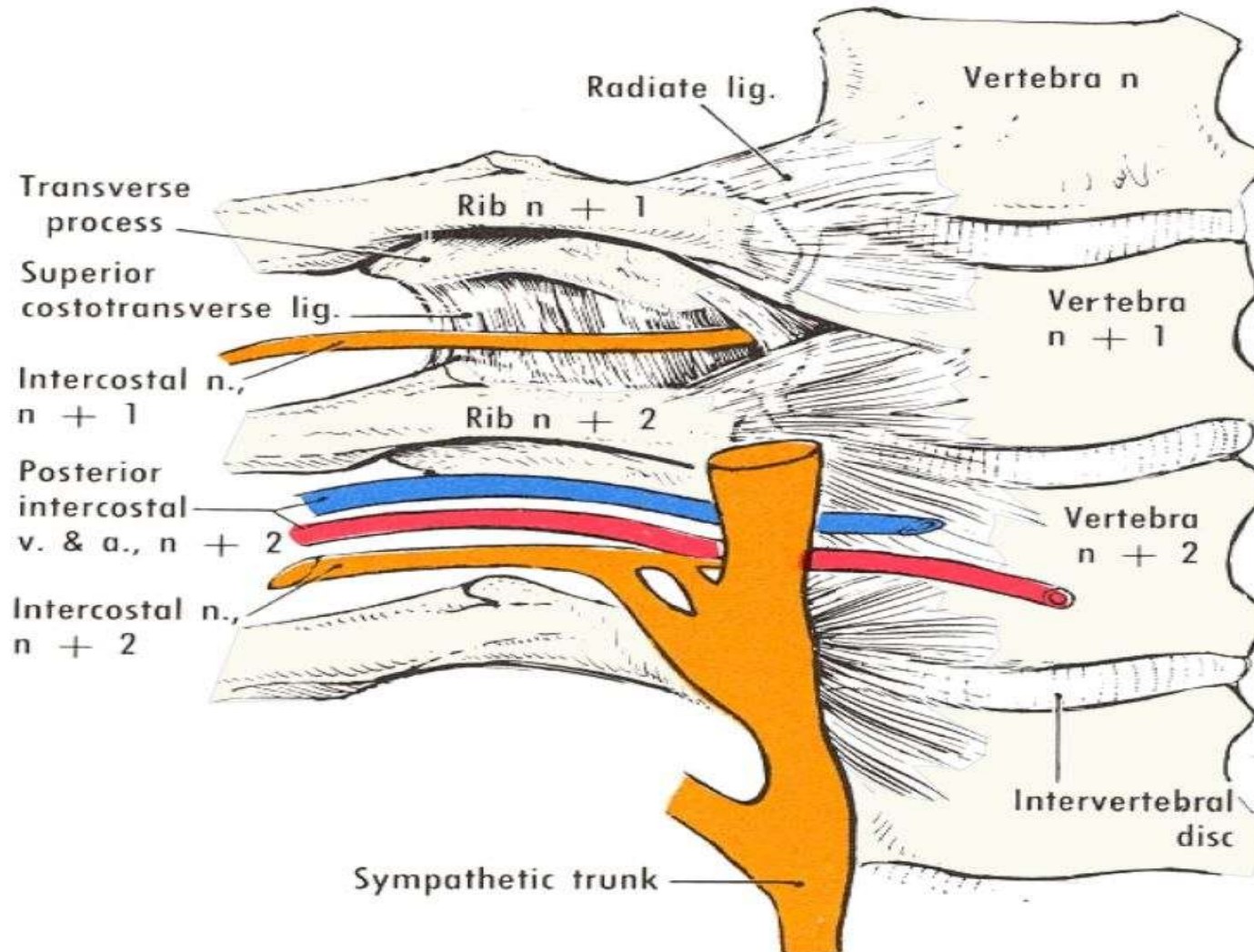
Treatment	Cost ^a	Side Effects
Topical, 20% to 35% aluminum chloride	\$288+/year	Skin irritation, localized burning, stinging, desquamation, poor efficacy, temporary (lasts about 48 hours per application)
Iontophoresis (usually 20 mA 3 to 4 treatments a week for 30 to 40 minutes each)	\$500/device	Irritation, dryness or peeling of skin, burning or stinging during therapy, temporary (one treatment lasts 1 to 4 weeks). Not recommended for women who are pregnant or for persons with pacemakers or substantial implants (eg, joint replacements)
Oral therapy (glycopyrrolate, atropine, acetylcholine inhibitors)	\$240+/year	Dry mouth, dry eyes, constipation, mydriasis, difficulty urinating, blurry vision
Botulinum toxin (Botox A or B)	\$2,250/session	Pain from injections, muscle weakness, headache, hematoma, swelling, need for repeat procedures
Liposuction/VASER	\$3,000/session	Hematoma, superficial skin erosion, alopecia, paresthesia
Endoscopic thoracic sympathectomy	\$15,000	Compensatory hyperhidrosis, bradycardia, pneumothorax, postoperative pain, Horner's syndrome

^a Approximate cost in US dollars.

Nomenclature for Sympathetic Surgery

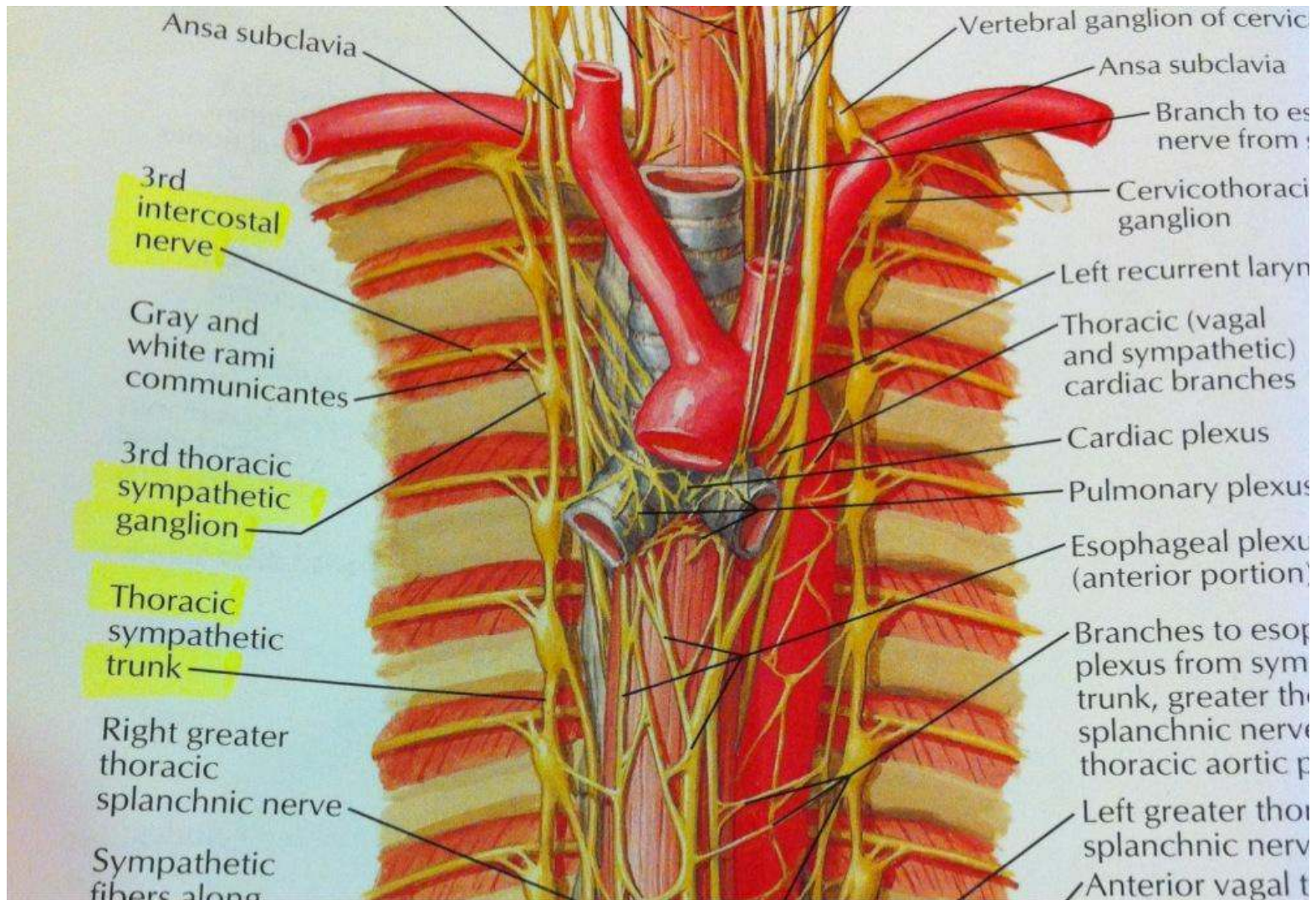
- **Rib- oriented nomenclature**
 - Too many patients having mediastinal fat that can obscure clear identification of the specific ganglia
 - Many anatomical variations in the ganglion anatomy
- **Type of interruption**
 - Clipped, cut, or cauterized, or a segment removed
- For example
 - Clipped R5, top
 - cauterized, top R4, bottom R4

Nomenclature for Sympathetic Surgery



Surgical Treatment

Nomenclature for Sympathetic Surgery



Patient Selection

- Surgical consultation should include
 - Secure diagnosis of **primary focal** hyperhidrosis
 - **Anatomic locations** involved
 - **Amount** of hyperhidrosis
 - Full discussion of the options to surgery and potential complications
- The patients should be made aware that the most satisfied patients are those with **palmar or palmar-axillary hyperhidrosis**, or both.

Location of Interruption of Sympathetic Chain

- **Palmar hyperhidrosis**
 - **R4 alone** interruption (*Yang and colleagues, 2007*)
 - Limits the degree of CH
 - May lead to moister hands
 - **R3, R4** interruption
 - Completely dry hands
 - Higher risk of CH
- **Palmar and plantar hyperhidrosis**
 - **R4** interruption
 - Reduce incidence of CH
 - **R4 and R5** intervention
 - Drier feet

AXILLARY HYPERHIDROSIS

- ETS for axillary hyperhidrosis
 - often less successful and has **higher “regret rates”** than ETS for palmar hyperhidrosis.
- **R4 and R5 transection is suggested**
 - Palmar-axillary, palmar-axillary-plantar, or pure axillary hyperhidrosis
- A qualitative review shows a trend of lower incidence of CH with fewer interruptions
 - Incidence of CH (*Munia and colleagues, 2008*)
 - R3/R4 ETS 100% and higher severity
 - R4 ETS alone (42%)
 - Patients who underwent R5 clipping alone experienced no CH, and none regretted having the surgery (*Chou and associates*)

CRANIOFACIAL HYPERHIDROSIS

- R2 vs R3
 - R3: 9% regretted the procedure, and 27% reported CH
 - R2: 16.7% regretted and more than 40% experienced CH
- R2 vs R2+R3
 - significantly higher CH rate in the group that underwent the R2 and R3 transection (95%), as compared with the R2 group (83%)
- **R3-alone interruption is suggested**
 - It reduces the risk of CH and the risk of Horner's when compared with R2 or an R2 and R3 transection

Type of Interruption

- Transection? Resection? Ablation with a cautery? Division with a harmonic scalpel? or Clipping?
 - No clear differences
 - If the correct level division was achieved
 - Enough separation between the ends of the chain
 - Regrowth is impossible

Complications and Treatment

- Primary side effects of hyperhidrosis surgery
 - **CH, bradycardia, and Horner's syndrome**
 - The higher the level of blockade on the chain, the higher is the expected regret rate

Compensatory Hyperhidrosis

- **The most common side effect**
 - which occurs in the literature from 3% to 98%
- **The most common risk factor**
 - **T2 ganglion interruption(R2, R3)**
 - The number of levels interrupted has been inconclusive as a risk factor
- **Preoperative testing**
 - Injecting bupivacaine
 - reversibly achieve sympathetic nerve blockade observe for CH
- **Treatment**
 - **Ditropan** or other **anticholinergic medications** in escalating doses

Horner's syndrome

- 0.7% and 3% after ETS
- Addressed in patients with **craniofacial hyperhidrosis**
 - Direct injury by cautery, traction, or surrounding inflammation can occur owing to **improper localization of the second rib**
 - The risk of this complication may be minimized with procedures performed below the second rib (R2)
 - Anatomically, the stellate ganglion can be lower on the left side down to R3

Complication after surgery

- **Permanent bradycardia**
 - Resting heart rate less than 55 or 50 beats per minute
 - who may require a pacemaker
- **Recurrent hyperhidrosis**
 - Incidence rates vary considerably and have been described as 0% to 65%
- **Others**
 - pneumothorax requiring chest tube drainage (1%)
 - pleural effusion (1%)
 - acute bleeding or delayed hemothorax (1%)
 - Chylothorax
 - persistent intercostal neuralgia (1%)

Conclusions

- **Endoscopic thoracic sympathectomy** with interruption of the sympathetic chain
 - **Treatment of choice** for patients with primary hyperhidrosis
- Interruption of the chain can be achieved by **cauterizing, cutting, or clipping the sympathetic chain**

Conclusion

- **palmar hyperhidrosis**
 - R3 interruption (cauterizing or clipping the sympathetic chain on top of the third rib) because it yields the driest hands
 - **R4 interruption** is also reasonable
 - Slightly higher risk of CH with an R3 but the risk of moister hands with an R4.

Conclusion

- **Axillary hyperhidrosis**
 - **R4 and R5** sympathetic chain interruption
 - palmar-axillary, palmar-axillary-plantar, or axillary hyperhidrosis alone
 - R5 interruption alone
 - axillary hyperhidrosis only
- **Craniofacial hyperhidrosis**
 - **R3** interruption
 - Craniofacial hyperhidrosis without blushing
 - R2 and R3 procedure
 - Higher incidence of CH
 - Increases the risk of Horner's syndrome, especially on the left side.



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