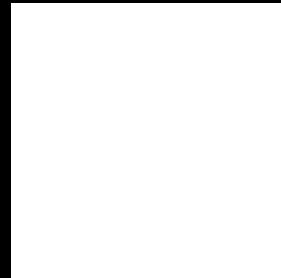
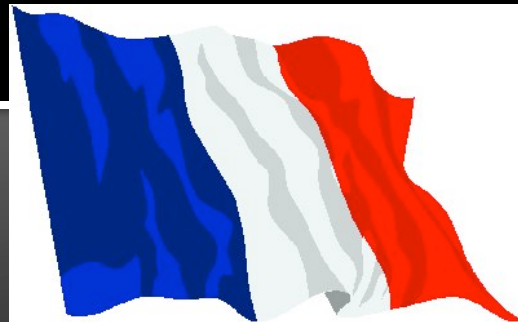


Massive Rotator Cuff in Patient without Arthritis: Why do We Choose LD Transfer instead of Reverse Prosthesis?



Jean Kany
Clinique de l'Union, Toulouse, France

Jean Grimberg
LIRCOS, Paris, France



Katowice, December, 2015

Conflict of Interest

Jean Kany:

FH Orthopedics (Arrow designer)

Is there still a role for open surgery?

When do I consider a tissue transfer?

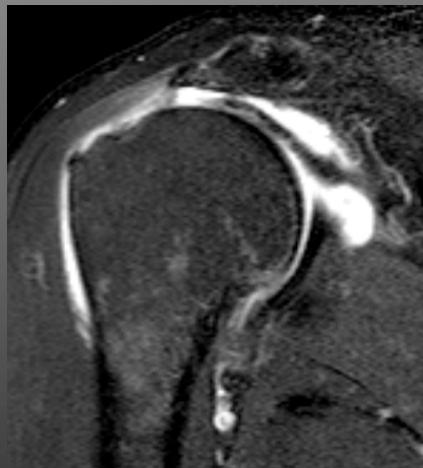
Pascal Boileau MD, Adam Rumian FRCS

Medical University of Nice, France

Patient



" Doctor, I have a cuff tear, and
I need you to fix it!... »



Surgeon's answer:

"Sure, I will"

Are you sure?



"Irreparable cuff tears do NOT exist!..."

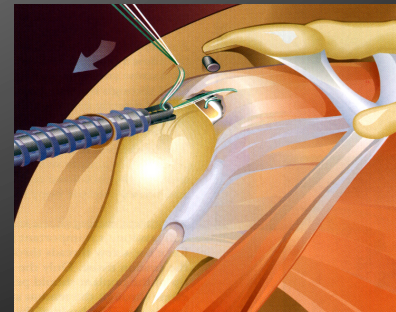
Outline

- *Irreparable RC Tears do exist*
- *Irreparable RC Tears can be preoperatively identified*
- *Some irreparable tears are best left untreated, specifically the RC 'wears'*
- *Some irreparable tears (wears) are becoming painful because the LHB is becoming pathologic*
- *Some irreparable tears do compromise the muscle balance (i.e., shoulder function) and need to be treated by tendon transfer and/or arthroplasty*

Open vs Arthroscopic Surgery??

NOT the important question!!!!

- Decide what is the cause of patients symptoms
- Decide what needs to be achieved according to the anatomical lesions
- THEN how to do it!
- Depends on surgeon experience....



If you don't ask yourself the good question,

You will do not find the good answer!



René Descartes, 1596-1650

4 relevant questions



1/ " Why is this patient coming to see me?..."

2/ " Is this shoulder functional or not?..."

3/ " Is this a « cuff tear », a « cuff wear », or both?..."

4/ " Is the LHB still present?"

Question #1

" Why is this patient coming to see me?..."

(i.e. , what are symptoms ?...)

Clinical assessment

- What is the patient complaining of:
 - Pain?
 - Painful Loss of movement?
 - Weakness?
 - Functional impairment- pseudoparalysis?
 - Loss of arm control?
- **Accurate history** — duration of symptoms, recent trauma, previous treatments/surgery, smoking, etc...

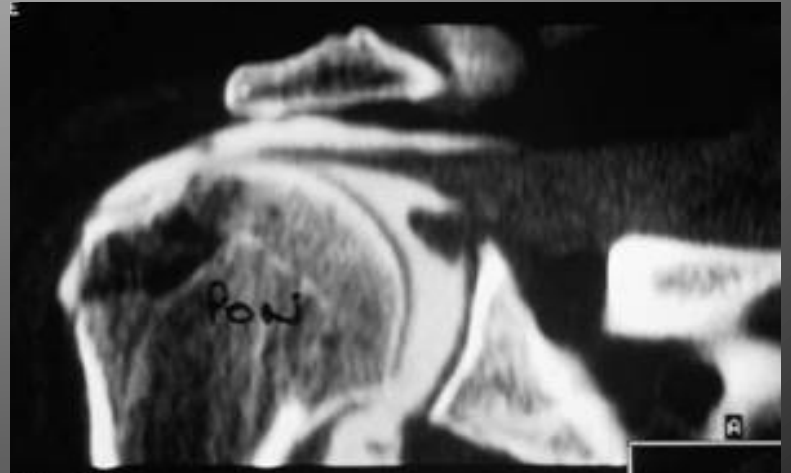
Question #2

" Is this a « cuff tear »,
a « cuff wear »,
or both?..."

ie, trauma?

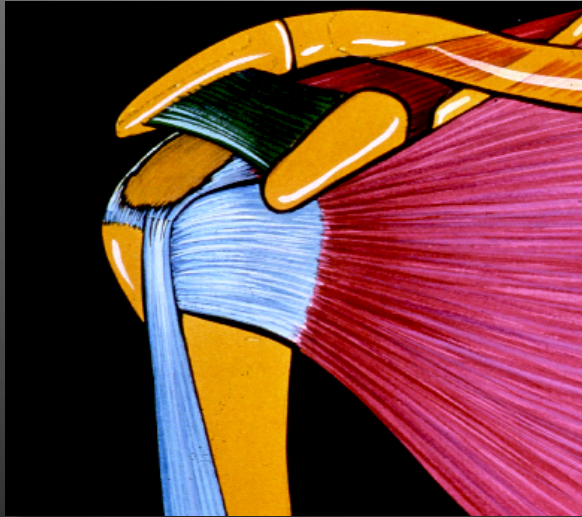
After 70 years

Frequency of asymptomatic RCT



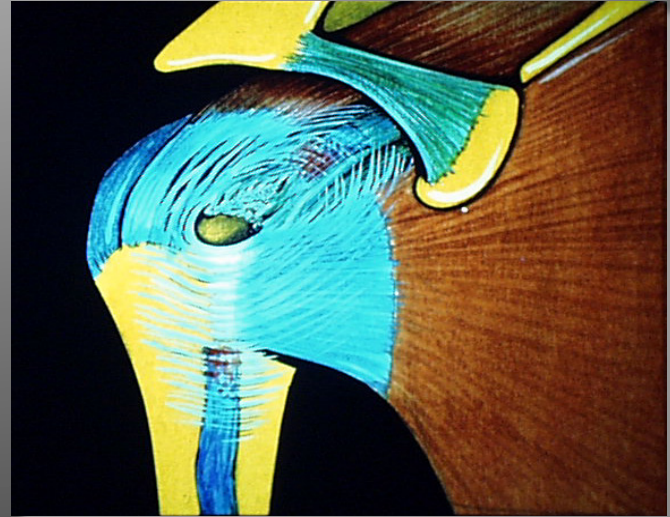
...50%

Rotator Cuff 'Tear'



Repair!

Rotator Cuff 'Wear'



Do not repair!

Key #3

" How do you know
that it is
a « cuff wear »?"

(i.e. , an old cuff tear?...)

cuff wear

Look at your patient's back shoulder!

Muscle atrophy???

Repair!

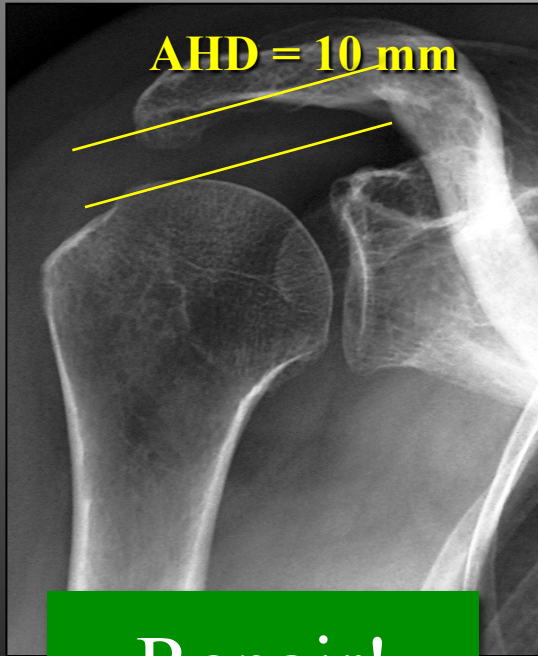


Do not Repair!

cuff wear

Ask for an AP view in Neutral Rotation!

Acromio-Humeral Distance???



Repair!



Don't Repair!

Look also for Osteoporosis...Osteoarthritis!...

cuff wear

Look at AP view in Neutral Rotation!

Hamada Classification

Repair!



Do not repair!

cuff wear

Ask for CT-scan or MRI!

Goutallier et al. CORR 1994

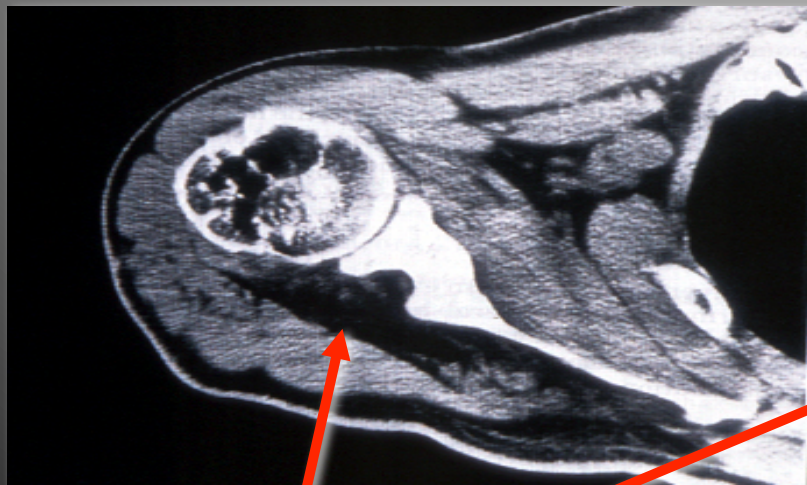


Repair!

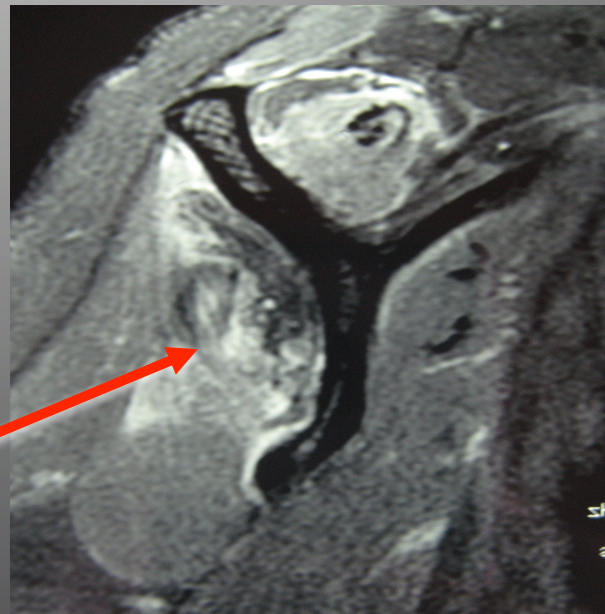
Do not repair!

cuff wear

You're an orthopaedic surgeon...



irreversible
fatty infiltration!



cuff wear

You're NOT a plastic surgeon!!!...



So, do not deal with FAT tissue!...

Assuming that:

- 1) the cuff (could) should NOT be repaired ('irreparable')
- 2) the shoulder is functional ($AEE > 90^\circ$)
- 3) but the shoulder is painful...

Question #3

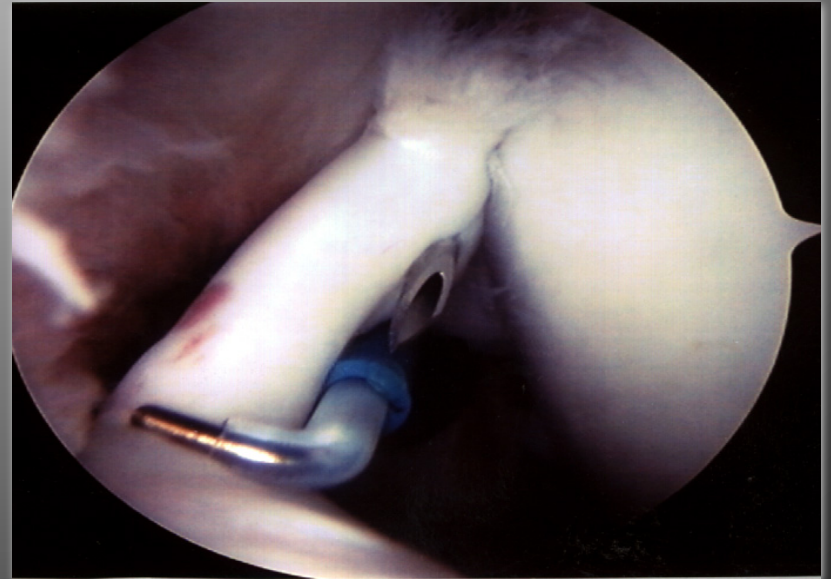
" Why has been this old cuff tear (wear)
becoming painful?"

" ie: is the LHB still present?"

Results of Biceps Tenotomy / Tenodesis

330 Patients / irreparable RCT

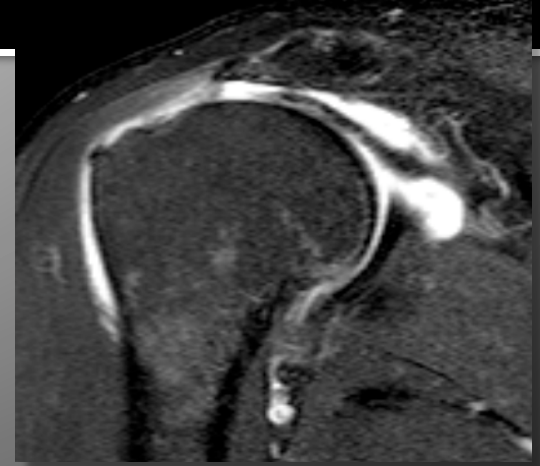
- Follow-up: 78 months (24 -168)
- 64 years (39 - 81)
- Satisfaction: 90%
- Constant : 48 → 67 pts
- Pain: 4 → 11 pts
- Evolution toward arthrosis: 9%
- Reoperation (RSA): 6%



Walch , JSES 2005
Boileau, JBJS 2006

7 Good Reasons NOT to Repair a RCT

1. No tendon (resorption)
2. No RC muscle (atrophy, fatty infiltration)
3. No good bone (GT osteoporosis, women)
4. No good joint (GH ostoarthritis)
5. Static Humeral head subluxation (AHD <6mm)
6. Dynamic Humeral head subluxation (pseudoparalysis)
7. Previous surgery (destroyed anterior deltoid, low grade infection...)



Question #4

" Is this shoulder functional or not?..."

(i.e. , is the muscle balance conserved?...)

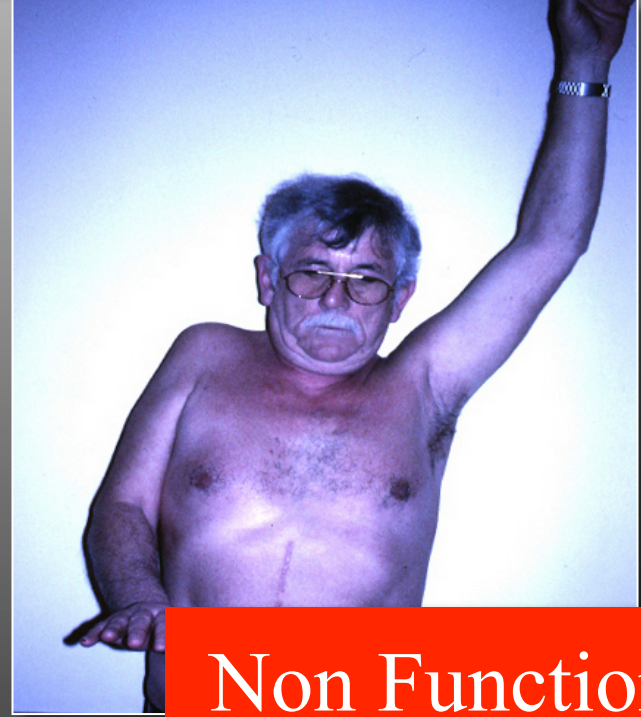
**Painful (or Not) but...
Functional Shoulder**



Functional

≠

**Painful (or Not) but..
Non Functional Shoulder**



Non Functional

Pseudo-paralysed shoulder

Some 'cuff wears' does not need any repair!!!

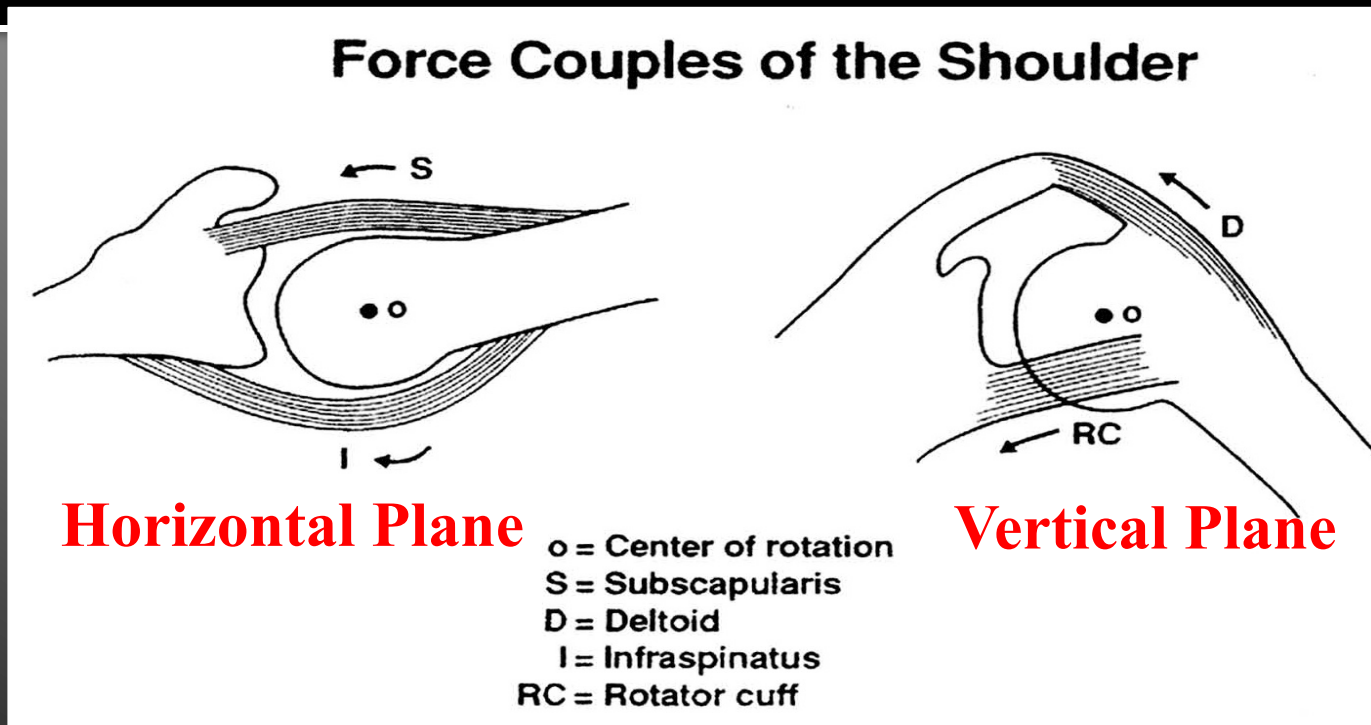


Key Question #2:

" In which plane is this shoulder unbalanced:

vertical, horizontal or both?... »

Shoulder Muscle Balance

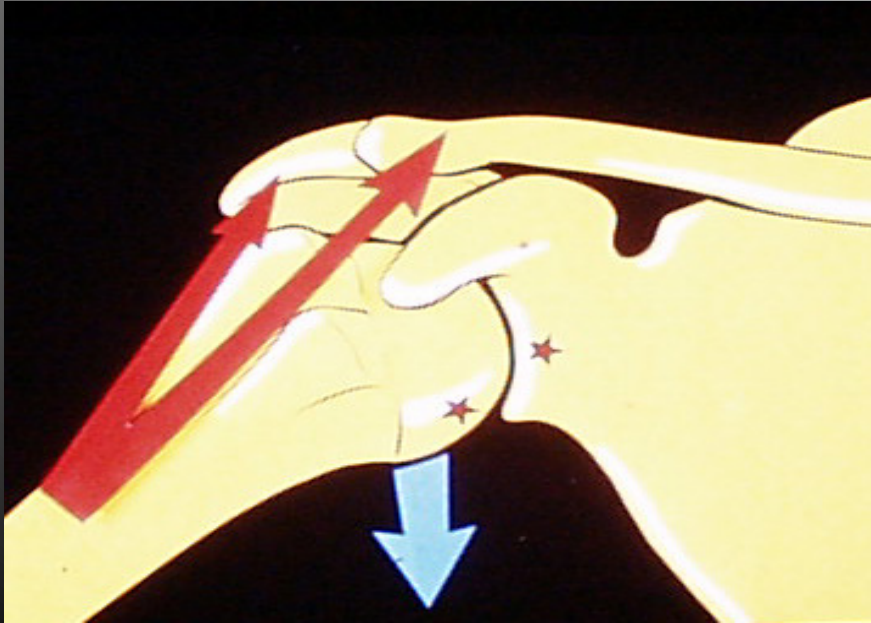


Burkhart SS et al.

Fluoroscopic comparison of kinematics pattern in massive rotator cuff tears. A suspension bridge model.

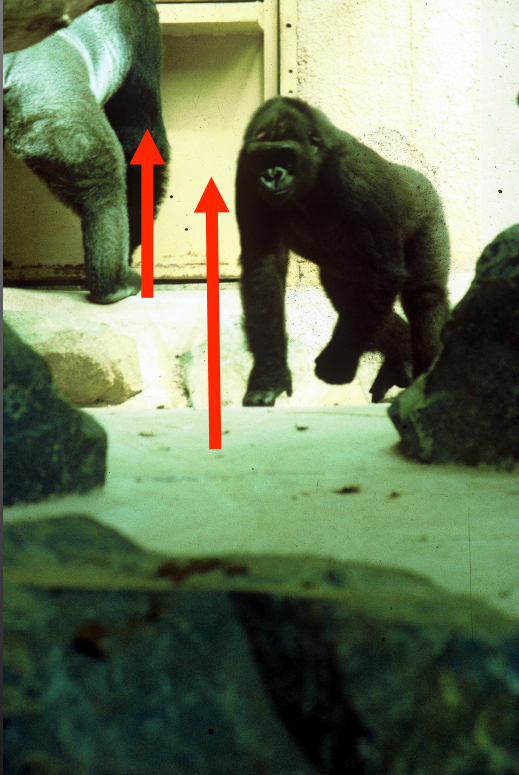
CORR 1992, 284;146

Natural Vertical Muscle Imbalance of the Shoulder



Deltoid > Rotator Cuff muscles

Natural Vertical Muscle Imbalance of the Shoulder

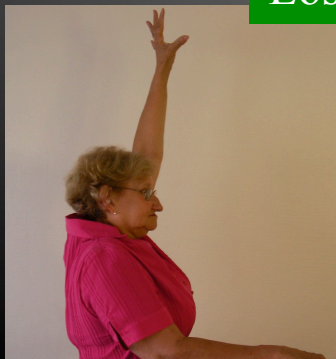


Shoulder => Hip

Most Cuff Deficient Shoulders



Loss of active elevation...

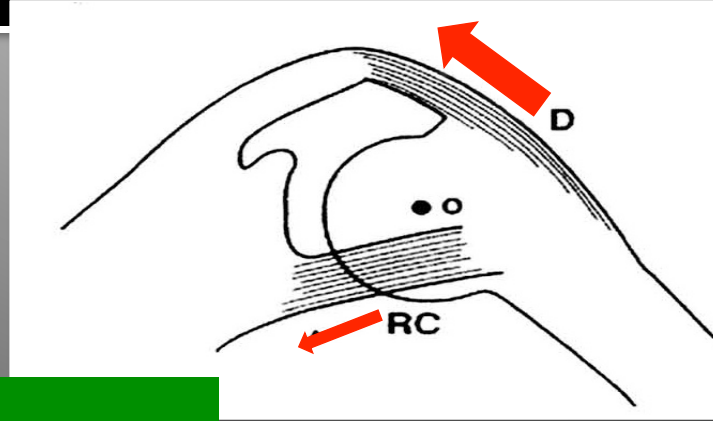


...but preserved some ER



= VERTICAL
imbalance of the
shoulder

Vertical muscle imbalance



ILEA

Isolated Loss of Elevation (active)

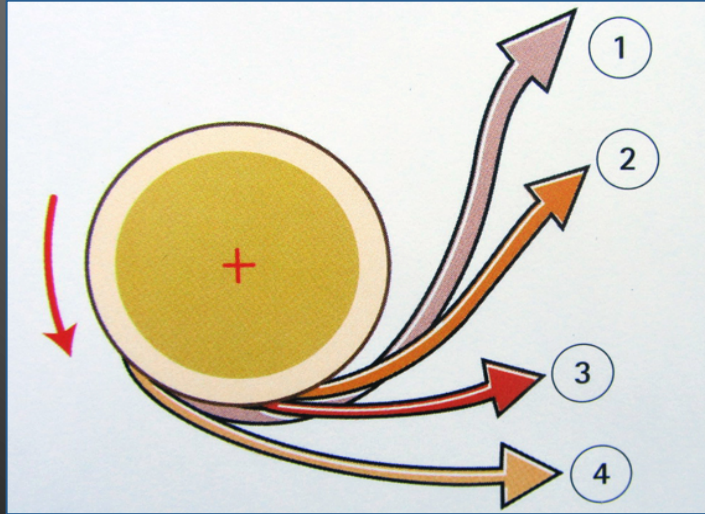


Strong Deltoid

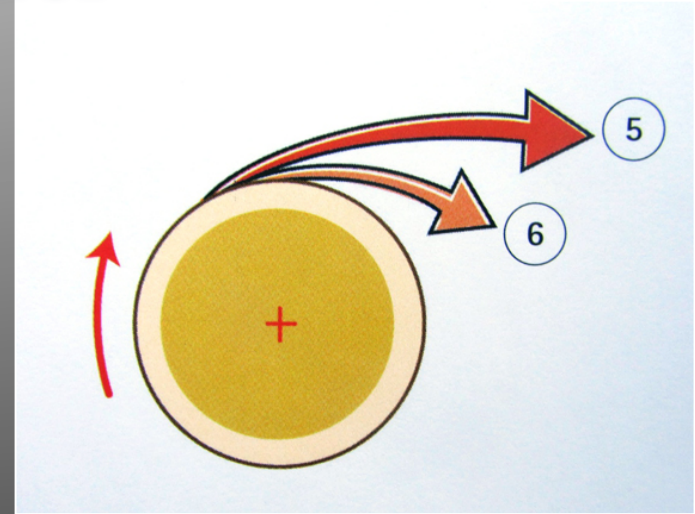
vs

Weak cuff muscles

Natural Horizontal Muscle Imbalance of the Shoulder



4 ER muscles



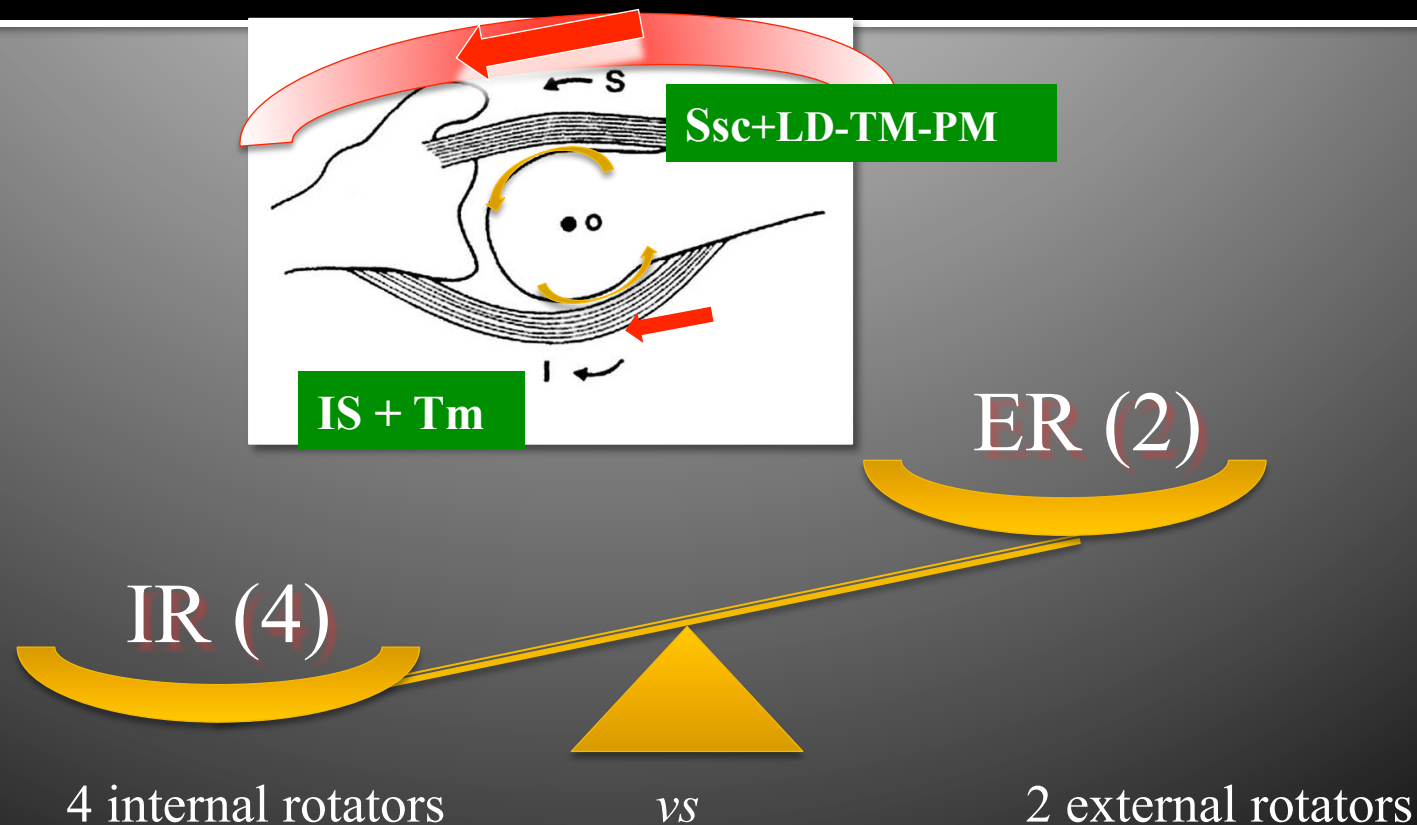
2 IR muscles

Non functional shoulder

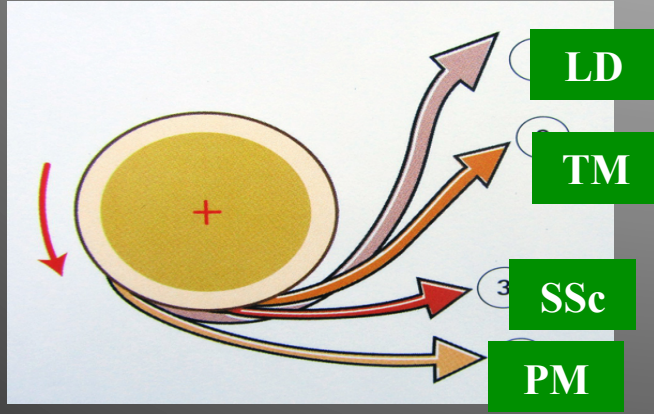
3 Patterns of presentation with Irreparable Massive Cuff Tear

- ILEA – Isolated loss of elevation (active)
- ILER – Isolated loss of external rotation
- CLEER – Combined loss of elevation and external rotation

'Natural' Horizontal muscle imbalance



Horizontal muscle imbalance of the Shoulder

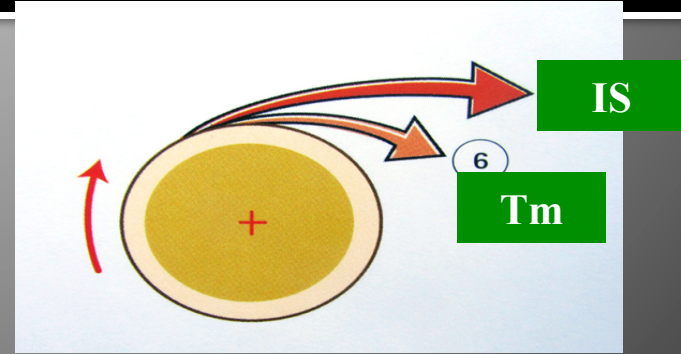


“

IR (4)

4 internal rotators

vs



ER (2)

”

2 external rotators

Hornblower's sign = NO IS/Tm++

= NO External Rotation possible!!!

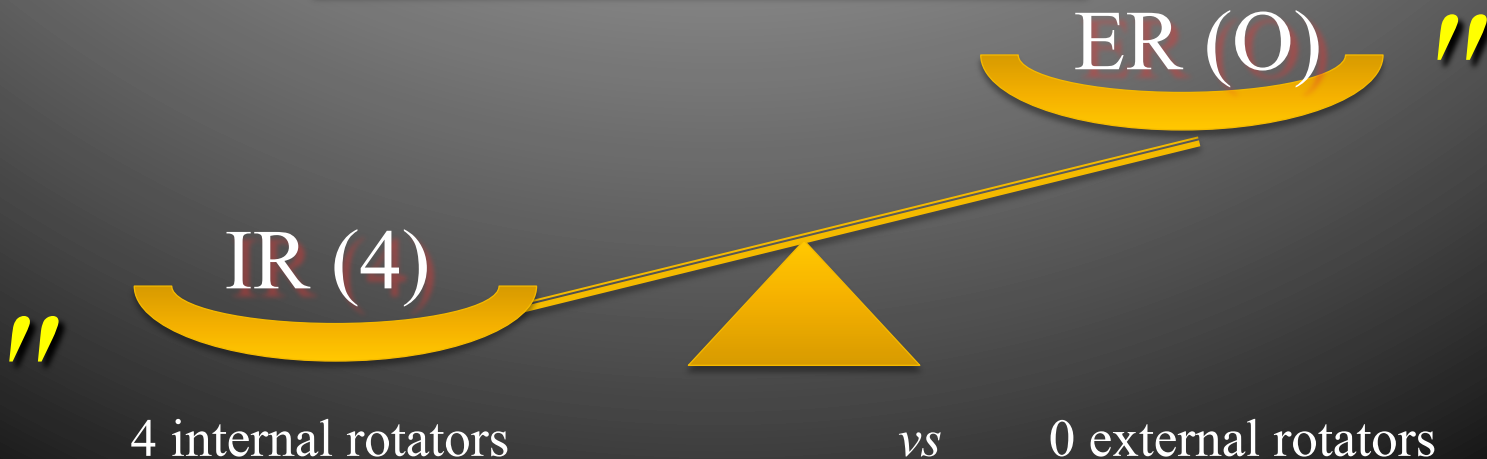
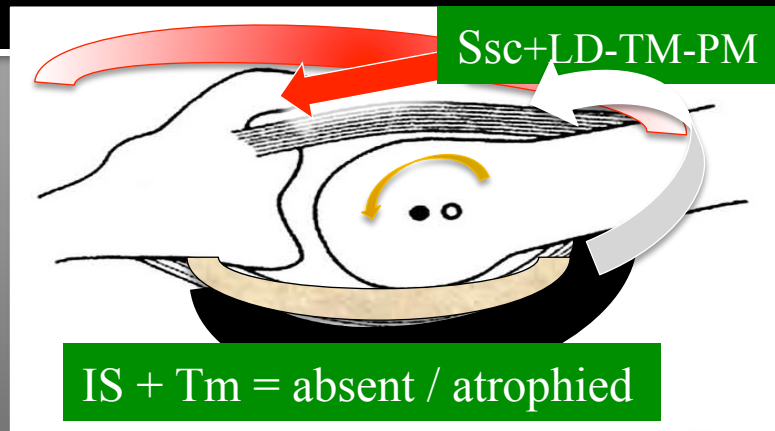


Tm: Fat!!

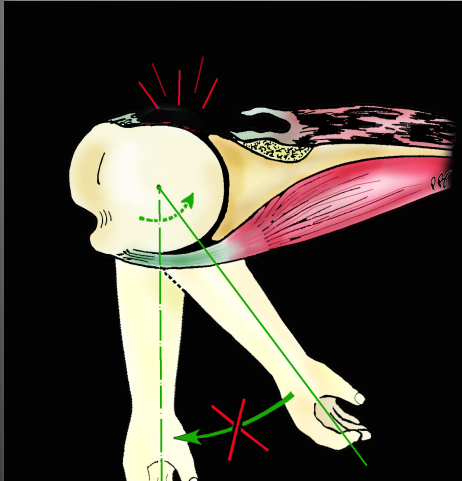
Walch et al JBJS Br, 1998

Horizontal muscle imbalance

(ILER)



Both Planes



No active elevation...

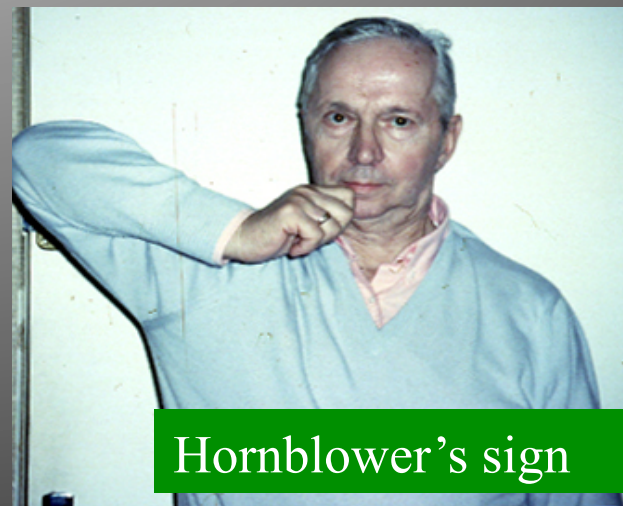


...and lost of ER

HORIZONTAL and VERTICAL
imbalance

ILER: Isolated Loss of External Rotation

- Patient is able to elevate arm
- Loss of spatial control of arm positioning++



= deficient teres minor

ILER: Isolated Loss of External Rotation

- Imaging :atrophy and fatty infiltration of teres minor++



Irreparable
Posterosup. cuff tear



Severe Muscle
Fatty infiltration



ILER: Isolated Loss of External Rotation

- External Rotation Deficit limits the ability to perform ADL (shaving, brushing teeth, combing hair, dressing, feeding or drinking...)



Horizontal muscle imbalance

Assuming that: (no arthritis)

- 1) the cuff (could) should NOT be repaired ('irreparable')
- 2) the shoulder is functional ($AEE > 90^\circ$)
- 3) LHB already torn (or tenotomized)



4) but the shoulder is painful...

Indication for tendon transfer

Supraspinatus => LD

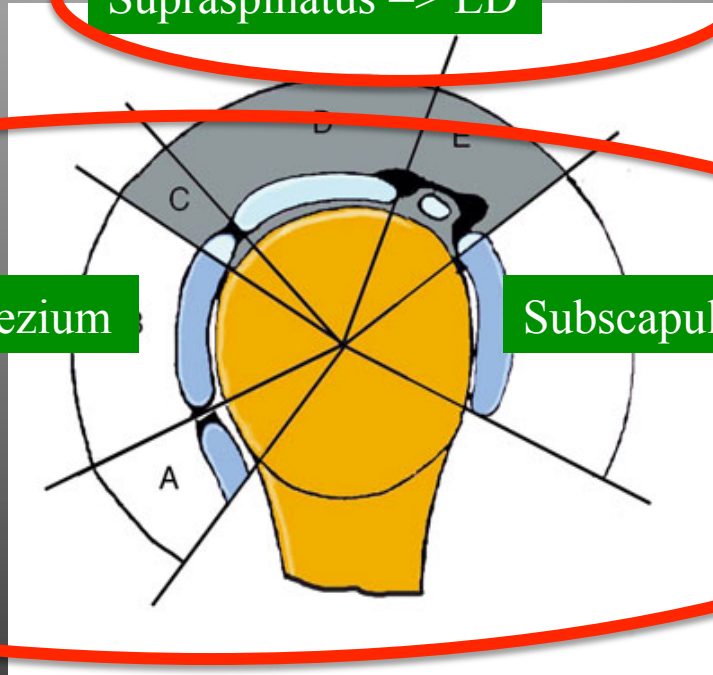
Vertical Plane

Infraspinatus => Inferior Trapezium

Subscapularis => PM

Teres minor => LD

Horizontal Plane



Ideal tendon transfer

1. Accurate fixation zone
2. Accurate tension fixation
3. Strong bone fixation
4. Accurate length and strength
5. No pedicle impingement
6. Mini invasive surgery
7. Synergistic function

Biomechanical analysis of tendon transfers for massive rotator cuff tears

D.J. Magermans ^{a,*}, E.K.J. Chadwick ^a, H.E.J. Veeger ^a, F.C.T. van der Helm ^a,
P.M. Rozing ^b

Effectiveness of tendon transfers for massive rotator cuff tears: a simulation study

D.J. Magermans ^{a,*}, E.K.J. Chadwick ^a, H.E.J. Veeger ^a, P.M. Rozing ^b,
F.C.T. van der Helm ^a

CLINICAL BIOMECHANICS 2004

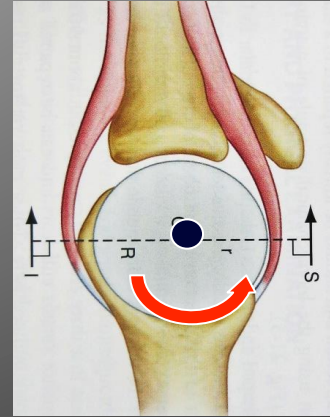
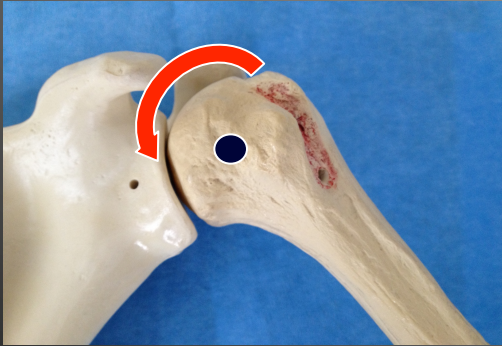
Biomechanics of latissimus dorsi transfer for irreparable posterosuperior rotator cuff tears

H.Y. Ling ^{*}, J.G. Angeles, M.B. Horodyski

Department of Orthopaedics and Rehabilitation, University of Florida, Gainesville, FL, USA

CLINICAL BIOMECHANICS 2009

Centre of rotation



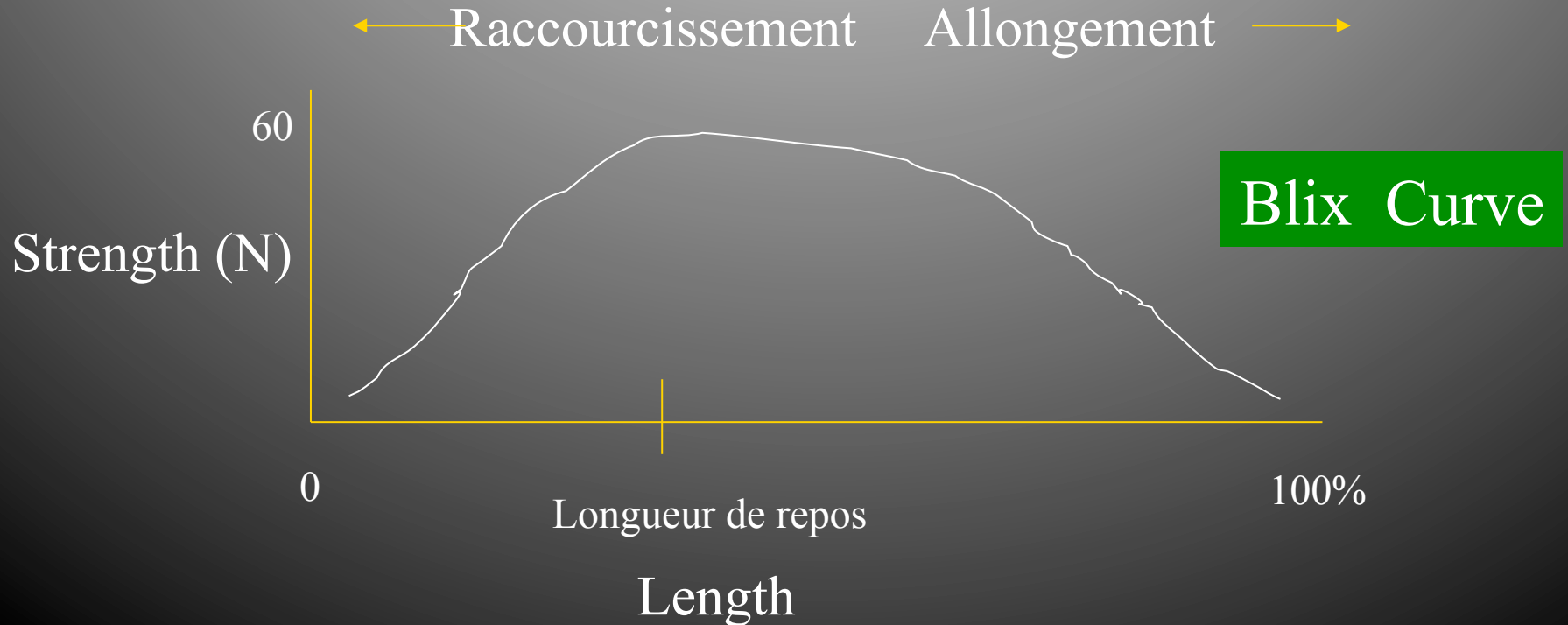
Finite elements Simulation

- LD (and TM) becomes :
 - Elevator  supraspinatus
 - ER  infraspinatus
- TM stronger than LD
- TM + LD stronger than LD alone

Ideal tendon transfer

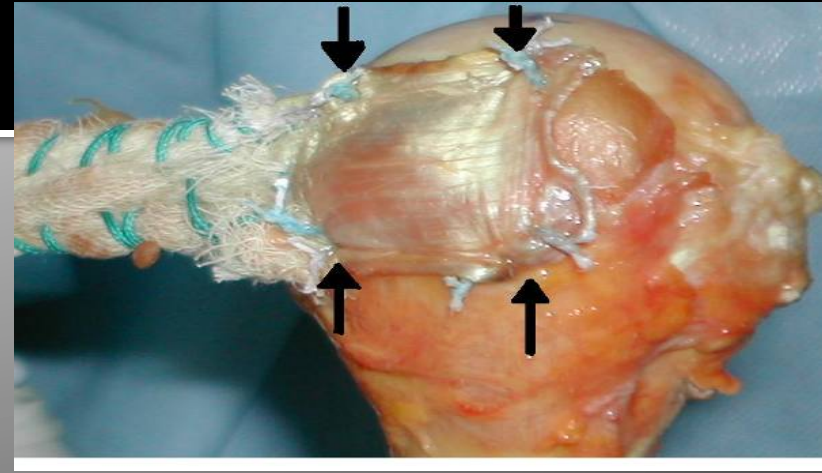
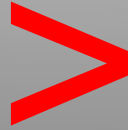
- Accurate fixation zone
- Accurate tension fixation
- Strong bone fixation
- Accurate length and strength
- No pedicle impingement
- Mini invasive surgery
- Synergistic function

“Strength/Length” Curve



Ideal tendon transfer

- Accurate fixation zone
- Accurate tension fixation
- Strong bone fixation
- Accurate length and strength
- No pedicle impingement
- Mini invasive surgery
- Synergistic function



Tendon fixation in arthroscopic latissimus dorsi transfer for irreparable posterosuperior cuff tears: An in vitro biomechanical comparison of interference screw and suture anchors

Amadou Diop^{a,*}, Nathalie Maurel^a, Vivian K. Chang^{b,c}, Jean Kany^d,
Louis-Denis Duranthon^b, Jean Grimberg^b

Clinical Biomechanics 26 (2011) 904–909

Ideal tendon transfer

- Accurate fixation zone
- Accurate tension fixation
- Strong bone fixation
- Accurate length and strength
- No pedicle impingement
- Mini invasive surgery
- Synergistic function

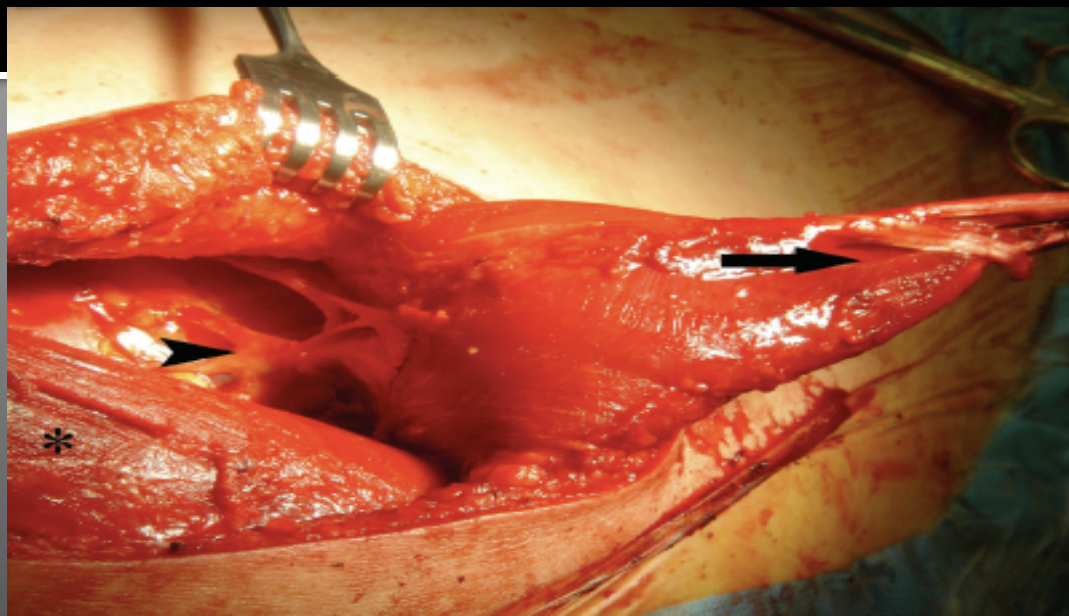
Excursion Potentielle (EP) and Tension Relative (TR)

MUSCLE	EP (cm)	TR (%)
Subscapularis	7,3	14,5
Pec Major (clavicular)	14,5	2,3
Pec Major (sternal)	18,8	5,4
Supraspinatus	6,7	5,2
Infraspinatus	8,6	9,7
Latissimus dorsi	33,9	5,9
Teres major	14,9	4,3
Anterior deltoïd	11,5	3,4

Herzberg et al J Shoulder Elbow Surg 1999

Ideal tendon transfer

- Accurate fixation zone
- Accurate tension fixation
- Strong bone fixation
- Accurate length and strength
- No pedicle impingement
- Mini invasive surgery
- Synergistic function



Ideal tendon transfer

- Accurate fixation zone
- Accurate tension fixation
- Strong bone fixation
- Accurate length and strength
- No pedicle impingement
- Mini invasive surgery
- Synergistic function

@ LD transfer

- 3 publications: 2 with anchors

Arthroscopic Latissimus Dorsi Transfer

Enrico Gervasi, M.D., Araldo Causero, M.D., Pier Camillo Parodi, M.D.,
Diego Raimondo, M.D., and Giuseppe Tancredi, M.D.

Arthroscopy: The Journal of Arthroscopic and Related Surgery, Vol 23, No 11 (November), 2007: pp 1243.e1-1243.e4

Arthroscopically Assisted Latissimus Dorsi Transfer for Irreparable Rotator Cuff Tears

Peter J. Millett, MD, MSc, Yi-Meng Yen, MD, PhD, and Michael J. Huang, MD

Techniques in Shoulder & Elbow Surgery 9(2):76-79, 2008

@ LD transfer

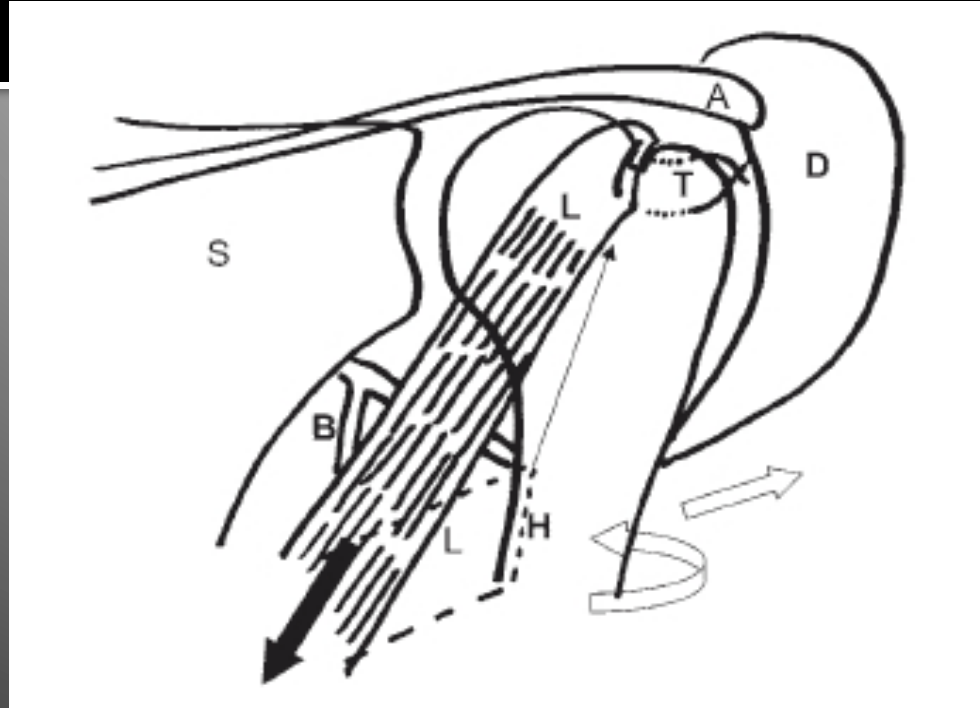
- Only one with tendon tubularization

Mini Invasive Axillary Approach and Arthroscopic Humeral Head Interference Screw Fixation for Latissimus Dorsi Transfer in Massive and Irreparable Posterosuperior Rotator Cuff Tears

Jean Kany, MD, Hemanth Alladu Kumar, MS,† Vivian K. Chang, MD,‡ Jean Grimberg, MD,§ Jérôme Garret, MD,|| and Philippe Valenti, MD¶*

Ideal tendon transfer

- Accurate fixation zone
- Accurate tension fixation
- Strong bone fixation
- Accurate length and strength
- No pedicle impingement
- Mini invasive surgery
- Synergistic function



Degreef et al, Acta Ortho Belg , 2005

Assuming that:

- 1/ the cuff (could) should NOT be repaired ('irreparable')
- 2/ the shoulder is NON functional
(the muscle balance is compromised)
- 3/ LHB already torn (or tenotomized)
- 4) and the shoulder is painful or not...



Non functional shoulder

ILEA

CLEER

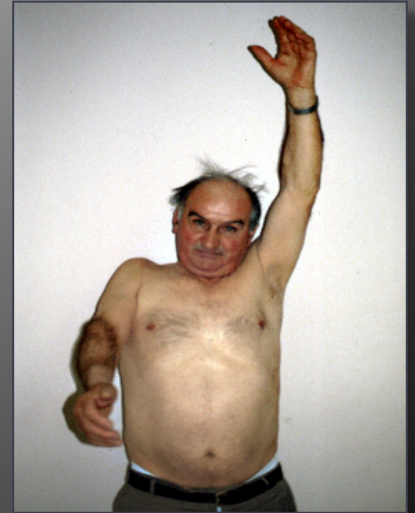
ILER



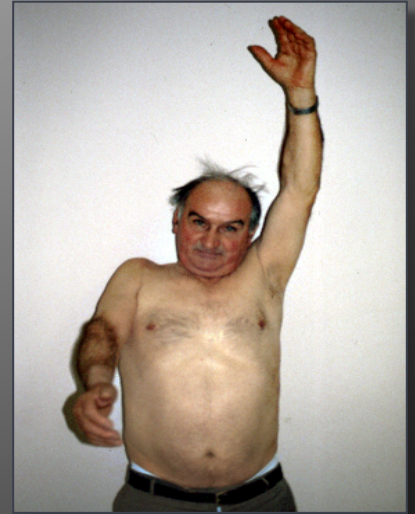
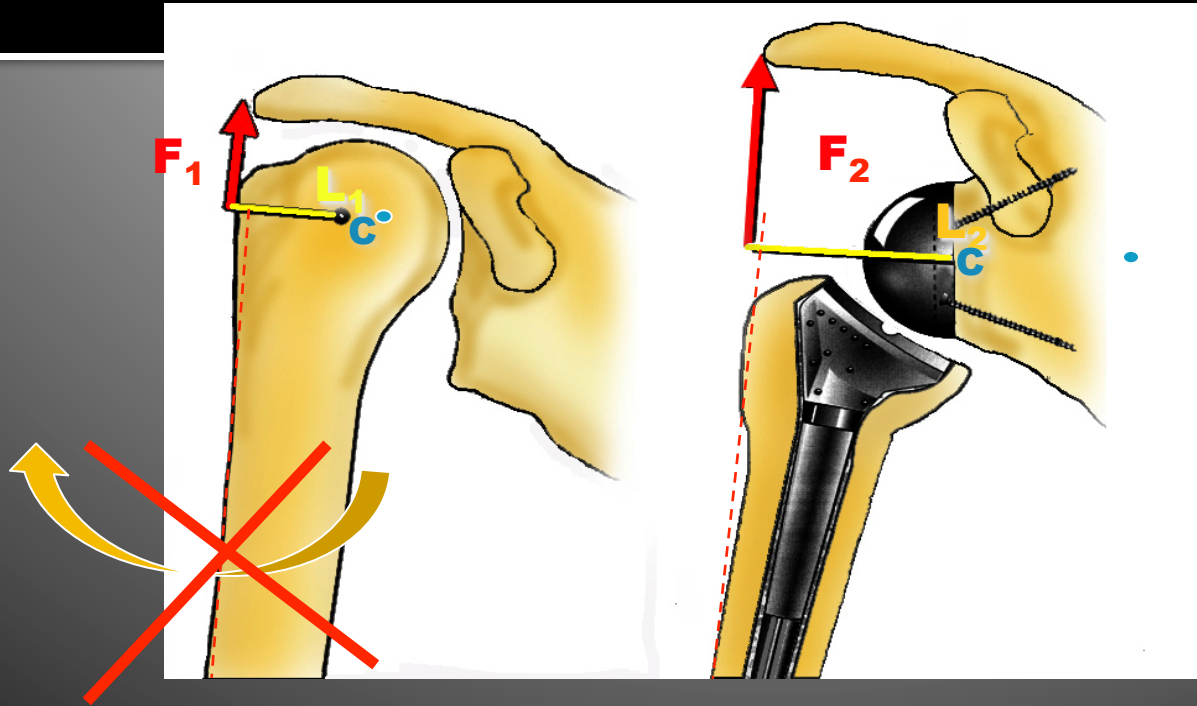
How to Restore the Vertical Balance?

ILEA: Isolated Loss of Elevation (active)

- Represents vertical muscle imbalance
- Classic “pseudo-paralyzed shoulder”
- Some external rotation preserved
- Treatment: Reverse Shoulder Arthroplasty
 - Provides pain relief
 - Restores function
 - BIO-RSA technique: improved rotation



VERTICAL Imbalance of the Shoulder

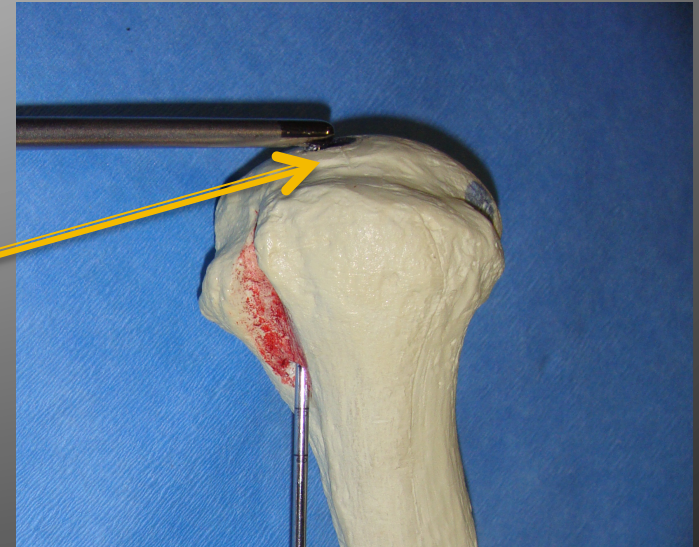


**SOLUTION = Reverse Shoulder Arthroplasty
(option 1)**

VERTICAL Imbalance of the Shoulder



@ LDT with Superior fixation
« over the top » (option 2)

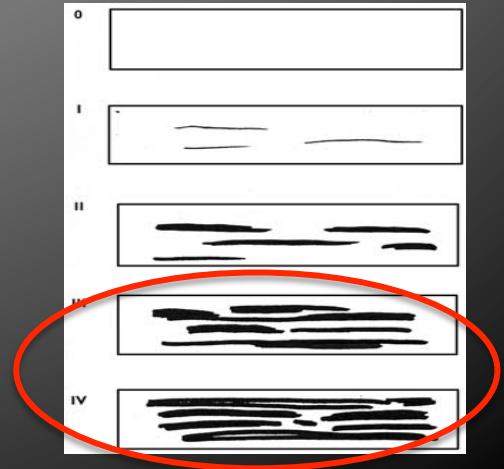
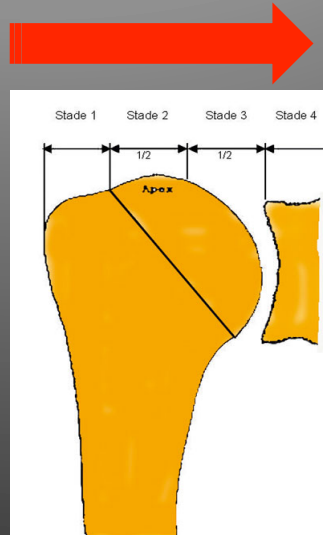
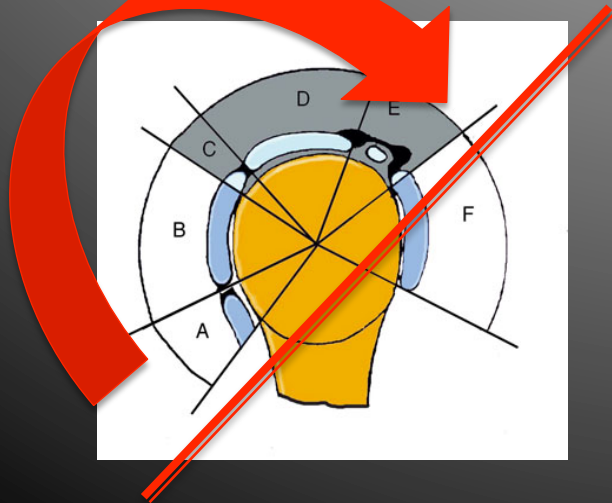


Latissimus dorsi transfer for the treatment of massive tears of the rotator cuff. A preliminary report.
Gerber C, Vinh TS, Hertel R, Hess CW.
Clin Orthop 1988;232:51-61.

Pilot study

Inclusion Criteria

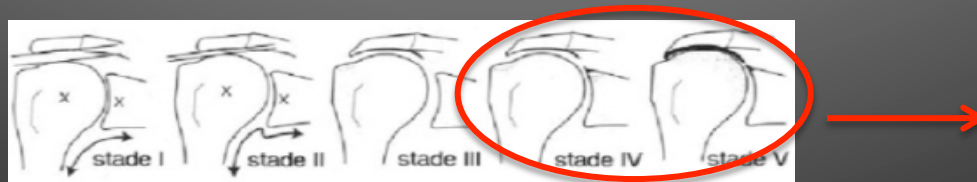
- Failed Postero superior RCR(salvage procedure)
- Previous LHB tenotomy/tenodesis
- Fatty infiltration >> 3



Pilot study

Exclusion Criteria

- Eccentric arthritis (Hamada 4-5)
- Deltoïd palsy
- Irreparable subscapularis tear
- Pseudo-paralytic shoulder



Post operative rehabilitation

- A 4-week 30° abduction sling is proposed
- Passive ROM is started at D1 without any limitation, except in IR
- Active exercises are started later.

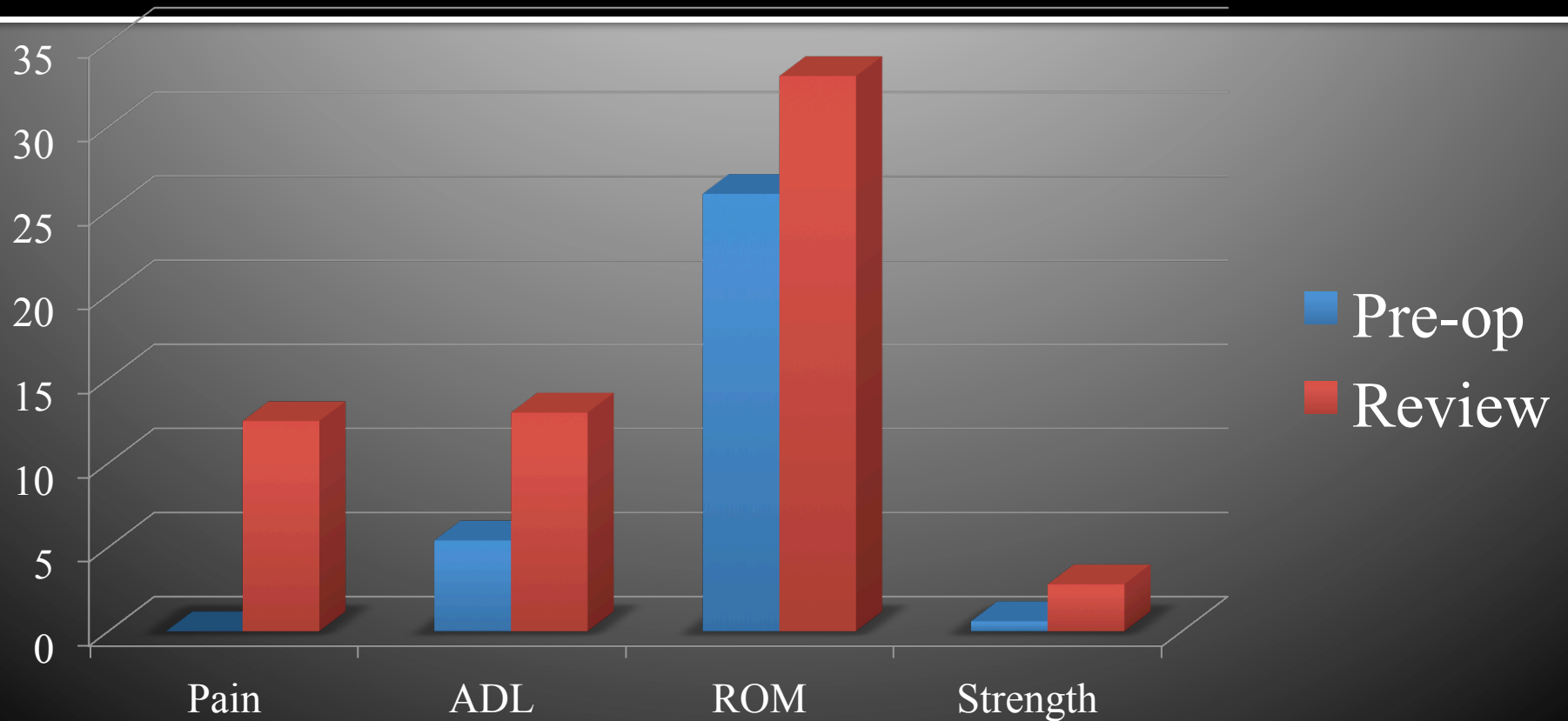
Materials and Methods

- 47 patients
- Mean age 58 yrs (31-73)
- Hamada 2 (42%), Hamada 3 (58%)
- Mean previous surgery 1.3 (1-6)
- Mean FU 24 mths (12-32)
- No lost FU

Results

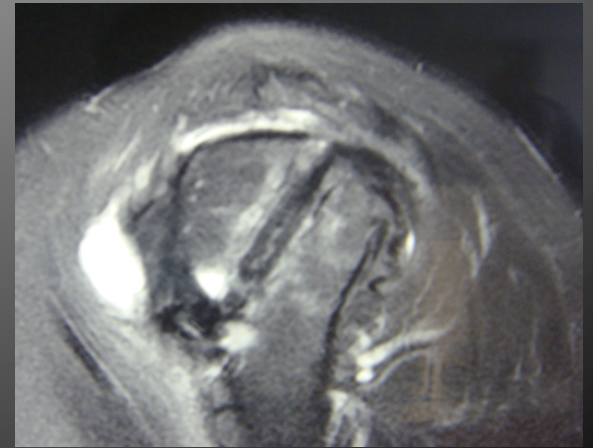
- Global Constant score:
 - Preop: 32.28 (25-39)
 - Review: 58.76 (50-67)
- SSV:
 - Preop: 20.6 (16-24)
 - Review: 67.62 (56-76)

Constant score Gain

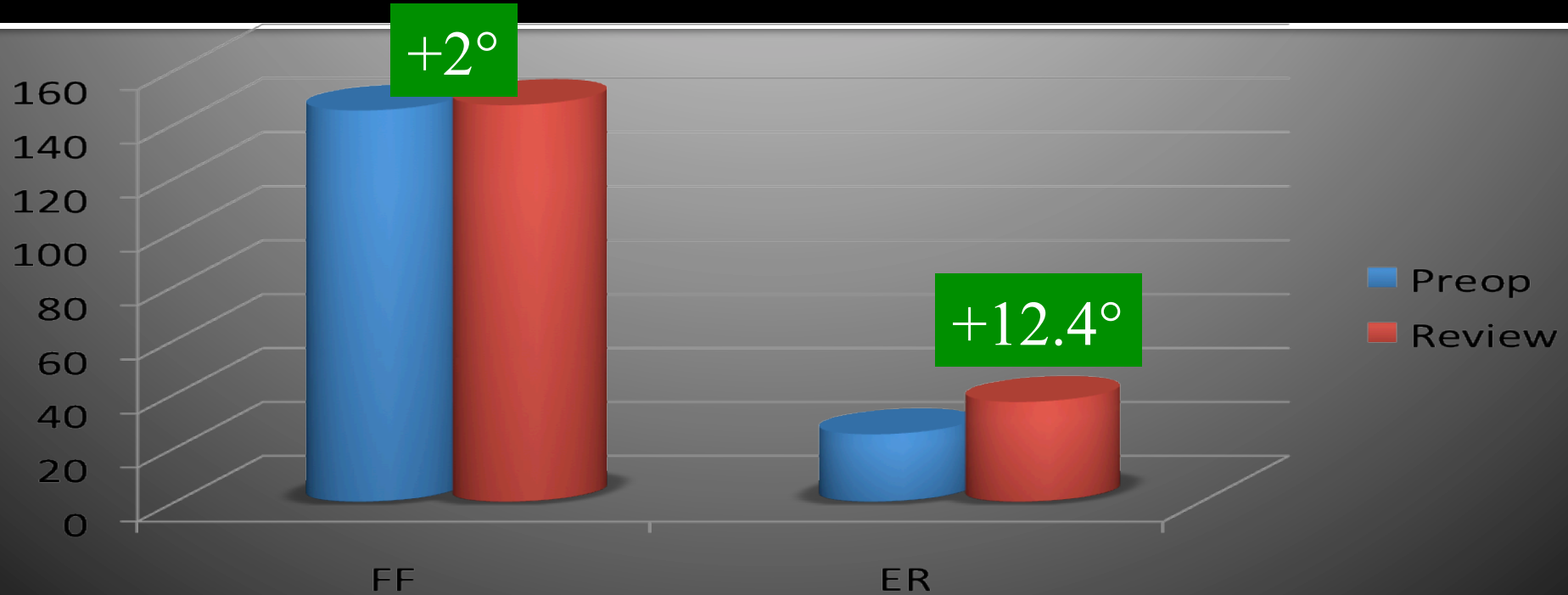


Results

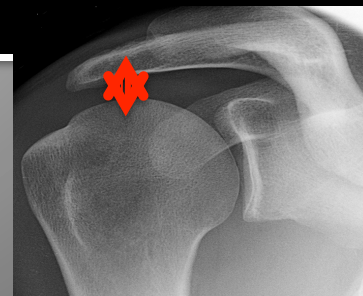
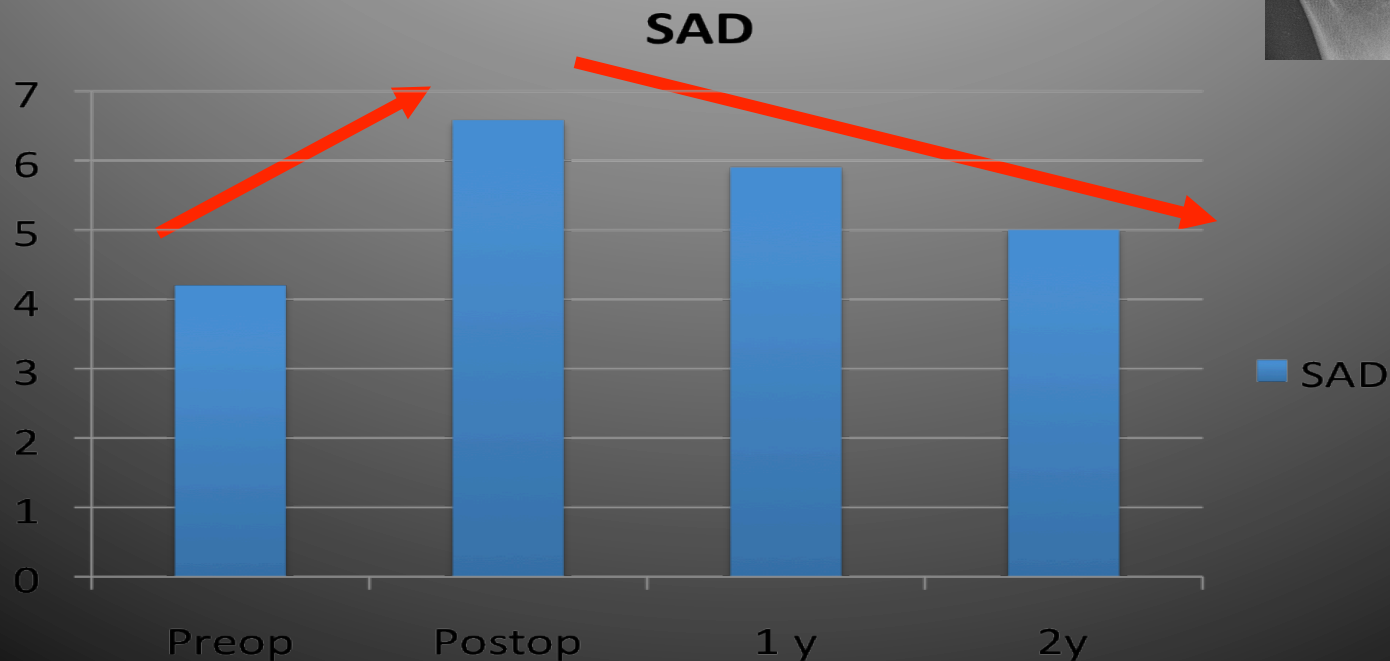
- 35 satisfied or very satisfied (74%)
- 4 were disappointed (9.5%)
- 8 not satisfied (16.5%)



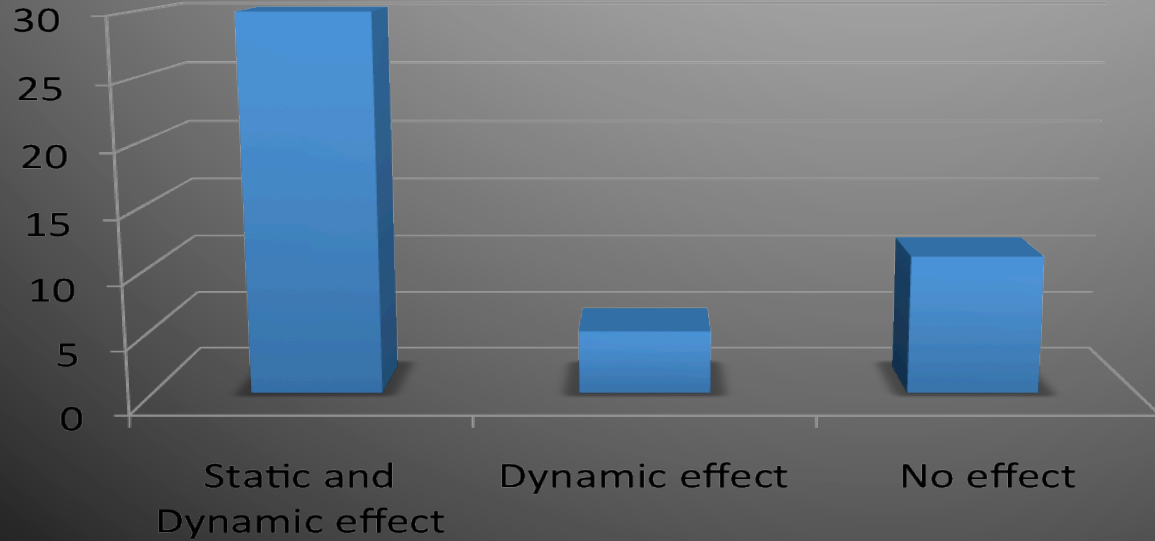
ROM Gain



Sub Acromial Distance: Xray Results



Dynamic Fluoroscopy



Complications n=7 (15%)

- 3 ruptured tendons
(3 bad results)



- 2 lateral cortical humeral fracture (IFS)
- 2 axillary hematoma (good evolution after drainage)

Complications

- No infection
- No neurologic complication
- No vascular complication

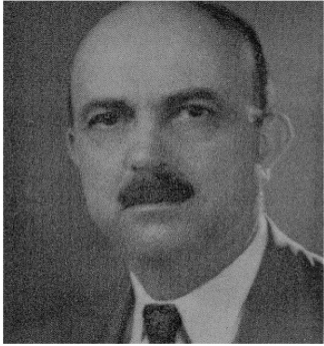
Salvage procedure?

	1 ^{ère} intention	« Salvage Procedure »
Warner (1999) (Constant modifié)	37/66 (+19)	36/52 (+16)
Gerber (2006) (Constant modifié)	49/59 (+10)	58/79 (+21)
Nové Josserand (2009)	?/75 (?)	?/67 (?)
Valenti (2010)	36/61 (+25)	35/52 (+17)
Moursy/Tauber (2009)	?/76 (?)	?/60 (?)
Kany/Grimberg/Valenti	38/71 (+33)	33/58 (+25)

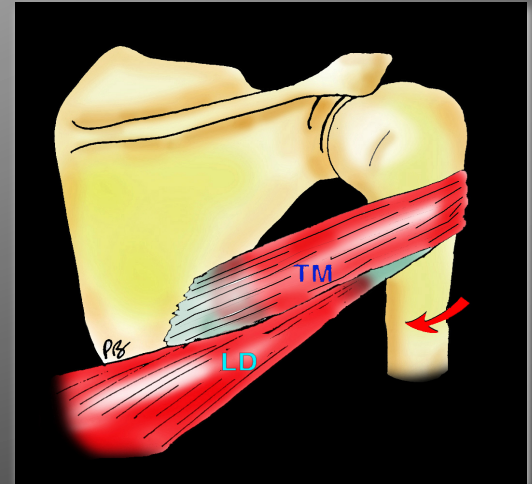
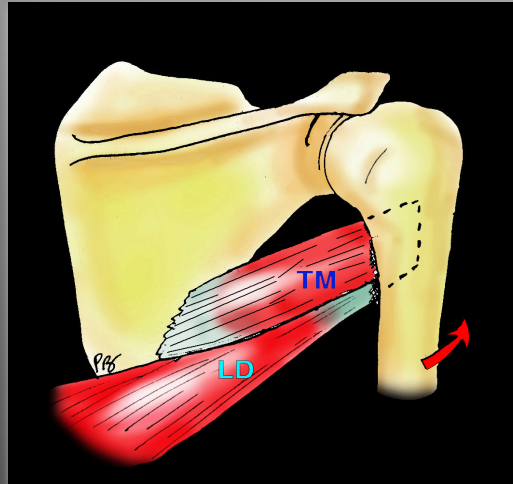
How to Restore the Horizontal Balance?

HORIZONTAL Imbalance of the Shoulder

Through a double approach (ant & post)



Joseph Batiatto L'Episcopo, MD (1890–1947).

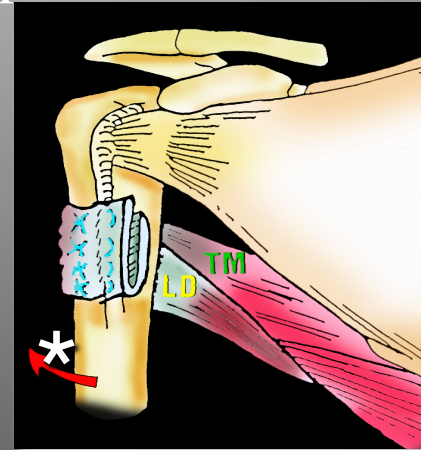
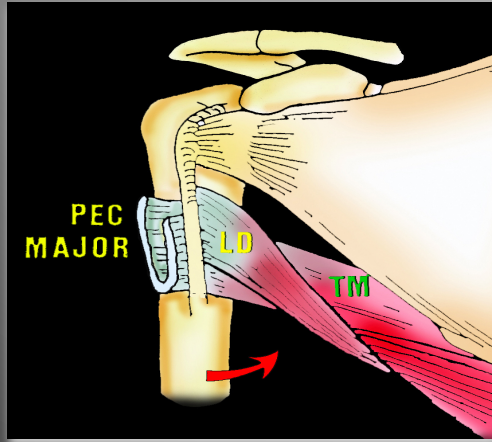


L'Episcopo, 1934: LD/TM transfer

To restore active External Rotation

ILER: Isolated Loss of External Rotation (active)

Through a single (ant) approach



Modified (Nice) L'Episcopo, 2005: LD/TM transfer

To restore active External Rotation

Post operative care

Immobilisation for 6 wks in a splint with 30° ABD / 30° ER



Beware!

Too early IR

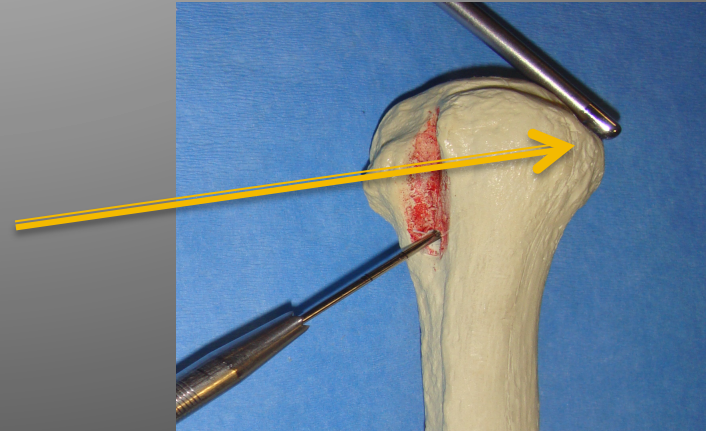
=

Rupture of Tendon Transfer

HORIZONTAL Imbalance of the Shoulder



@ LDT with Postero-Superior
fixation (option 2)



3D modelisation of latissimus dorsi transfer in rotator cuff surgery: what point of fixation on the humeral head?

Herzberg Guillaume

1st closed Meeting ESSSE, 2001

HORIZONTAL Imbalance of the Shoulder



@ Lower Trapezius Transfer with allograft
(option 3)

Elhassan B

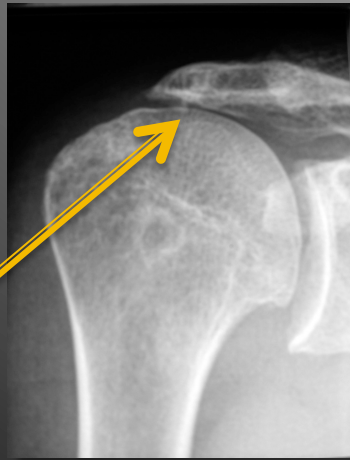
Lower trapezius transfer for shoulder external rotation in Patients with Paralytic Shoulder
J Hand Surg Am. 2014;39(3):556e562.

How to Restore

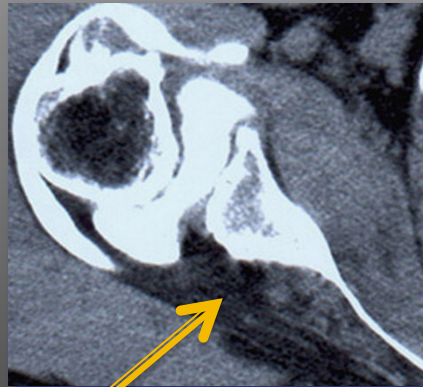
Both

Horizontal and Vertical Balance?

Both HORIZONTAL and VERTICAL Imbalance



vertical

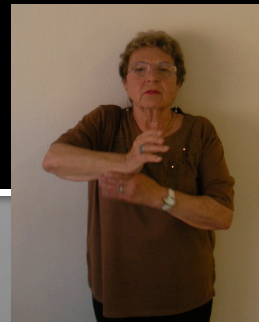


horizontal



RSA alone will give poor result

For CLEER: RSA alone....



VERTICAL balance restored

BUT

HORIZONTAL balance NOT restored

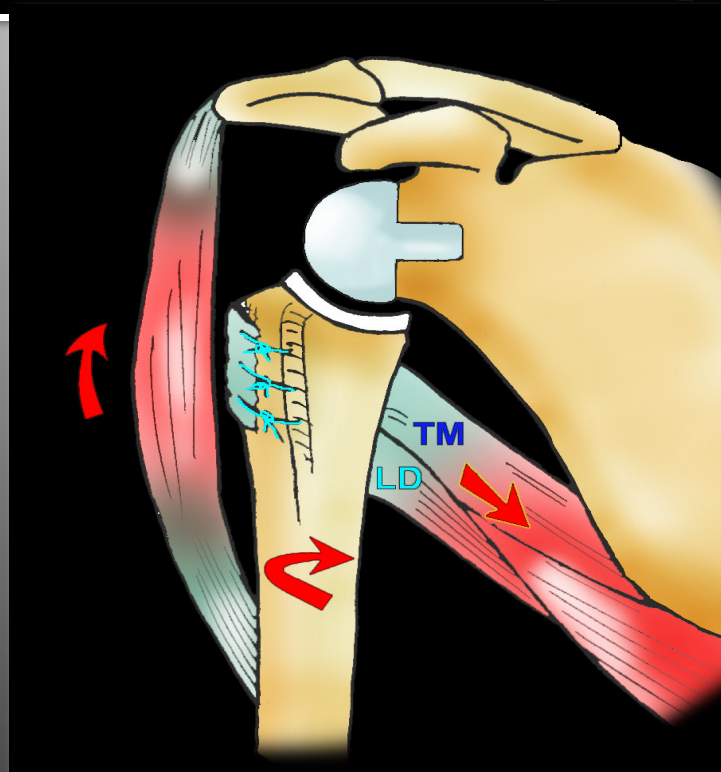
= Unhappy patient!

CLEER Solution:

RSA Combined with
Nice L'Episcopo



single (DP) approach



Boileau et al, TSES 2006

CLEER patient:



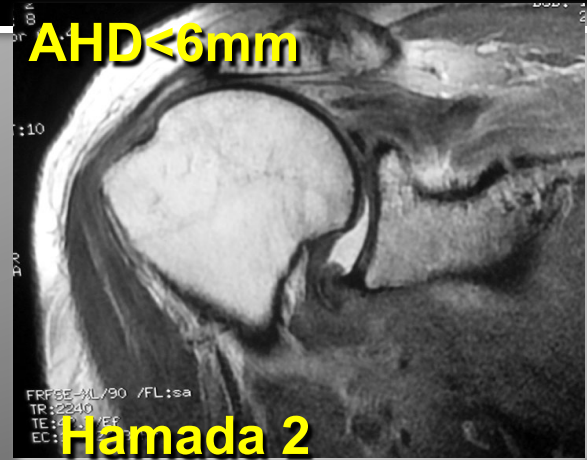
Pain ++
Pseudoparalysis



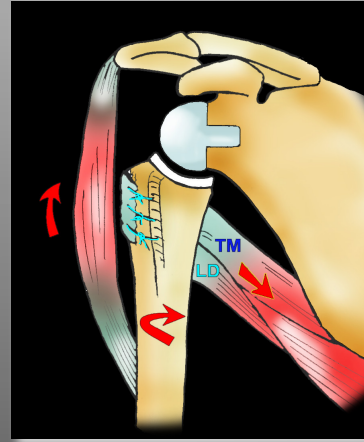
Impossibility to
maintain NR



Hornblower's sign



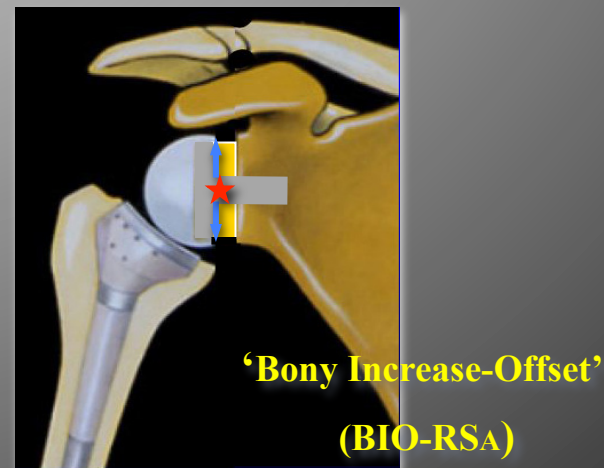
Both HORIZONTAL and VERTICAL Imbalance



RSA Combined with Nice L'Episcopo technique
(Option 1)

Both HORIZONTAL and VERTICAL Imbalance

- ✓ Biological (Bony) lateralization
- ✓ Increases rotations



Bio-RSA (Option 2)

CLEER Solution (option 2)

BIO-RSA

- Biological (Bony) lateralization:
 - respects Grammont's principles
 - Autologous bone graft from humeral head
 - Bone graft under compression = ideal environment

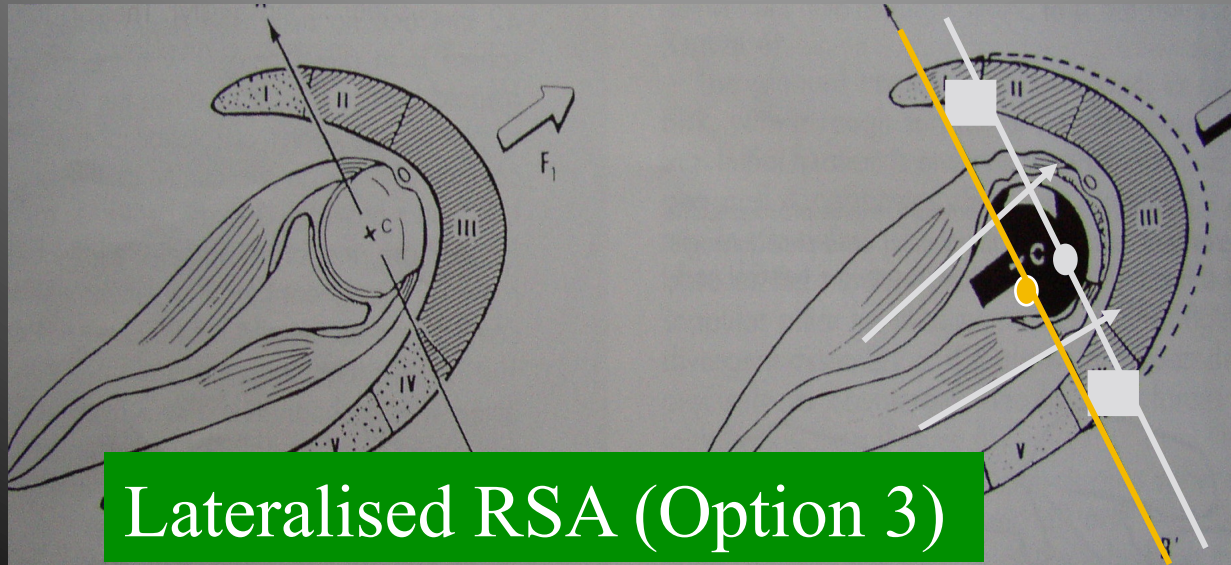
Both HORIZONTAL and VERTICAL Imbalance

Recruiting medial fibers of the deltoid and tensioning remaining external and medial rotators seems improving range of rotation

Anatomic

DELTA

ARROW



P Boileau JSES 2005

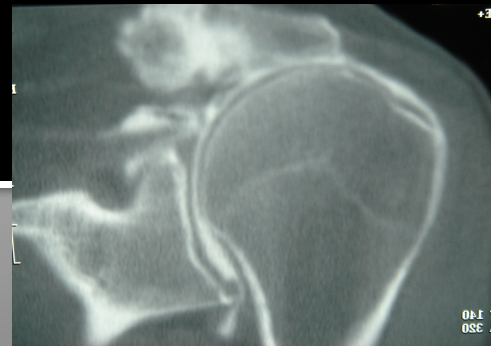
CLEER Solution (option 3)

Lateralized RSA Combined with Tubularized LDT

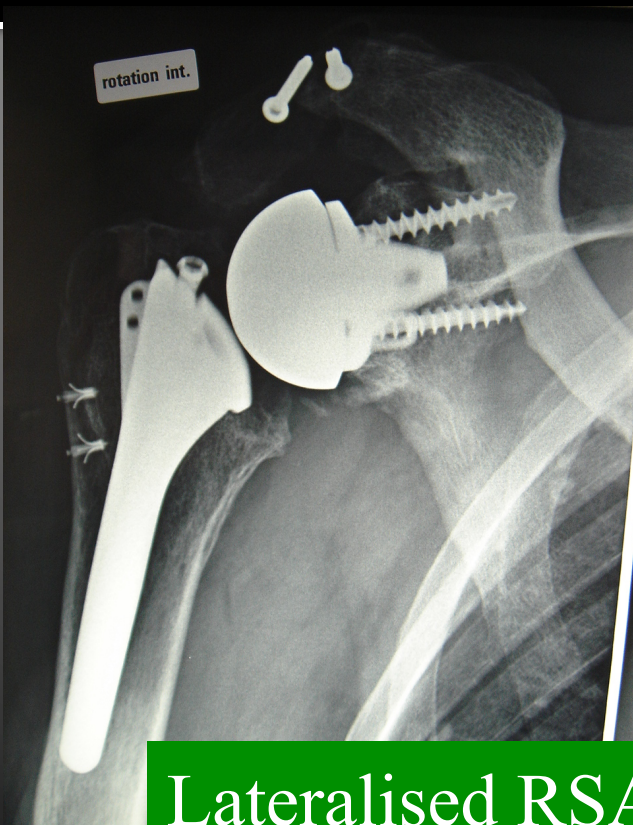
Irreparable RCT
Pseudoparalytic shoulder
No active AE
No active ER



RSA + Tendon Transfer

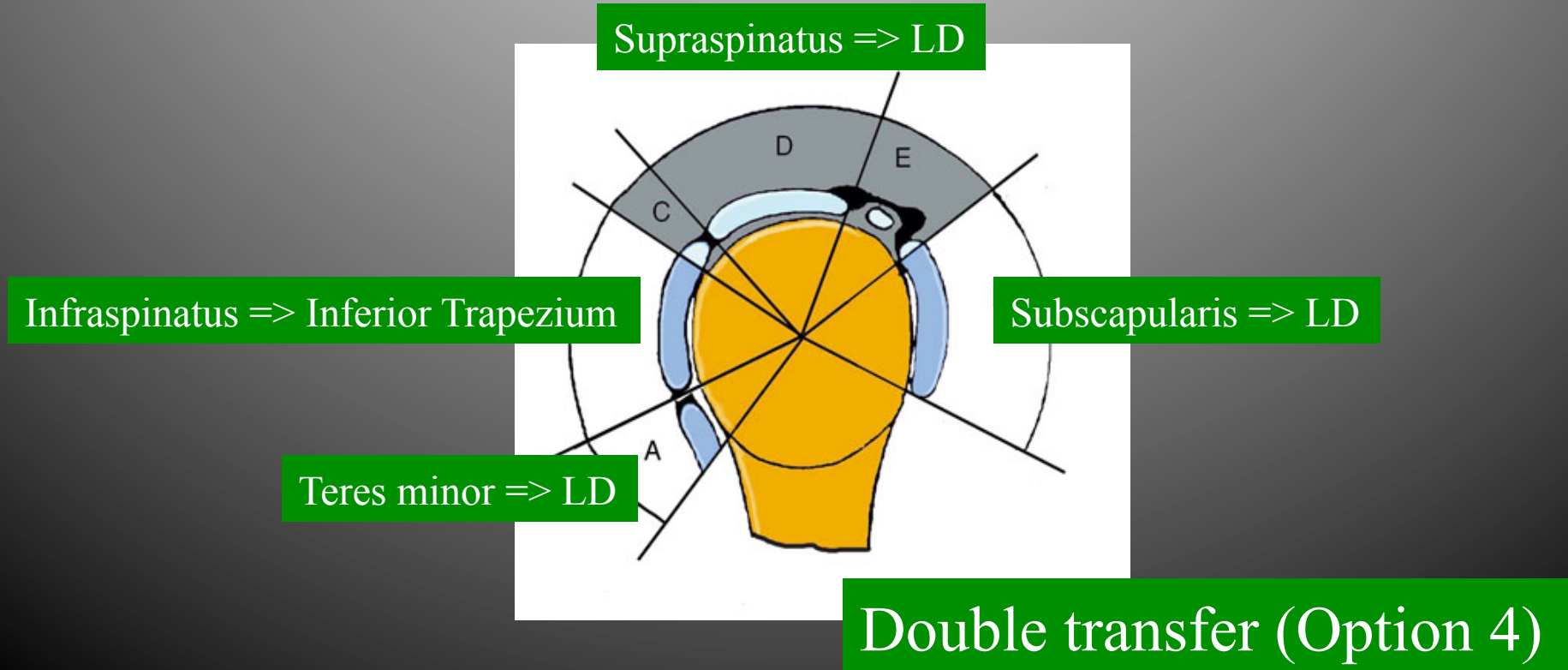


Both HORIZONTAL and VERTICAL Imbalance



Lateralised RSA: Arrow (Option 3)

Both HORIZONTAL and VERTICAL Imbalance



Conclusion

1. Irreparable RC Tears do exist
2. Irreparable RC Tears can be preoperatively identified
3. Some irreparable tears are best left untreated (cuff 'wears'))
4. Some irreparable tears (wears') are becoming painful because the LHB is becoming pathologic
5. Some irreparable tears do compromise the muscle balance (i.e., shoulder function) and NEED TO BE TREATED BY TENDON TRANSFER AND/OR ARTHROPLASTY

Irreparable Rotator Cuff Tear

**Functional (Balanced)
Shoulder**

**Non Functional (imbalanced)
Shoulder**

Biceps
still present

Vertical Muscle
imbalance

Horizontal Muscle
imbalance

Horizontal+Vertical
imbalance

**@ BICEPS TENOTOMY
+/- Partial Cuff Repair**

**RSA/
@LD**

**L'Episcopo
/
Inferior Trapezium**

**Lateralised RSA +
L'Episcopo
Double transfer?**



Beware!



Which box??

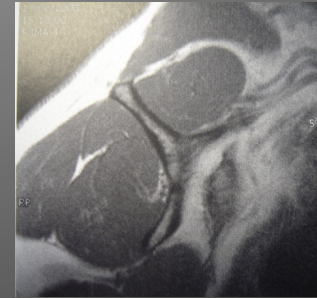
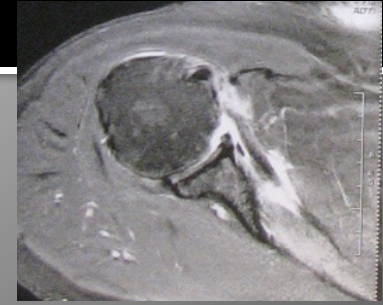
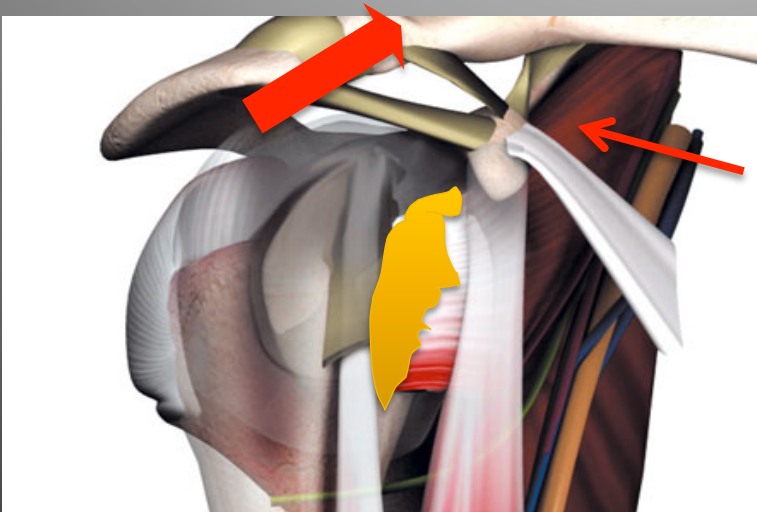


- ILEA 1, 2, 3 ??

- CLEER 1, 2, 3?

- ILER 1, 2, 3?

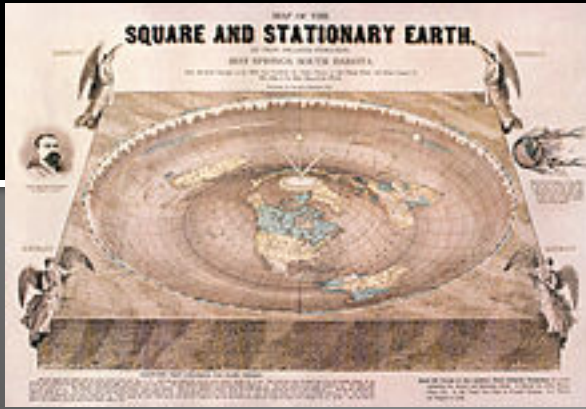
Which box??



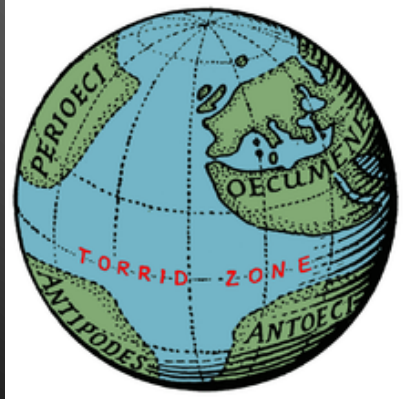
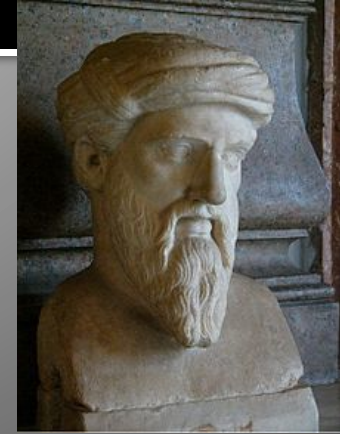
Subscapularis tear Type 5

ILIR??

Isolated Loss of Internal rotation



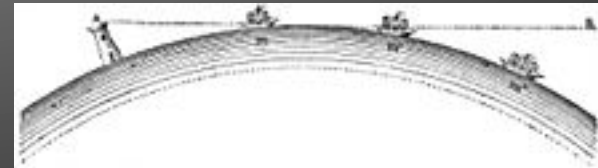
Pythagore (560-480 BC)



Erasthotène 273-192 BC

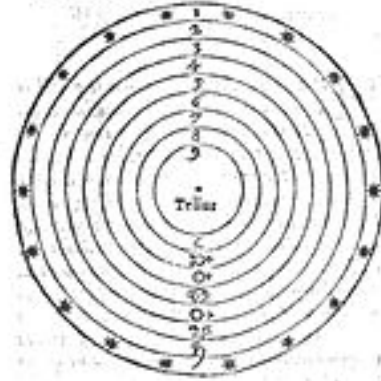


1^{er} globe de Cratès (150 BC)



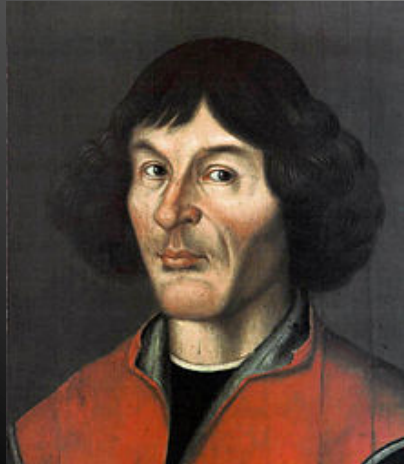
Aristote (384-322 BC)

Systēma maximarum mundi partium,
quibus totam rerum vniuersitatem
connexam esse tradiderunt communi-
ter authores.

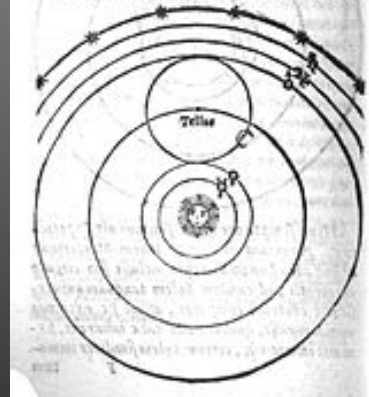


Ptolémée 90-168 AC

Géocentrisme



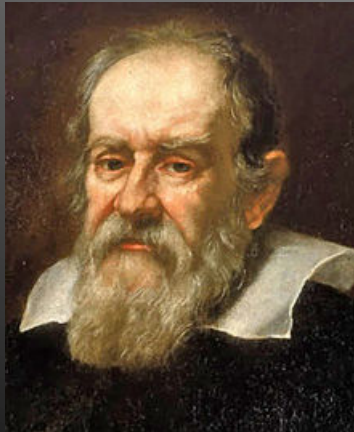
Systēma vniuersitatis de sententia sum-
mi viri Nicolai Copernici Torinensis.



Copernic 1473-1543

Héliocentrisme

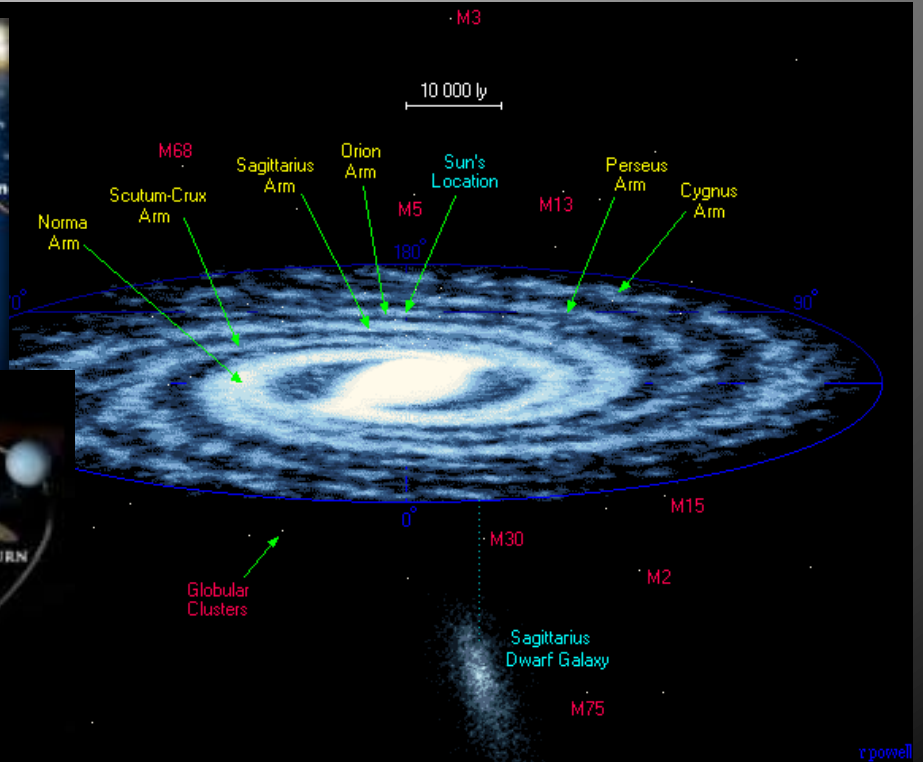
E pur si muove!



Galileo Galilei 1564-1642



Where are you going to?





Take Home messages

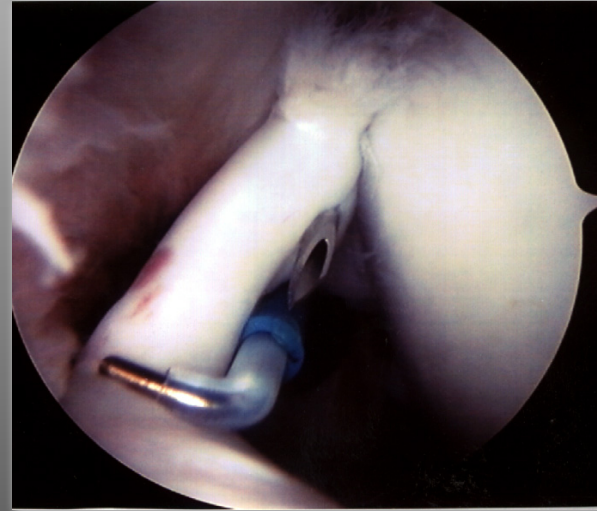
Patient Selection +++



Game's over!

Don't try to repair RC tendons with
atrophied / fatty infiltrated muscles!!!

Symptomatic irreparable RCT



@ Tenotomy / Tenodesis may be enough!

Think about the LHB++++

Understand shoulder imbalance!

Vertical plane



Horizontal plane

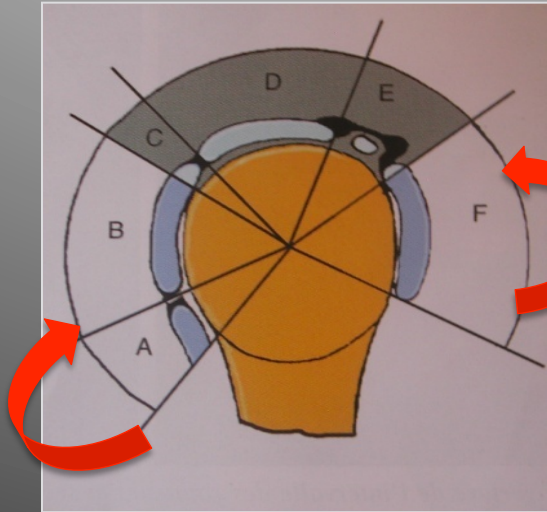


Both planes



Teres minor / Subscap teared

Teres minor



Subscapularis

Horizontal Imbalance

Look for the Teres Minor++

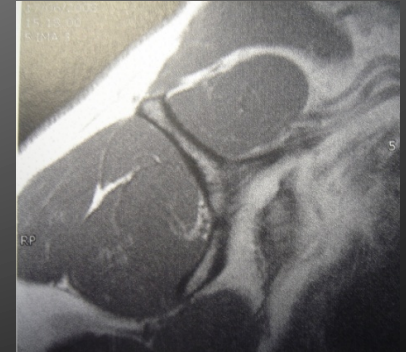


= NO ER possible!!!

Hornblower's sign



Look for the Subscap ++



Indications @Transfer

- 10% RCT
- 5% Shoulders

Thank you
for your attention!



Broadcast

jean.kany@clinique-union
epaule-toulouse.com

Vims