

***Constrained (Rotator Cuff Substituting)
Total Scapula Prosthesis Following
Tumor Resection***

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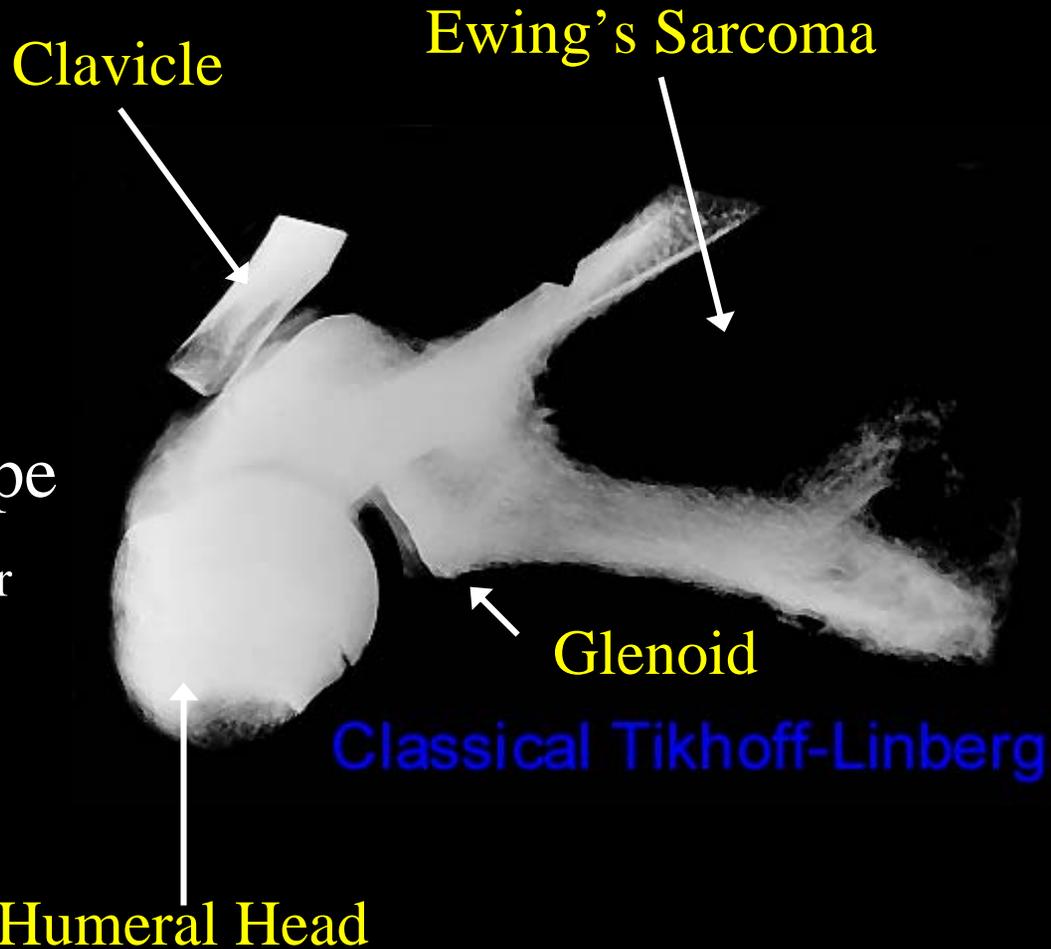
Background

- Shoulder Girdle: 3rd most common site for sarcoma
- Most common tumors of the scapula:
 - Ewing's sarcoma
 - Osteosarcoma
 - Chondrosarcoma
 - Metastatic Hypernephroma/Lung CA
 - Periscapular Sarcomas

Treatment

Limb-Sparing Resection

- Tikhoff-Linberg Type Resection (extraarticular total scapulectomy)
- Intra-articular Total Scapulectomy



Anatomic Reconstruction

- Restores the scapula with a metallic endoprosthesis
- 23 pts total scapula resection; 15 prosthetic replacements
- Utilizes the remaining periscapular muscles for soft tissue reconstruction
- Restoration of both Glenohumeral and Scapulothoracic mechanisms
- Restores Muscle Force Couples

Scapular Design

- Non-Constrained Components (Earlier Versions; n=12)

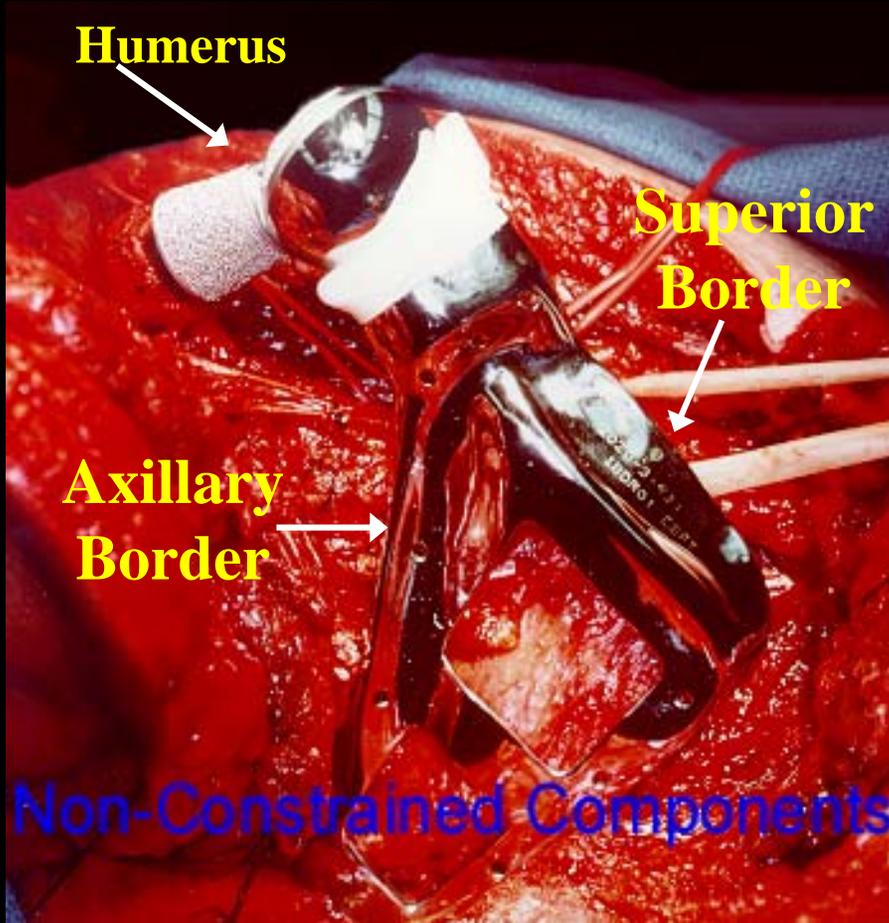
Modular Proximal

Humerus

Superior
Border

Axillary
Border

Non-Constrained Components

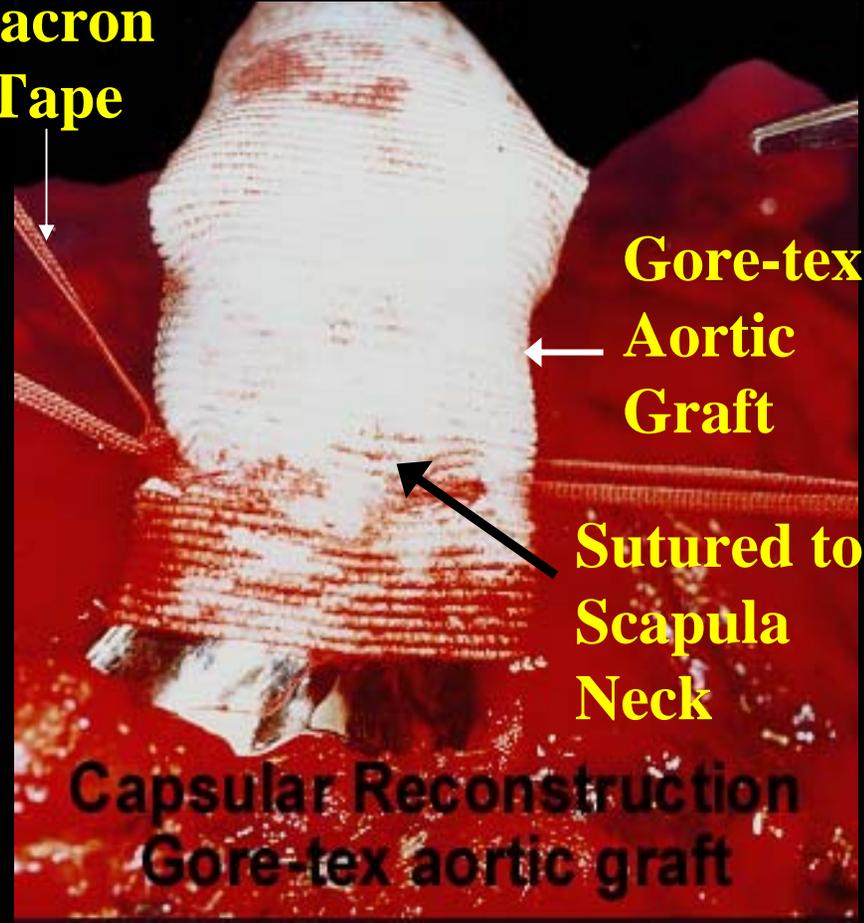


Dacron
Tape

Gore-tex
Aortic
Graft

Sutured to
Scapula
Neck

Capsular Reconstruction
Gore-tex aortic graft



Non-Constrained 10 yr Follow-UP

**Non-Constrained
10 yrs post-op**



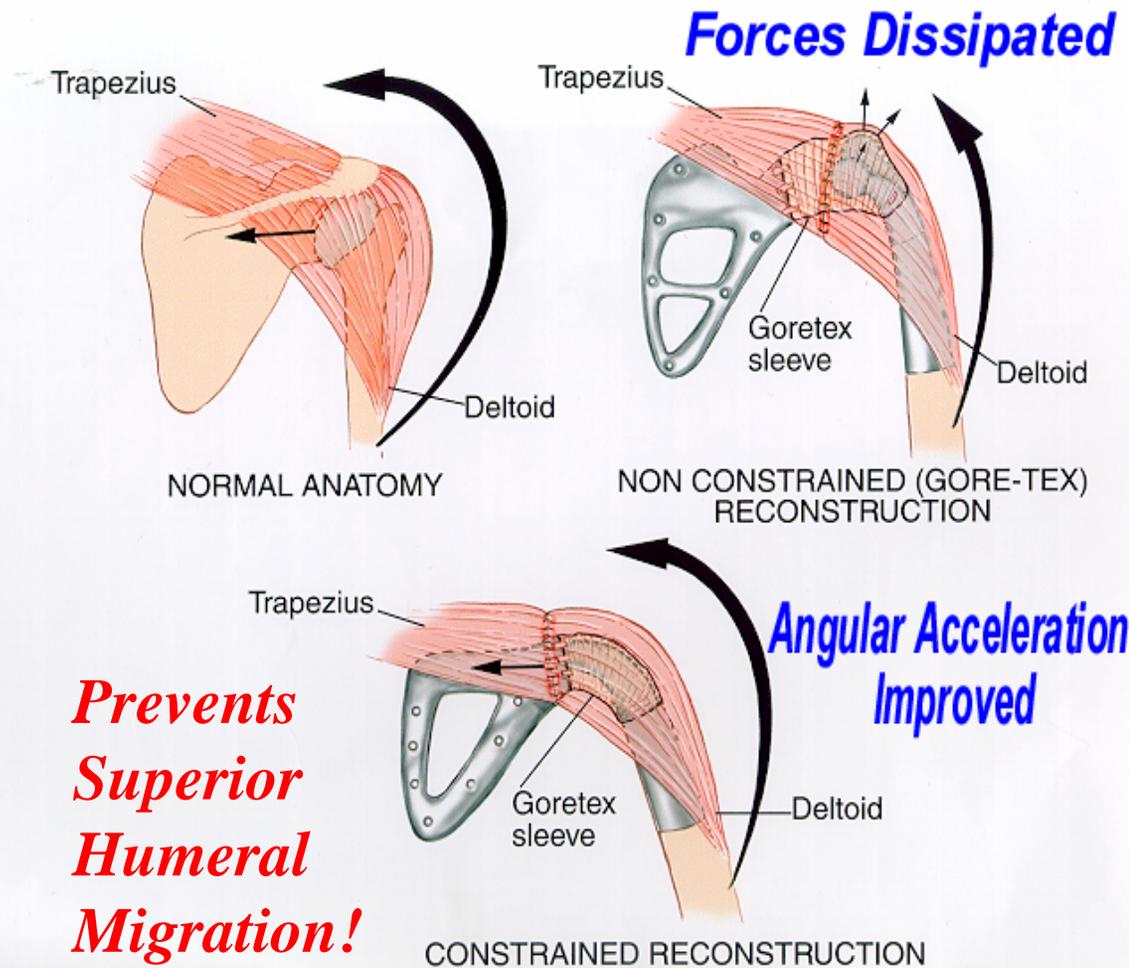
**Non-Constrained
10 years post-op
Excellent elbow flexion**



Constrained Component

Why Designed??

- Improve stability
- Mechanically restore rotator cuff function more efficiently (gore-tex elastic)
- Ease surgical reconstruction



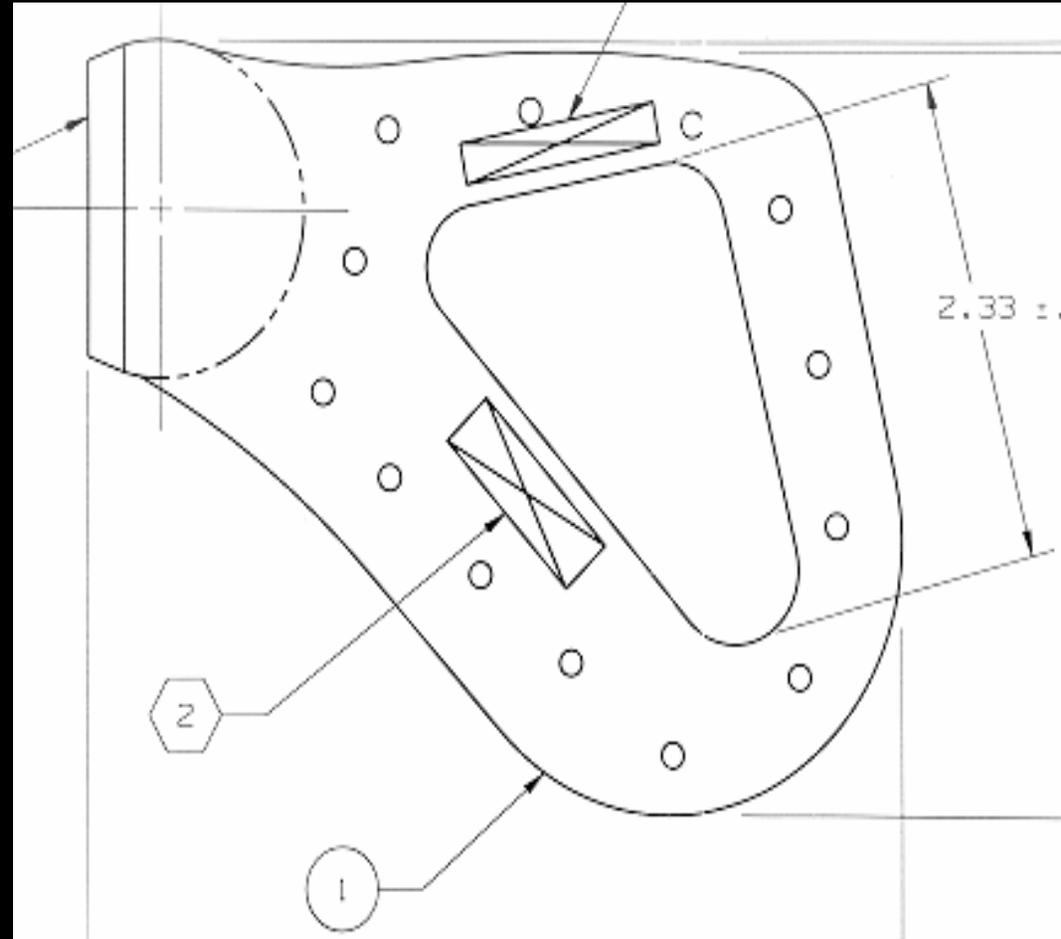
Constrained Components

Body

- Down-sized
- Holes for myodesis
- Vacant area

Glenoid

- Bipolar hip
- Captured polyethylene liner



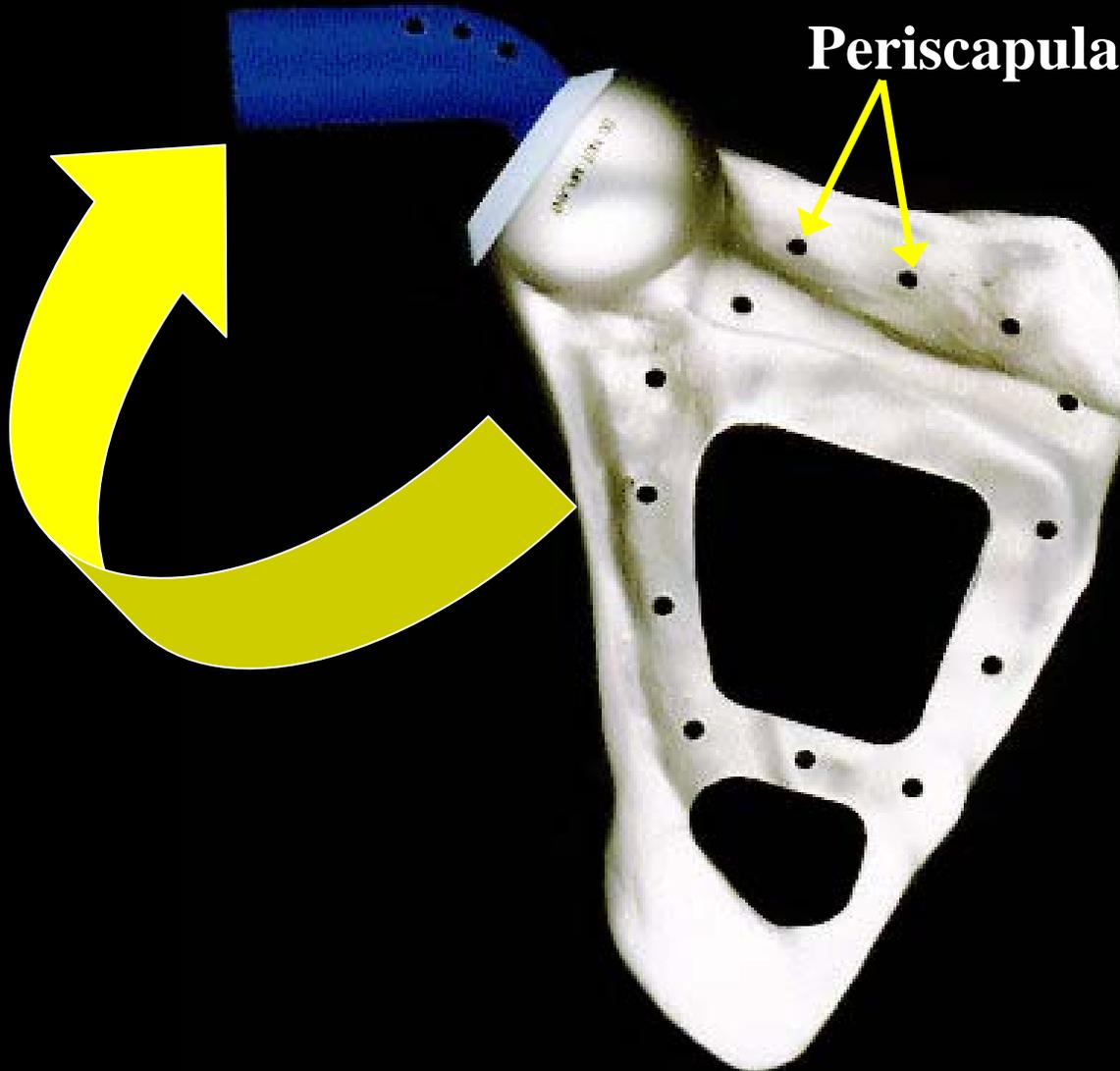
Constrained Total Scapula



*****SNAP FIT DESIGN*****

Motion

**Holes for Myodesis of
Periscapular Muscles**



Purpose

- To describe the indications and surgical technique for total scapular prosthetic reconstruction following tumor resection
- Report preliminary functional results and complications with **constrained** total scapula reconstruction

Indications

Muscle Force Couples

- Required: Periscapular Muscles and Axillary Nerve
 - Trapezius
 - Deltoid
 - Latissimus
 - Rhomboids
 - Serratus Anterior

Patient Demographics

- Three Patients (all males)
- Ages: 13 yrs, 16 yrs, 26 yrs
- Follow-up: 7 mos, 15 mos, 20 mos

Diagnoses:

- Recurrent High Grade OS –Scapula Neck
- Ewing's Sarcoma
- Undifferentiated HG Soft Tissue Sarcoma—
Subscapularis with invasion of the Scapula

***All received induction chemo

- Function assessed according to MSTS System

Patient Demographics

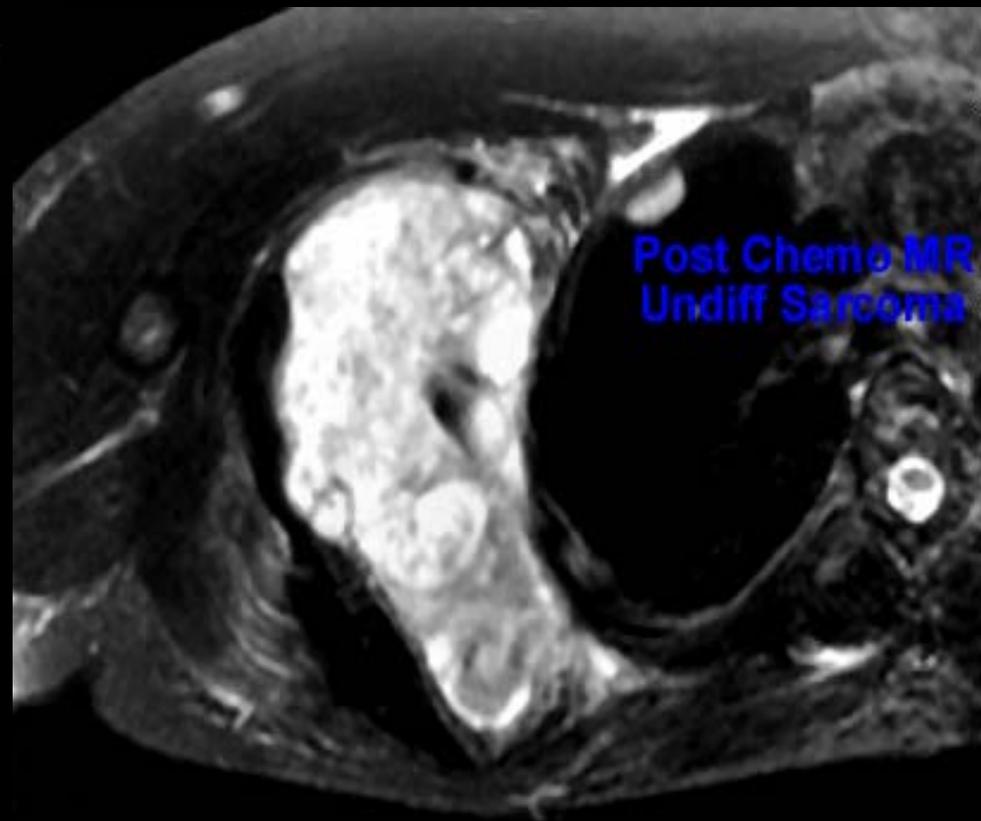
- 26 y.o. male
- Navy S.E.A.L.
- 9x7x11 cm mass
- Anterior surface of scapula/subscapularis
- High grade undifferentiated sarcoma
- Multiple pulmonary nodules
- DOD at 7 mos post-op



**Extensive Necrosis
Post-Chemo**

**CT Post Chemo
Undifferentiated Sarcoma**

P125



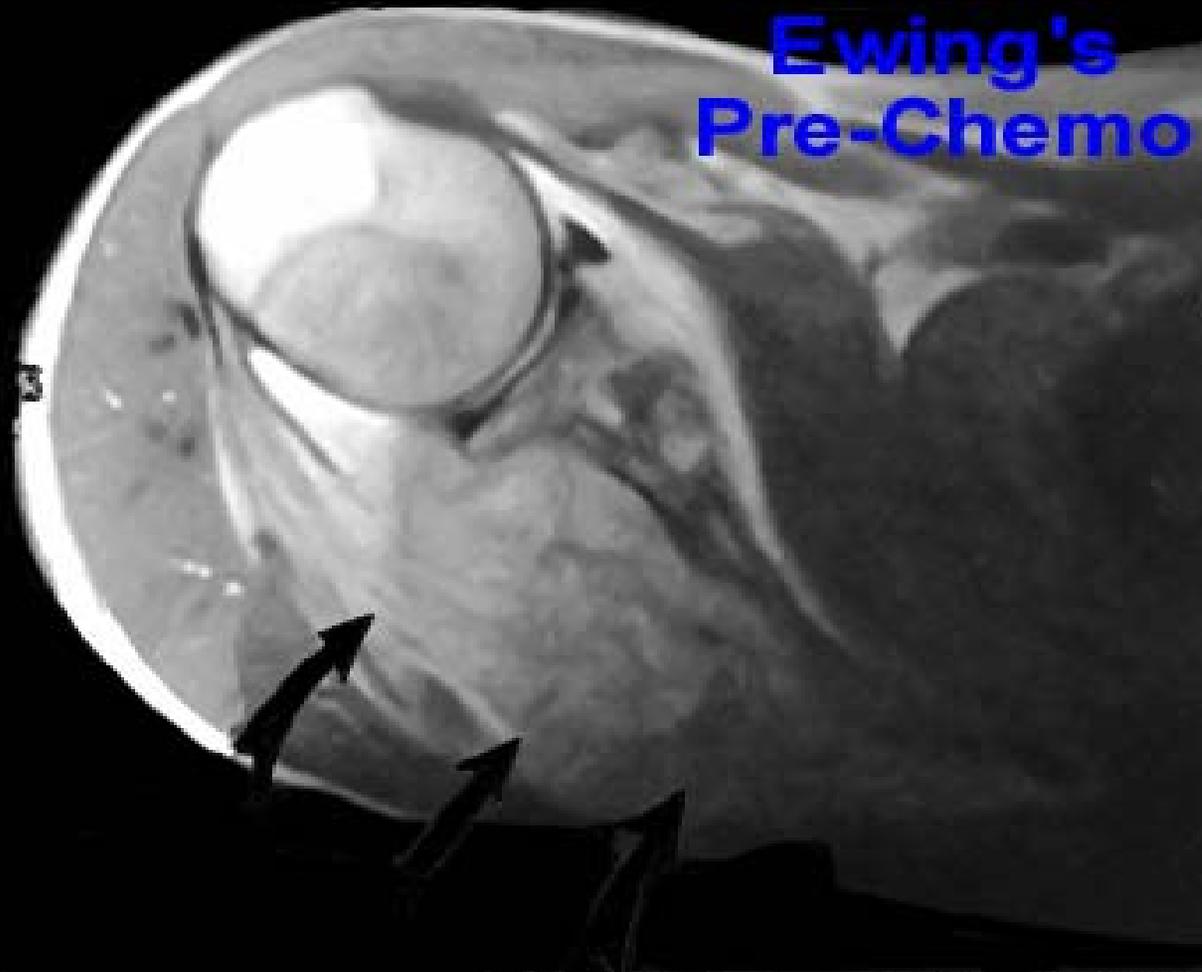
**Post Chemo MR
Undiff Sarcoma**

Ewing's Sarcoma

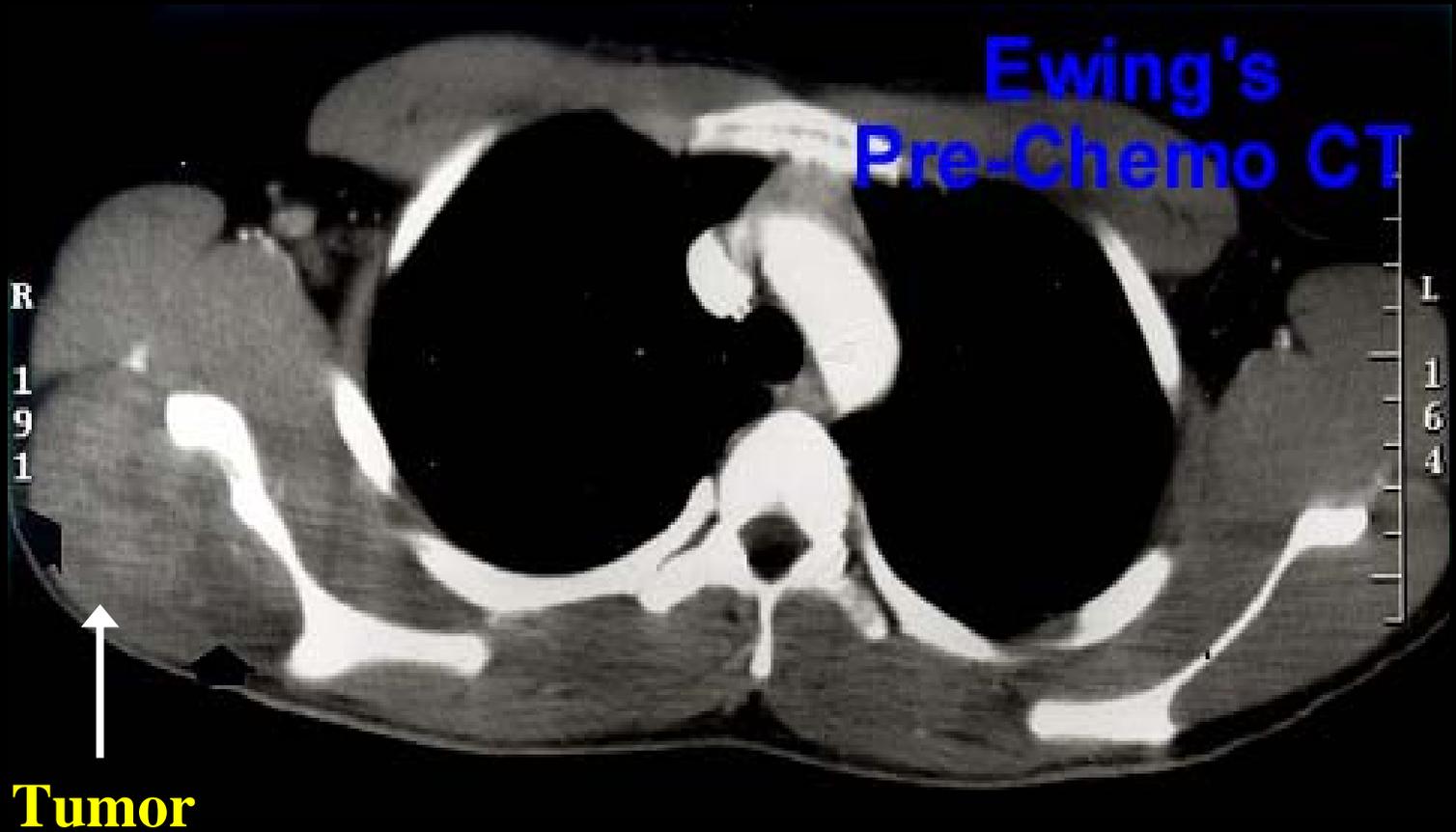
- 17 y.o. male with a Ewing's sarcoma of the right scapula
- Good response to induction chemo
- Complete resolution of soft tissue component
- AWD at 15 mos

Pre-Chemo MRI

**Ewing's
Pre-Chemo**



Pre-Chemo CT



Post-Chemo CT

HISpeed Adv SYSWCT01
26051
3 RETRO
I105.7
11 +C
V 16.0cm
E

Ewing's
Post Chemo CT
Complete Response



120
200

Recurrent Osteosarcoma

- 13 y.o. boy
- Telangiectatic OS of proximal humerus
- Tx in Macedonia with intraarticular resection and recon with fibula
- Local recurrence along inferior scapular neck
- Failure of hardware
- ANED at 20 months

Fibula



Surgical Procedure

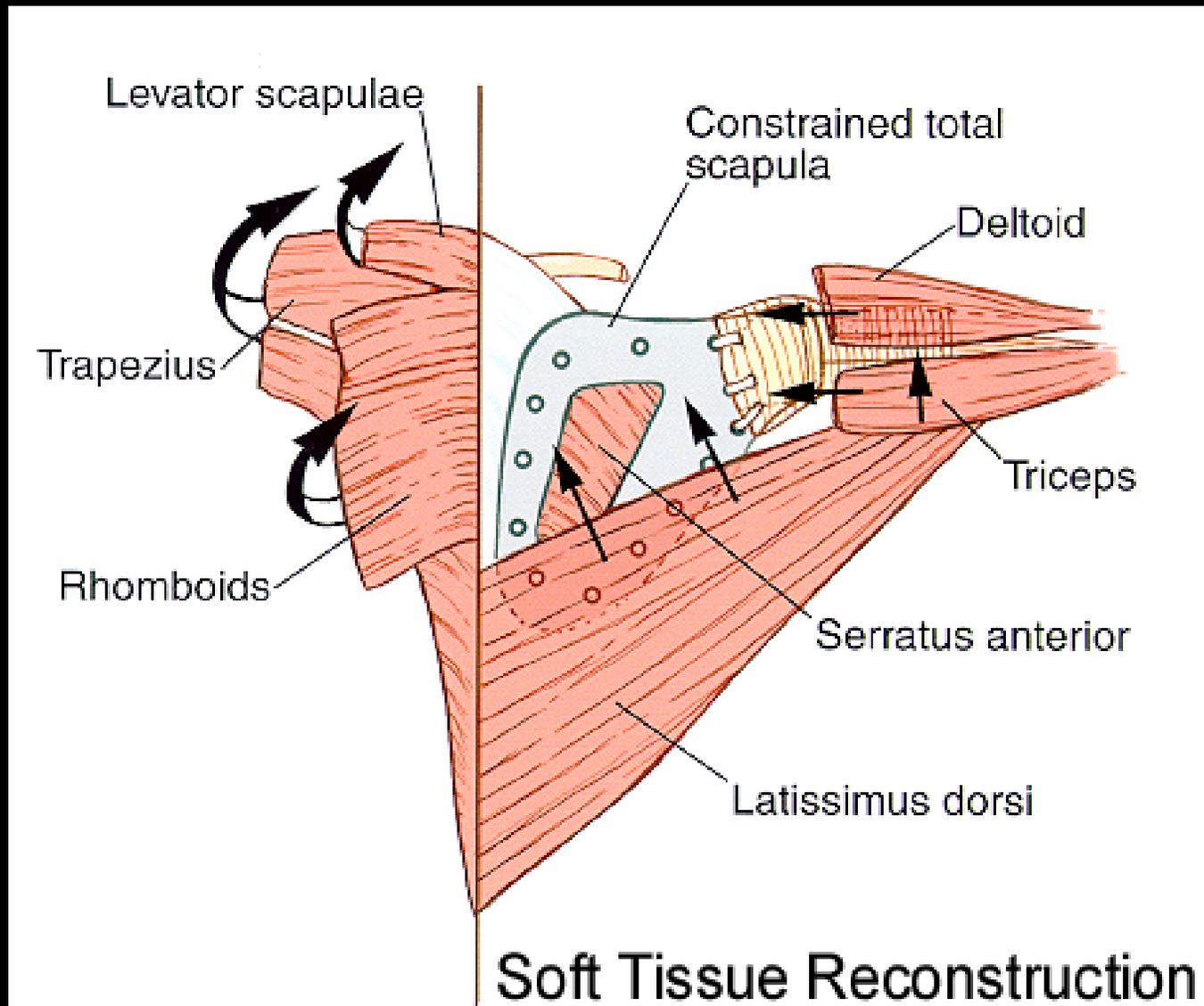
- Resection: combined anterior and posterior approach
- Neurovascular bundle explored and mobilized
- Tumor explored
- **Required muscles preserved**, when feasible

Reconstruction

- Prosthesis placed close to midline
- Pocket between *Serratus Anterior* and *Rhomboids*
- All other periscapular muscles transferred and tenodesed
- Latissimus mobilized
- Proximal humerus snapped into place (Gore-tex)
- Entire prosthesis covered with soft tissue

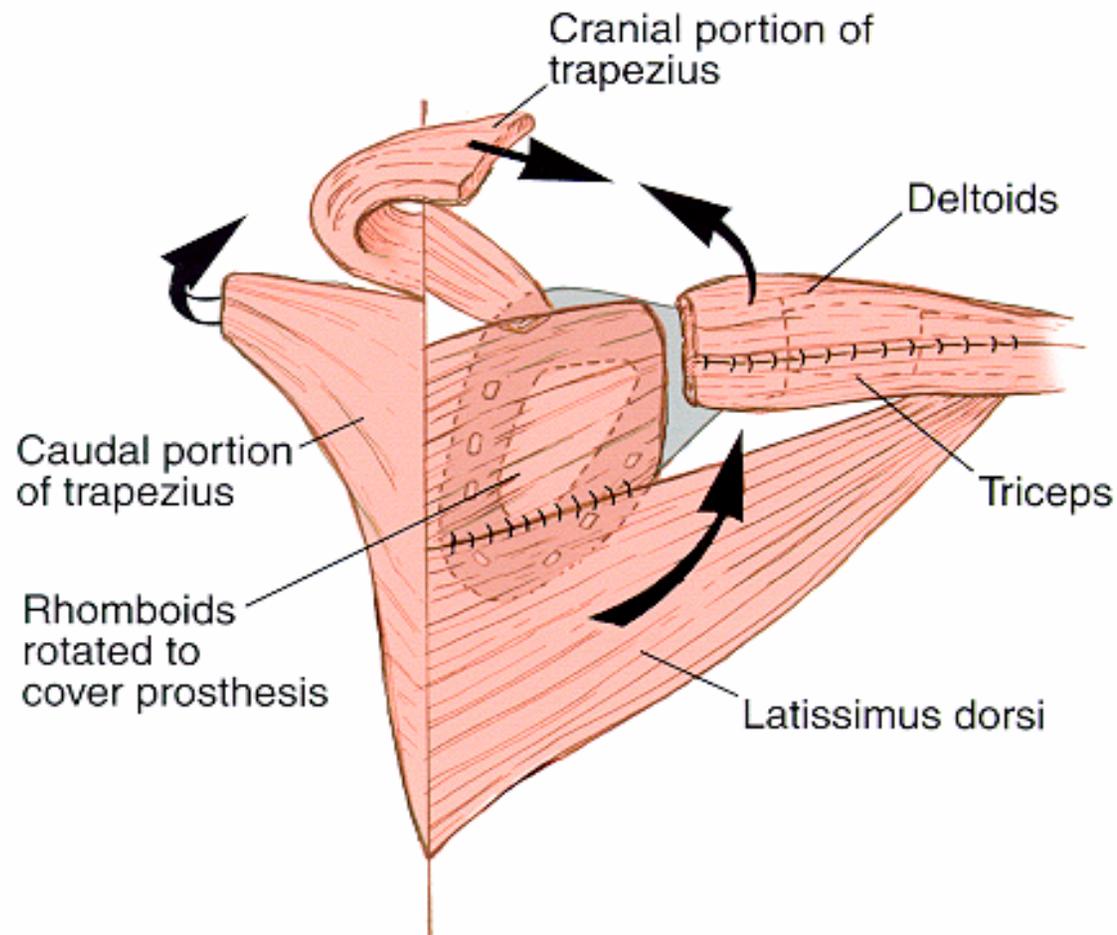
Soft Tissue Reconstruction

Prosthesis Placed Between Serratus Anterior and Rhomboids



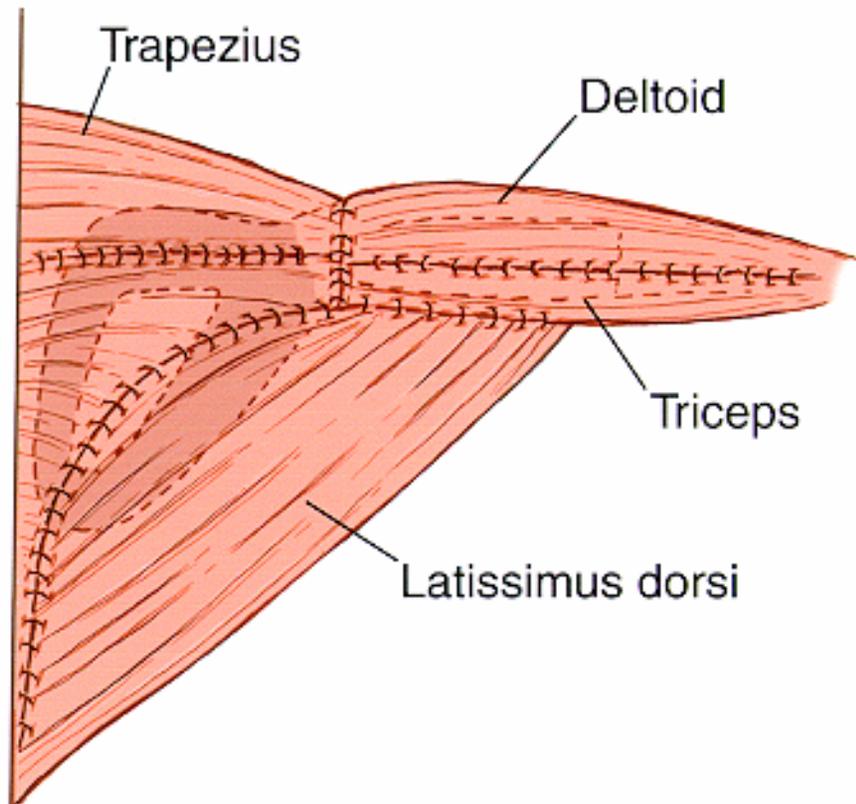
Muscle Force Couples

Soft Tissue Reconstruction



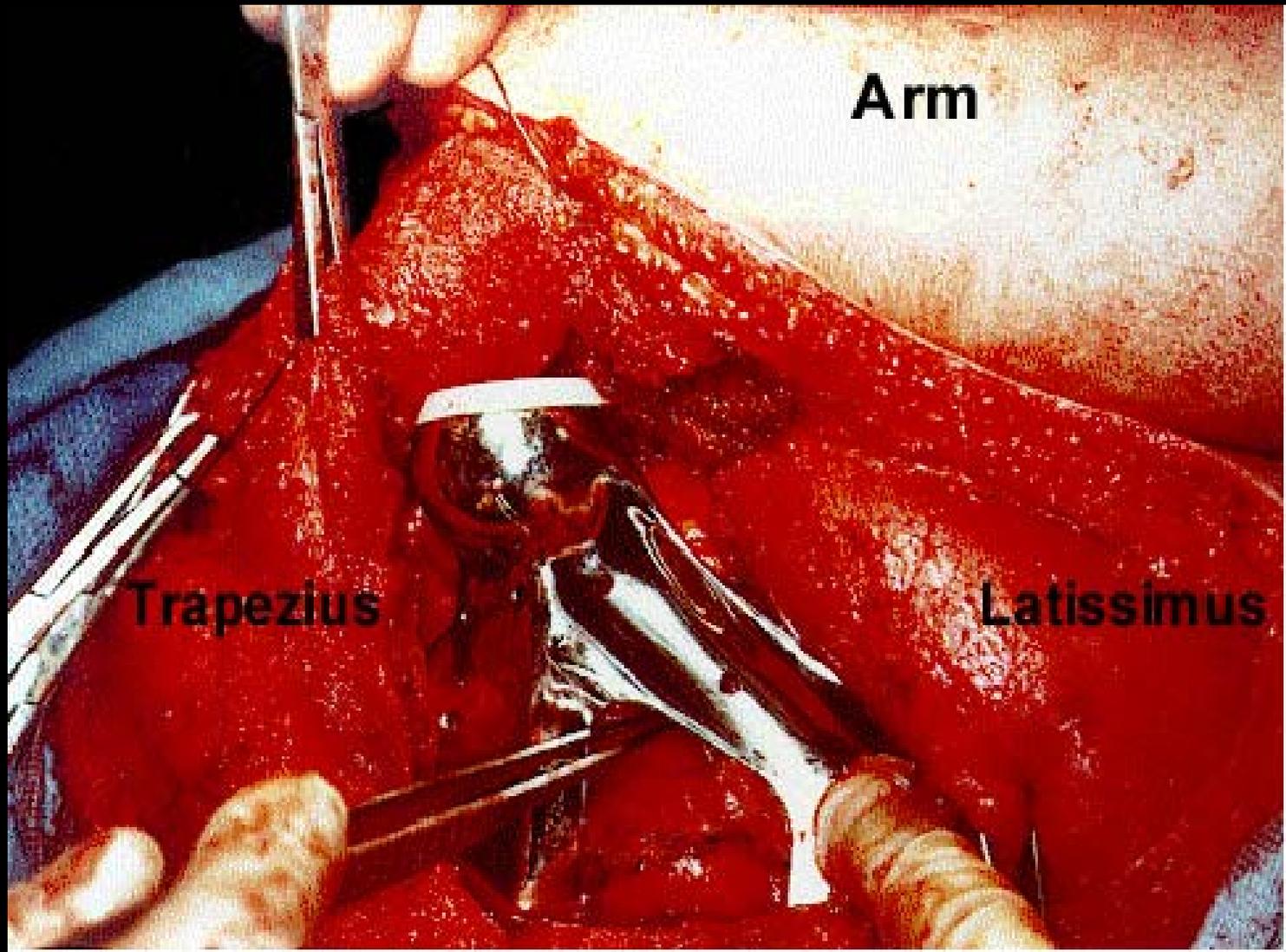
Entire Prosthesis Covered

Soft Tissue Reconstruction

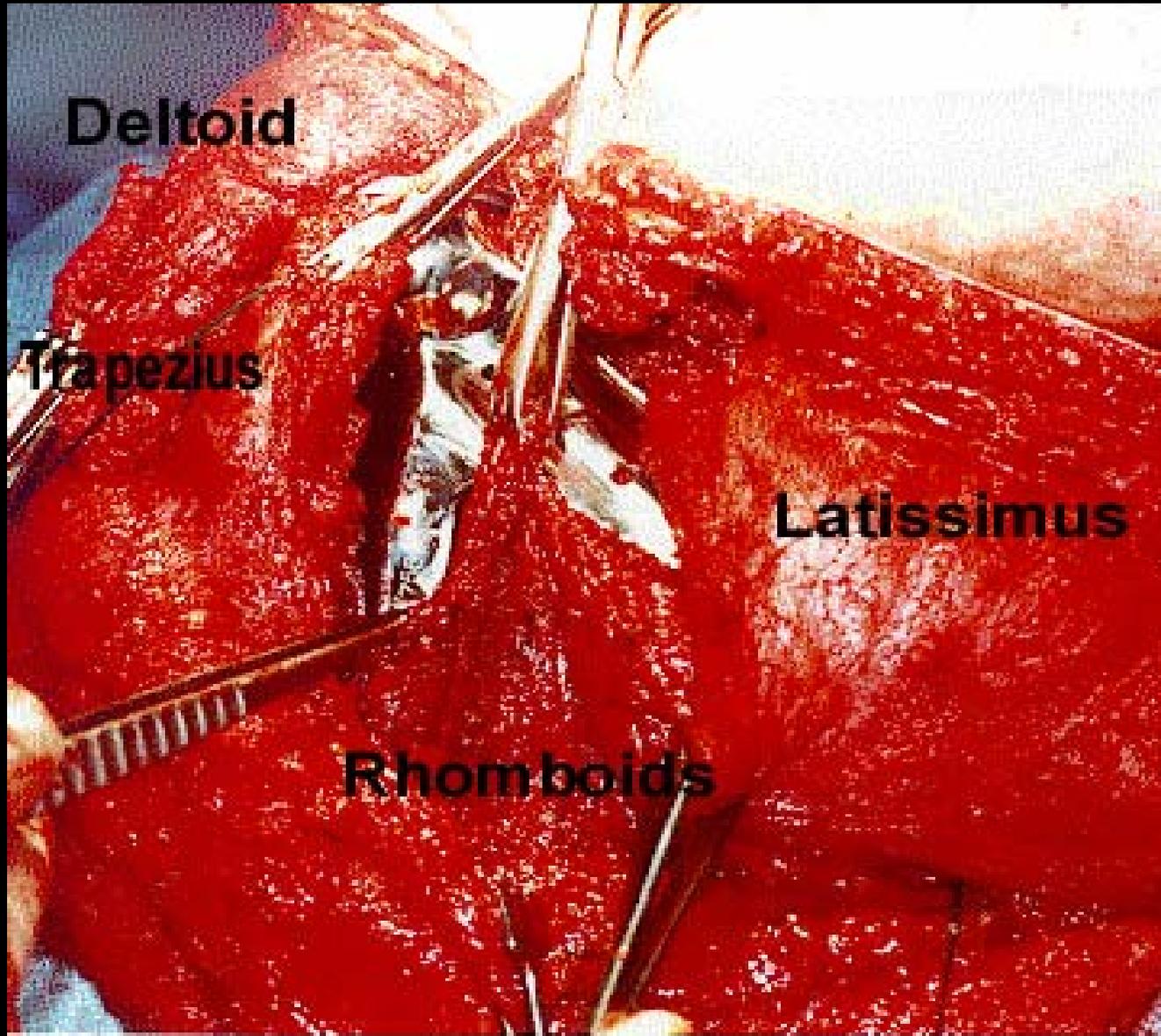


The entire prosthesis is covered!

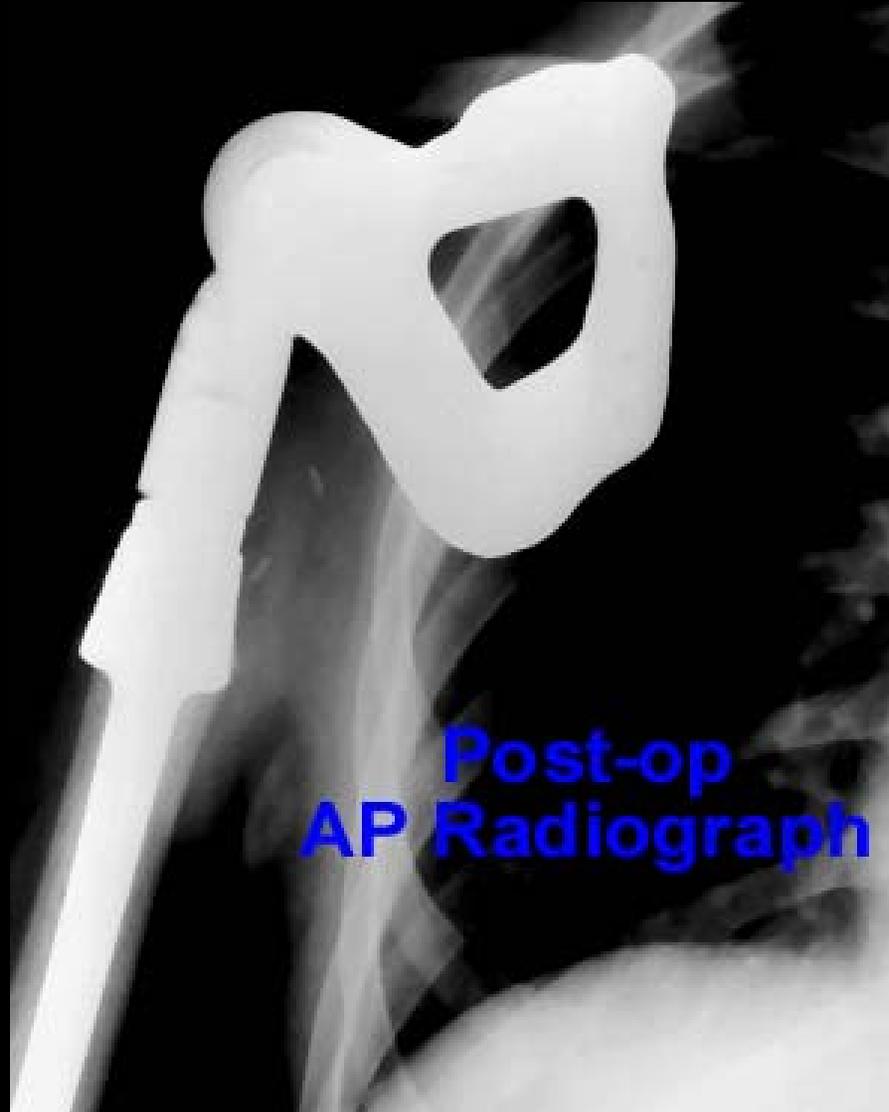
Intraoperative View



Intraoperative View



Postoperative AP



Postoperative Lateral



**Post-op
Lateral Radiograph**

Postoperative Axillary



**Post-op
Axillary Radiograph**

Postoperative Function

MSTS Score: 24-27/30 (Consistent Results)

Pain: 5 (All pain free)

Hand Dexterity: 5 (Normal)

Emotional Acceptance: 5 (All enthused)

Lifting Ability: 3-4 (Normal at side of body)

Hand Positioning: 3-4 (Hand above shoulder)

Function/Activities: 3-4 (Athletic restrictions)

Function

- All shoulders **stable**
- Functional hand and elbow
- Scapular protraction, retraction and elevation intact
(Assist in stabilizing extremity when carrying objects)
- No complications



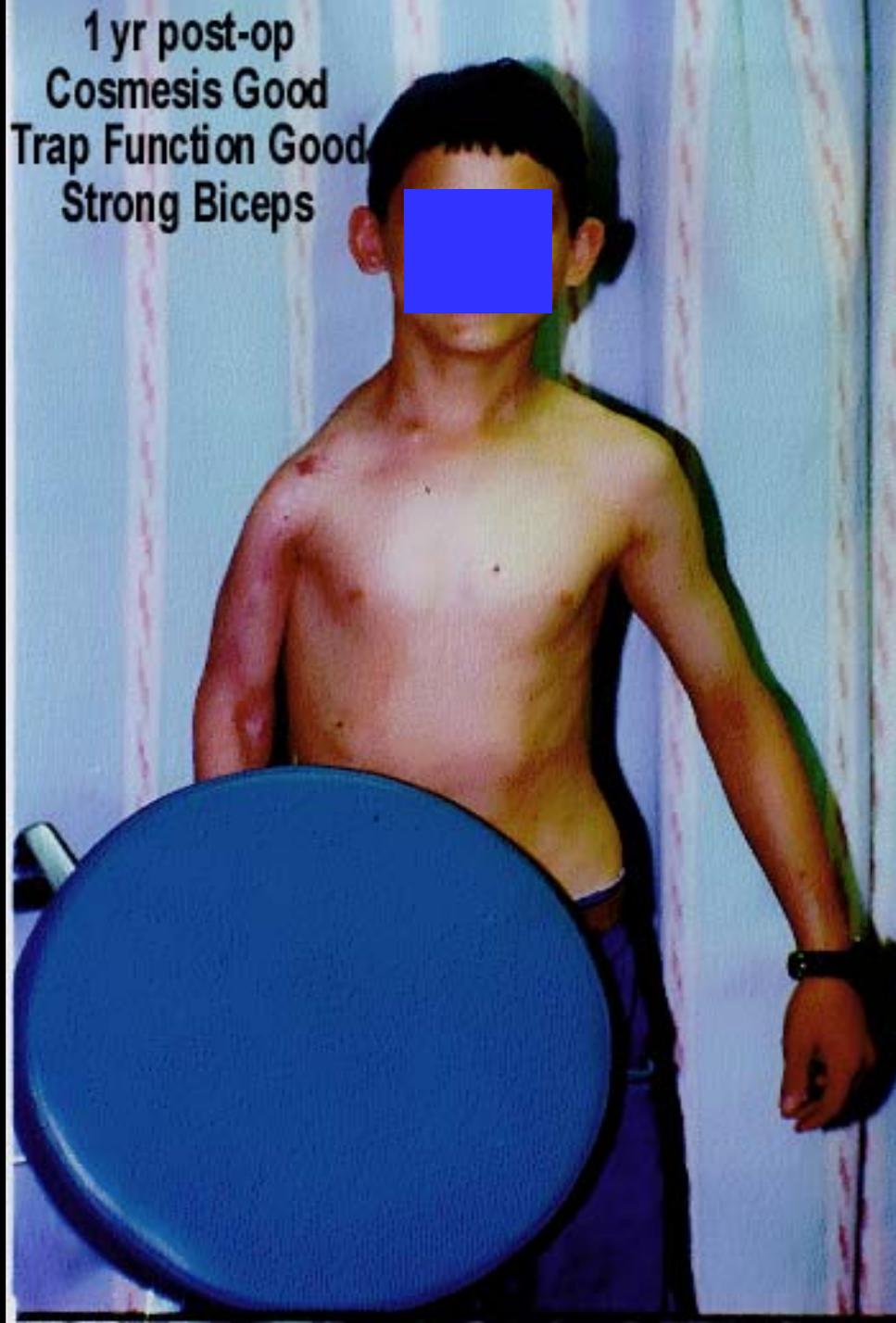
13 y.o.

6 mos post op

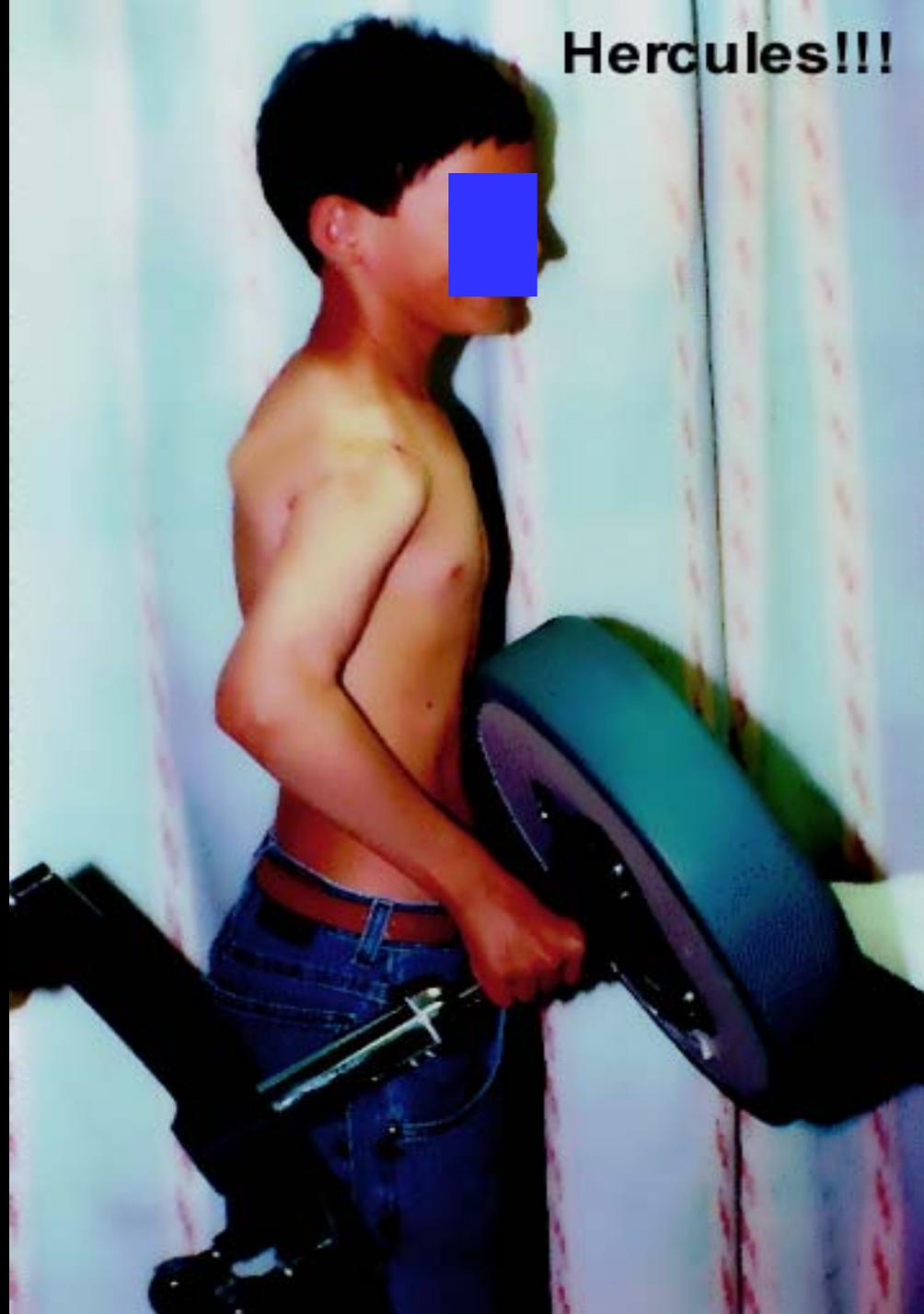
Normal elbow flexion

Some FF of Shoulder

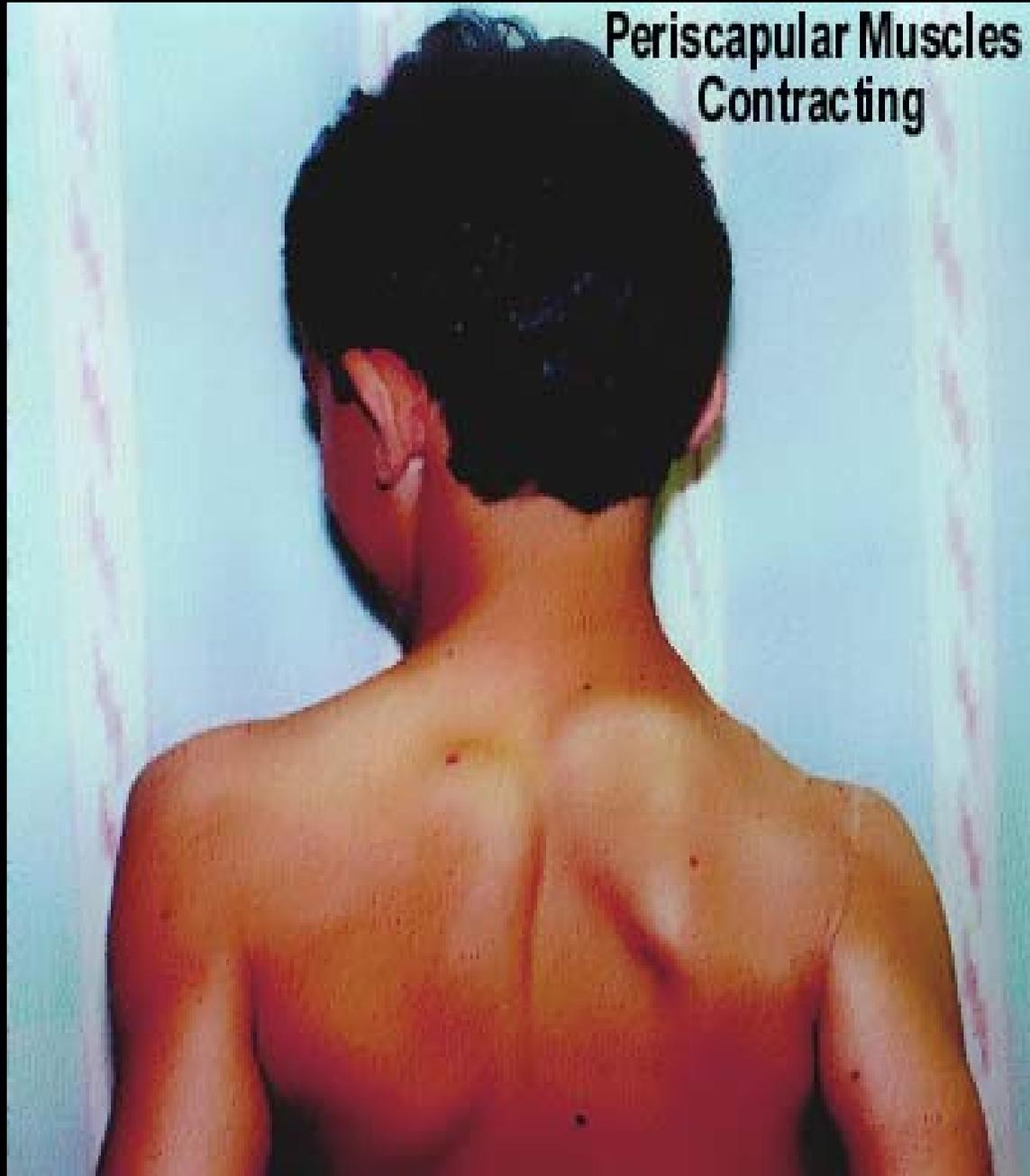
1 yr post-op
Cosmesis Good
Trap Function Good
Strong Biceps

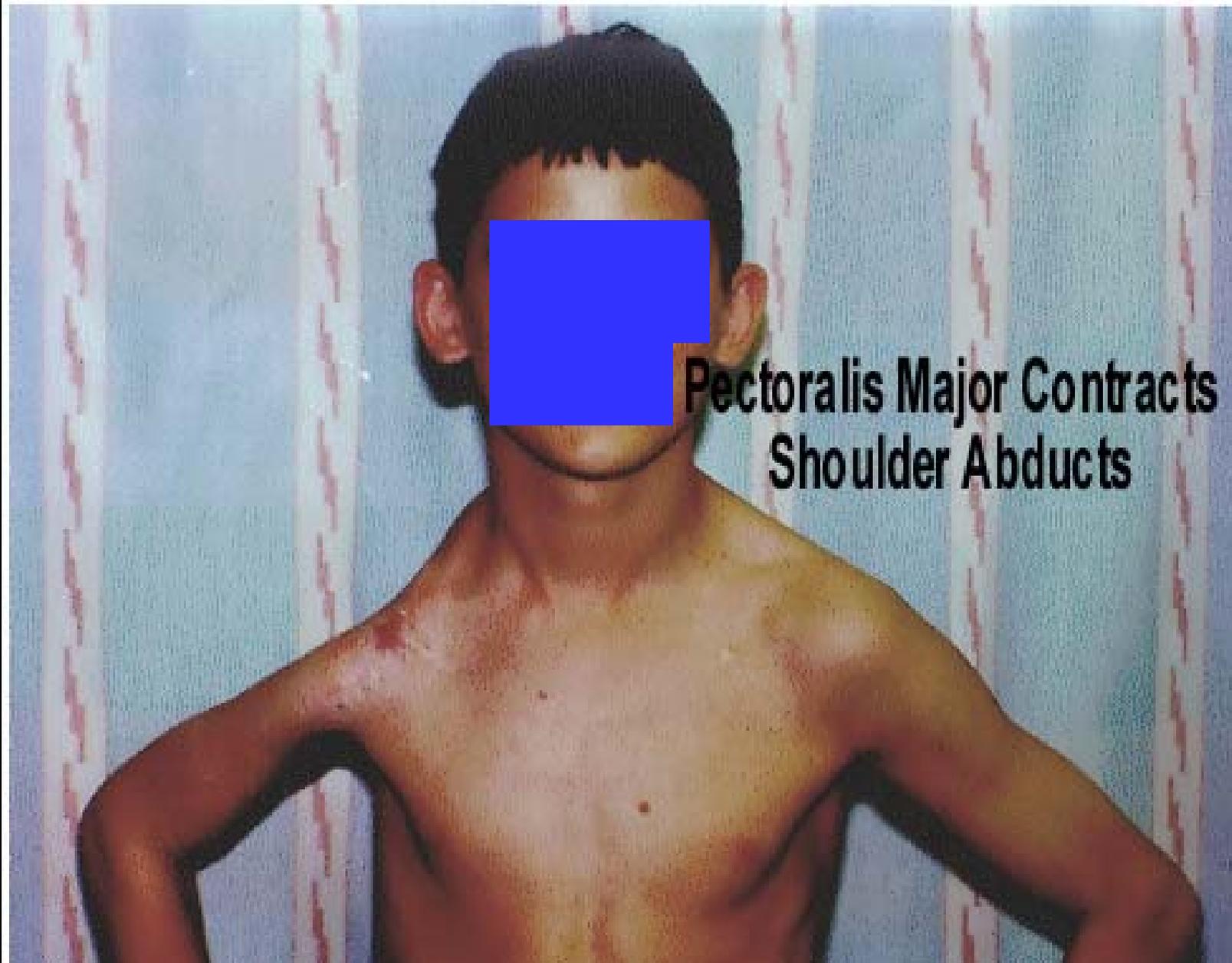


Hercules!!!



**Periscapular Muscles
Contracting**





**Pectoralis Major Contracts
Shoulder Abducts**







Conclusions

- Total scapula prosthetic reconstruction appears to be a safe and reliable method for anatomically reconstructing the shoulder girdle following total scapulectomy
- The following periscapular muscles must be preserved for soft tissue coverage and reconstruction of the muscle force couples (**Deltoid, Trapezius, Rhomboids, Serratus Anterior, Latissimus**) and axillary nerve

Conclusions

- It permits reconstruction of the *glenohumeral and scapulothoracic mechanisms*, both functionally important
- Constrained components ease reconstruction
- Further follow-up is necessary to determine if the constrained versions provide an improvement in function over non-constrained versions

Reconstruction Options

Non Anatomic Methods

- Glenohumeral and Scapulothoracic Mechanisms Not Reconstructed
- No Reconstruction—Flail Shoulder
- I.M. Rod or Spacer
- Attach Humerus to Clavicle or Rib

Problems:

- Unstable Extremity
- Poor Lifting Ability
- Remaining Periscapular Muscles Not Utilized
- Chronic Traction Neuropraxia
- Pain
- Frequent Complications
- Hardware Failure

Indications

- Primary high grade and select low grade scapula sarcomas
- Periscapular soft tissue sarcomas invading the scapula
- Select metastatic carcinomas with extensive scapular destruction and a soft tissue component, especially radioresistant lesions