

THE ROTATOR CUFF

the science behind the disease

Jerome Goldberg

www.orthosports.com.au

29-31 Dora Street, Hurstville
160 Belmore Road, Randwick



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What do we know

- Many older people have RC tears
- Many people with RC tears have no pain and full or near full function
- Non operative management gives good outcome in many
- Risk of developing arthritis small
- Surgery fails to repair the RC in up to 40% of cases yet many of those have no pain and good function
- Larger tears will get bigger with time



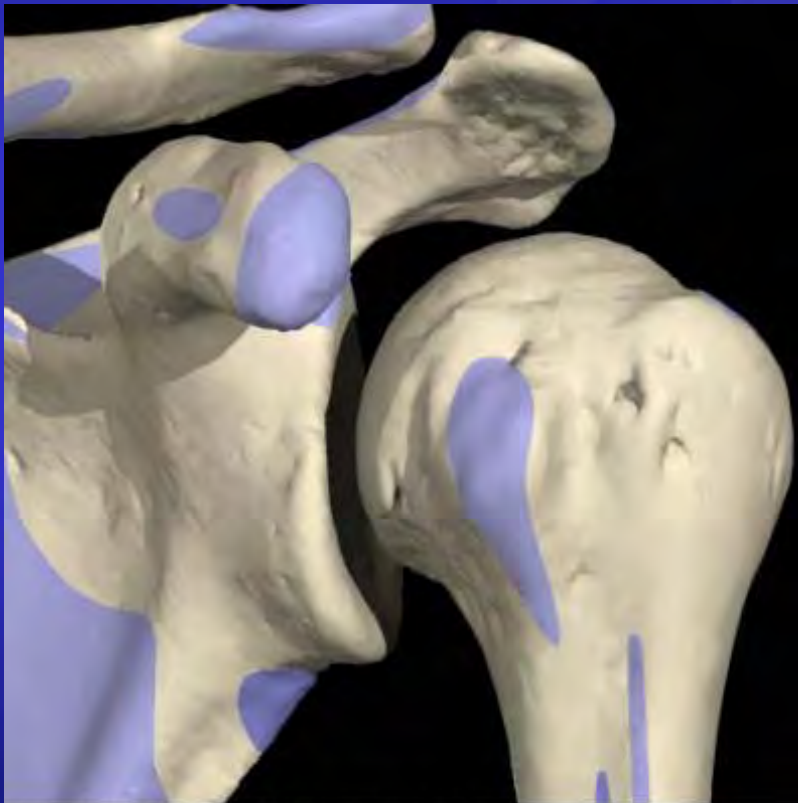
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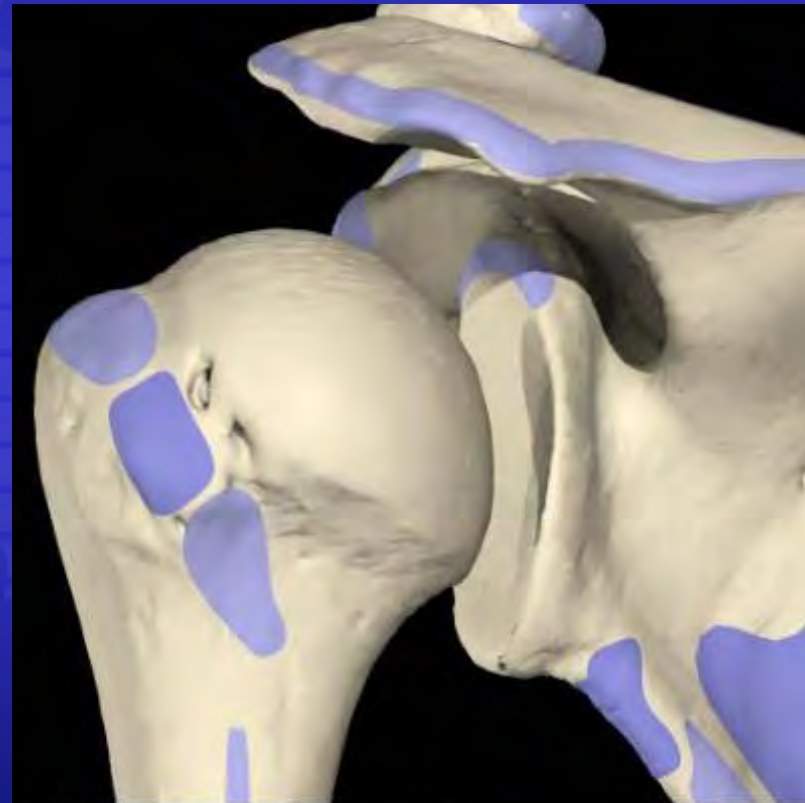
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ANATOMY



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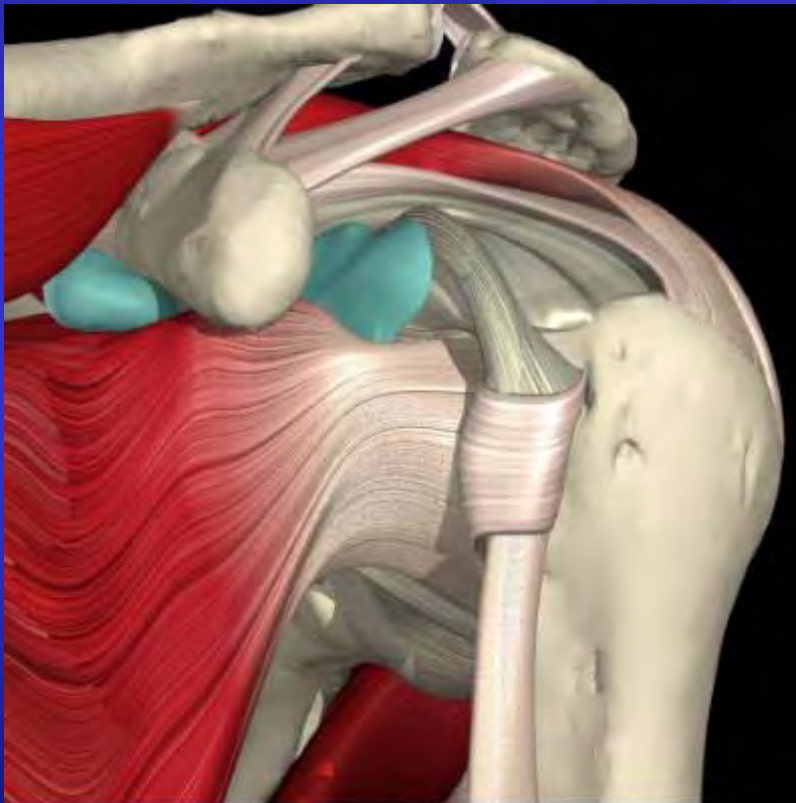


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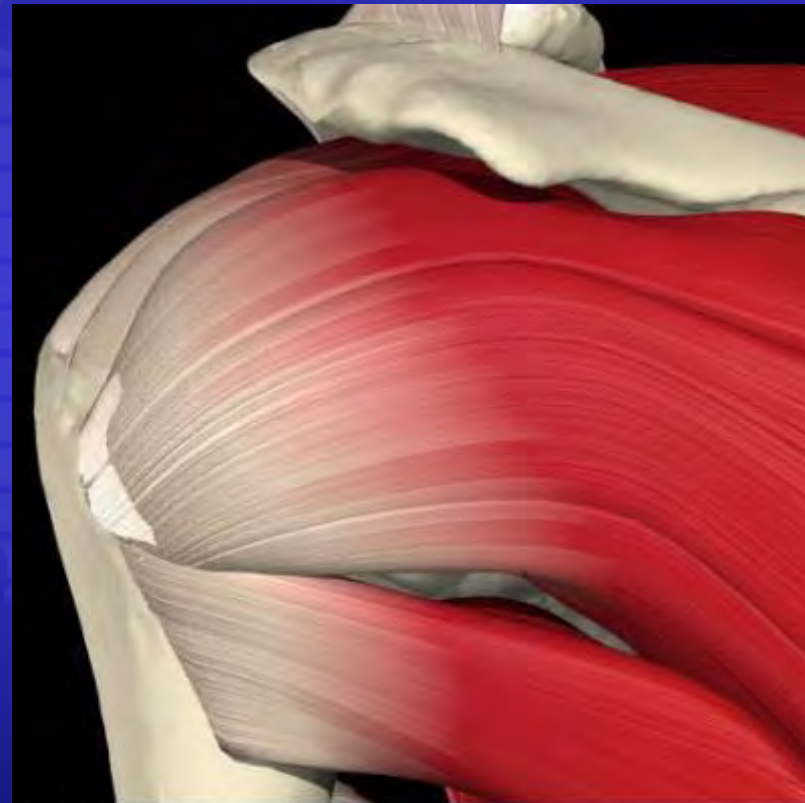
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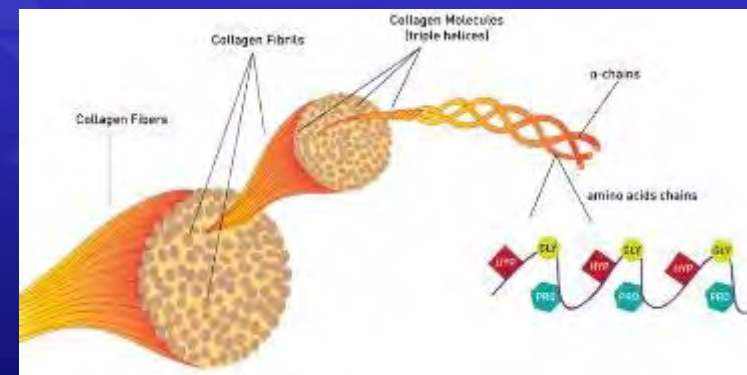
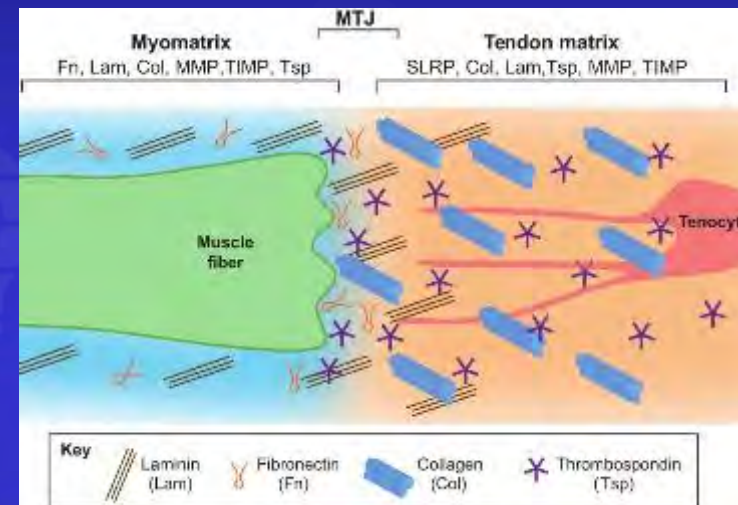


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TENDON ULTRASTRUCTURE

2 components

- Cells
 - Tenocytes
 - Tenoblasts
- ECM
 - Collagen (70%) mainly T1
 - Elastin
 - Proteoglycans
 - GAGs
 - water



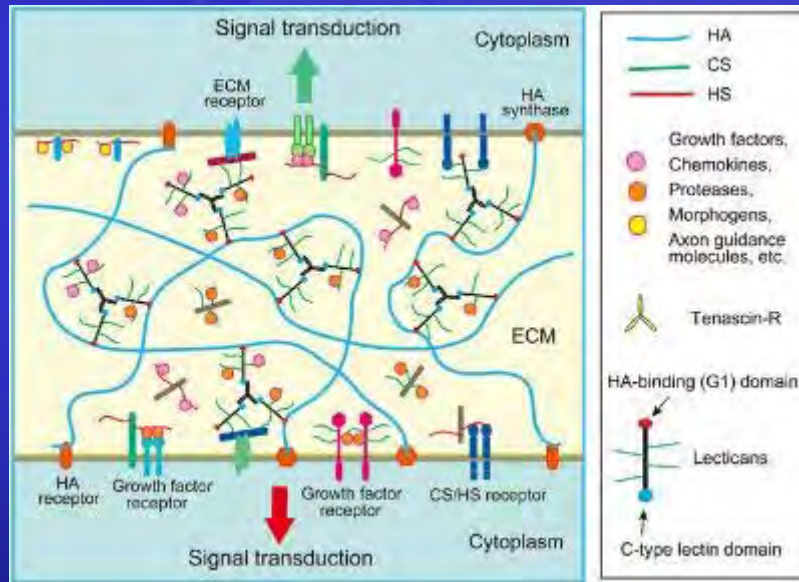
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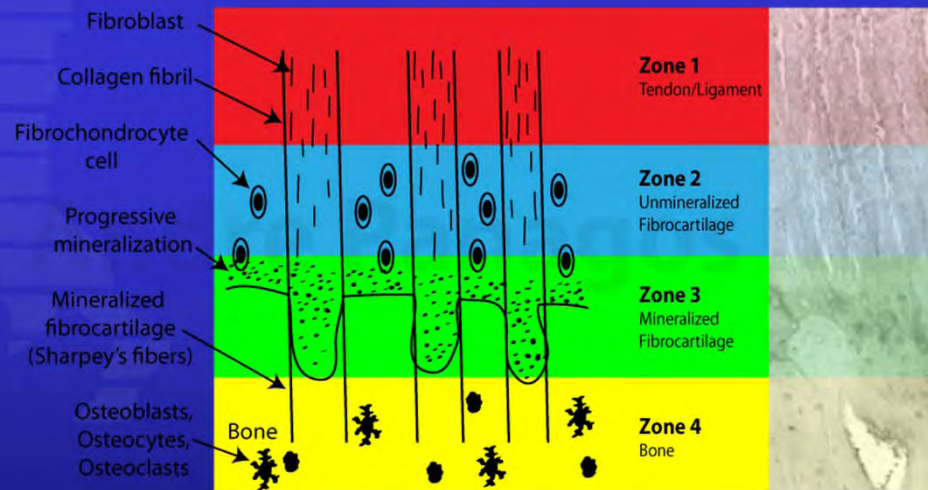
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TENDON ULTRASTRUCTURE



Bone Tendon/Ligament Junction

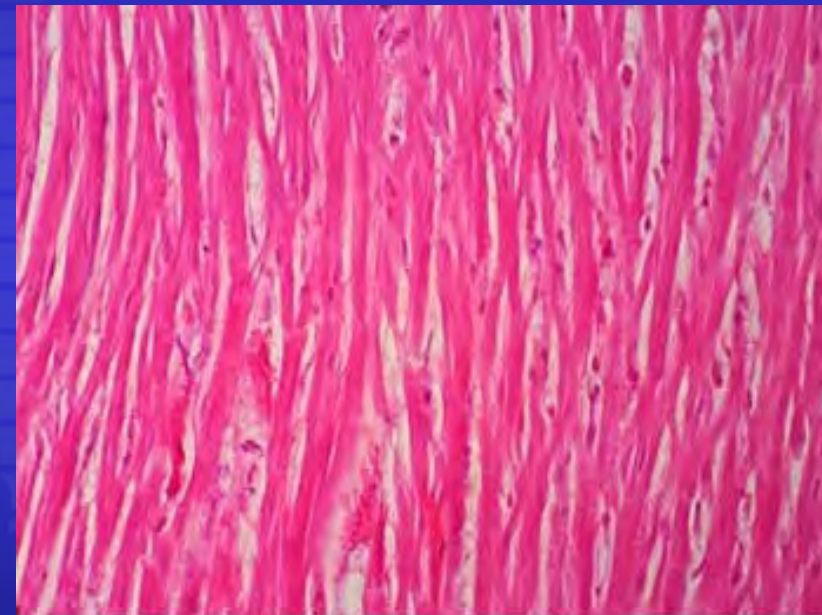
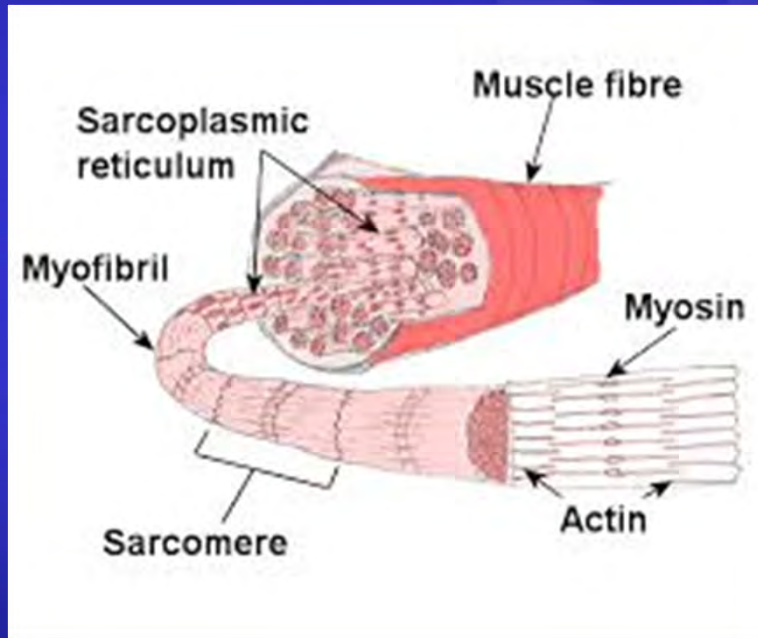


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MUSCLE ULTRASTRUCTURE



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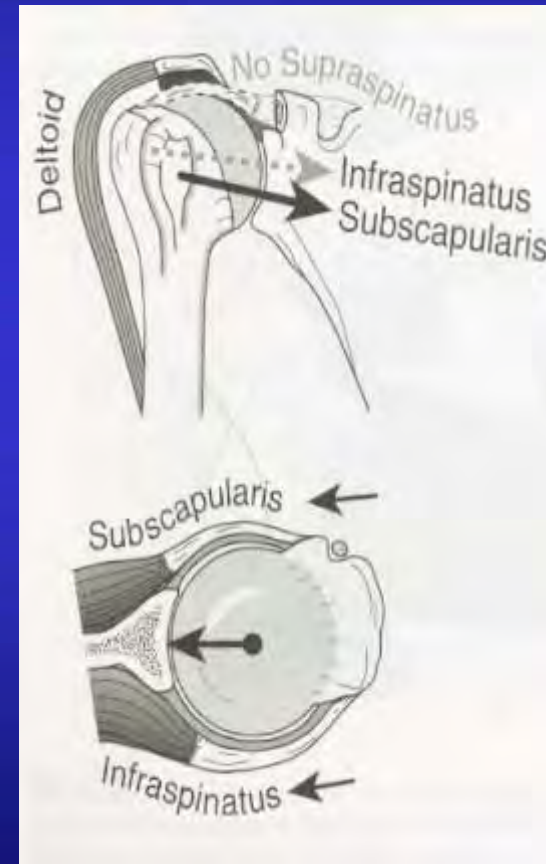
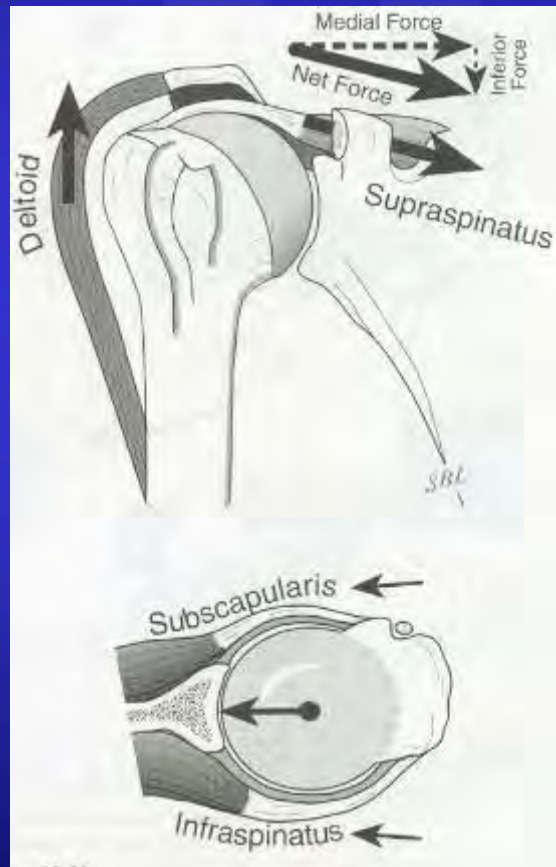
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BIOMECHANICS

balance force couples



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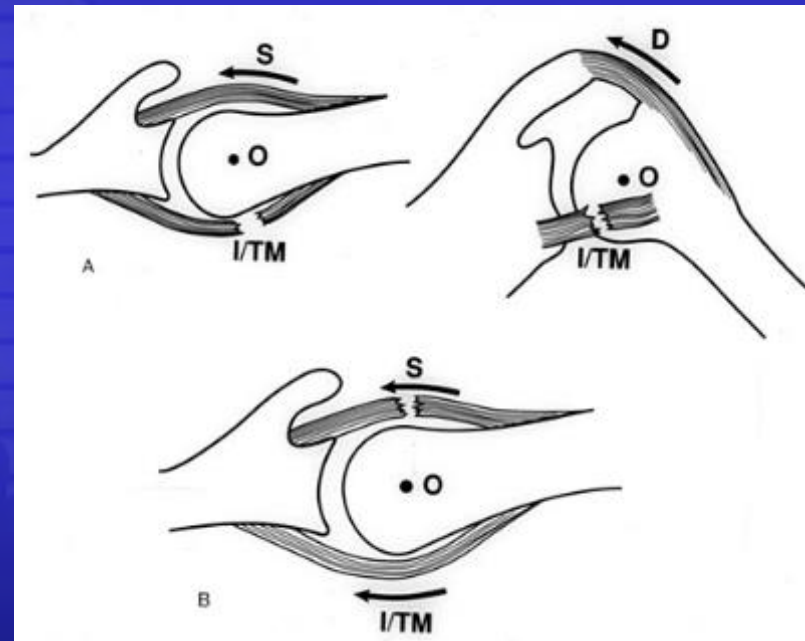
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CLINICAL IMPLICATIONS

Normal function will occur with unrepaired R.C. tears when

- Force couples intact (humeral head can be kept adjacent to glenoid)

if pain relief can be achieved



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INCIDENCE OF RC TEARS

- 10% to 40% of 60 year olds have R.C. tears
- 50% to 75% of 70 year olds have RC tears

MOST ARE ASYMPTOMATIC.

AUTHOR	NUMBER OF SHOULDERS	MALES FEMALES	AGE (YEARS)	FULL-THICKNESS RUPTURES (%)	AGE OF YOUNGEST WITH FULL-THICKNESS RUPTURES
Codman and Ackerson ⁶ (1934)	200	72/28	46 to over 80	16.5	—
Skinner ⁴¹ (1937)	100	—	—	6	55
Grant and Smith ⁵⁹ (1948)	190	85/10	17–86	19	47
DePalma ¹⁷ (1950)	96	36/14	18–74	9	40–50
Olsson ⁵⁸ (1953)	106	28/25	25–88	8	57
Petersson ⁵³ (1983)	250	69–57	18–93	14.5	60
Fukuda ⁵² (1986)	249	—	—	7	—
Neer (unpublished) (1965, 1973)	212	—	40–85	7	40–50
Jafferlee and Dalsey ⁵⁹ (unpublished) (1988)	62	—	—	9	—

EPIDEMIOLOGY

Minagawa (J Orthop 2013)

full thickness tears in single village

- 0% under 50 yrs
- 11% 50 yrs to 59 yrs
- 15% 60 yrs to 69 yrs
- 27% 70 yrs to 79 yrs
- 37% 80 yrs to 89 yrs
- 35% symptomatic
- 65% asymptomatic



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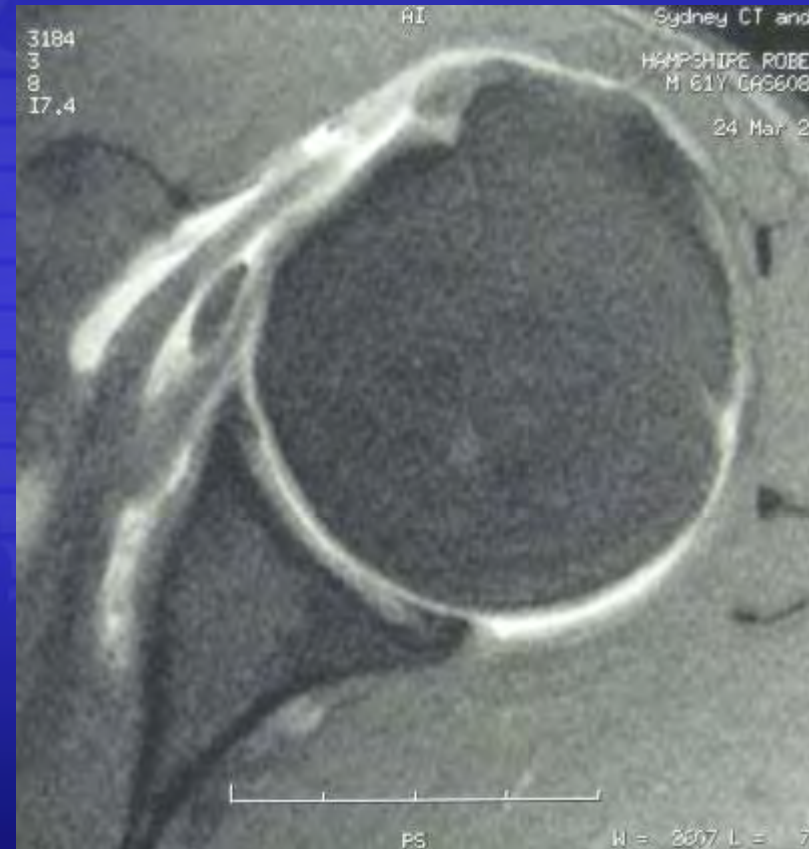
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EPIDEMIOLOGY

Yamamoto (JSES 2015)

- Observed 464 people without RC tears for 3.5 yrs
- In 3.5 yrs 30 (6%) developed F/T RC tears



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EPIDEMIOLOGY

Risk Factors

- Smoking (dose & time dependent)
- Diabetes
- Cholesterol
- Alcohol intake
- ? NSAIDs



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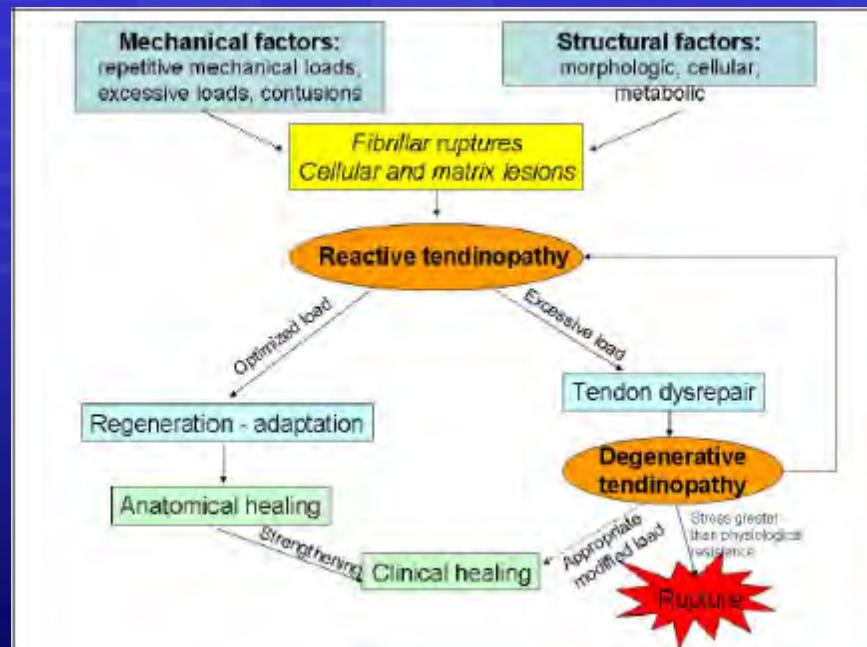
PATHOLOGY

MECHANICAL

- Acromial shape
- Distal clavicular hook
- MECHANICAL OVERLOAD
- trauma

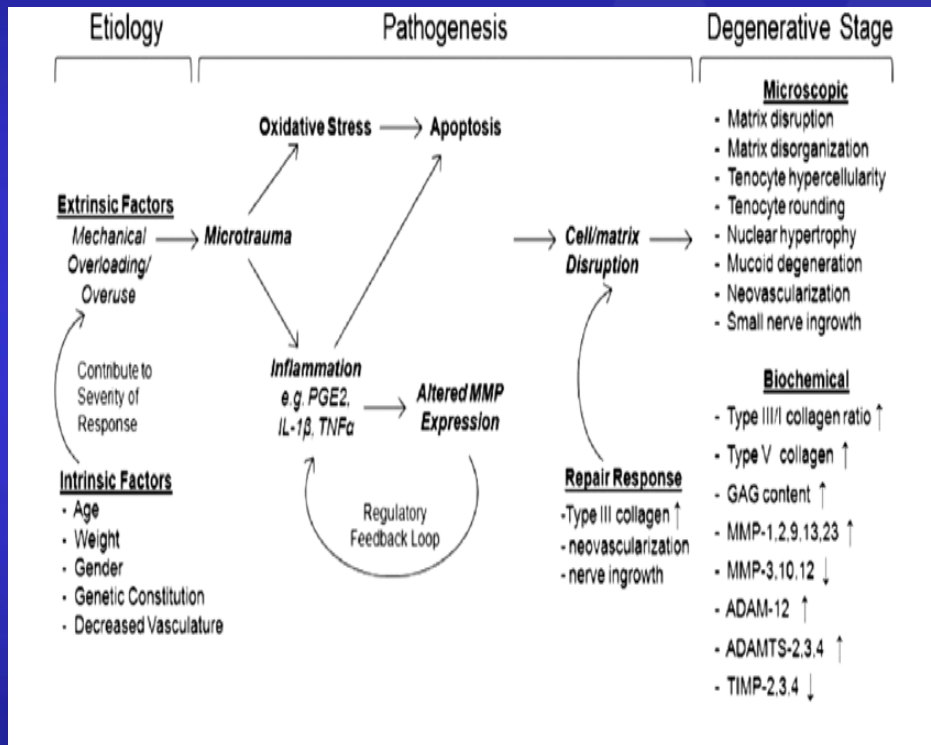
BIOLOGICAL

- complex
- Tendon inflammation
- Tendon/muscle degeneration



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PATHOLOGY



- Loading & age → ↑T3 collagen via gene expression
- Tenocyte apoptosis
- Loss of blood supply
- Matrix metalloproteases ratio changes (control ECM) + other enzyme/protein changes → degradation of ECM
- Rupture RC
- Muscle retraction → atrophy → fatty infiltration

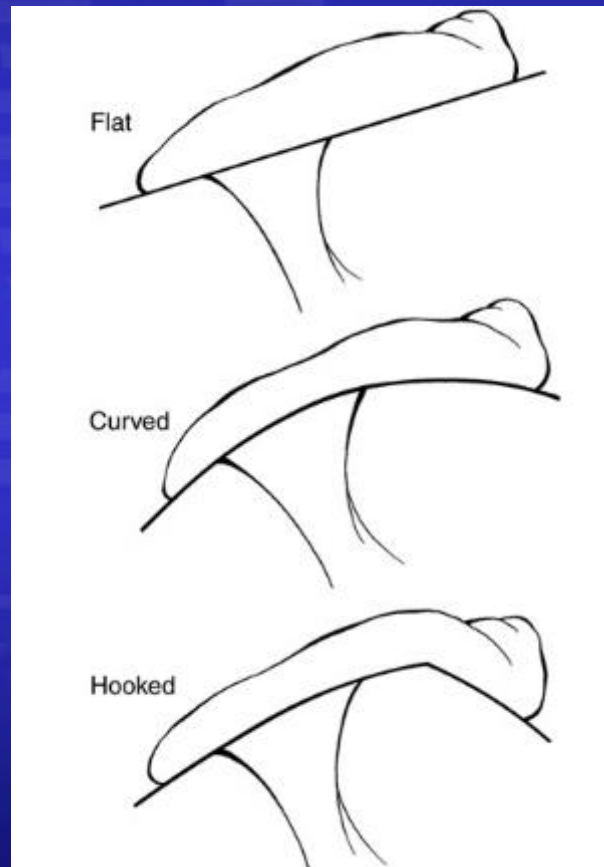


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PATHOLOGY



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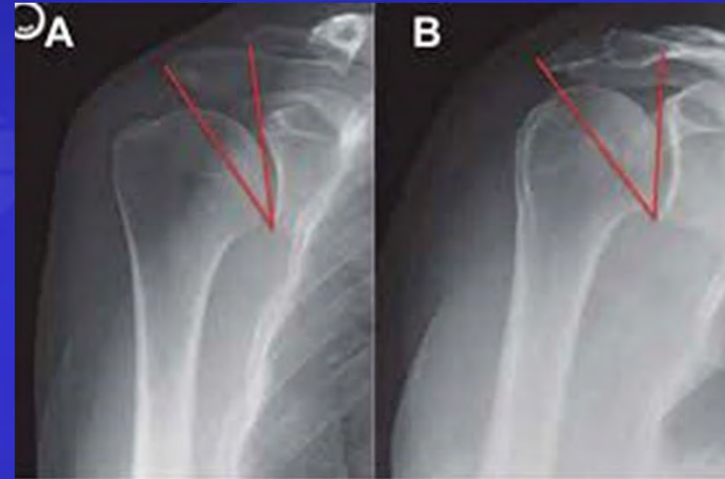


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PATHOLOGY

CRITICAL SHOULDER ANGLE

- $> 35^\circ$ RC tear
 - \uparrow superior shear force to RC
 - Requires 44% more SS muscle activity
 - Causes SS overload
- $< 20^\circ$ OA



CSA $> 38^\circ$ 15X higher risk of retear after RC repair
? Lateral acromionectomy



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SYMPTOMS

- Pain with movement
- Pain at night
- Loss of movement
- Loss of power



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SIGNS

- wasting
- RC tenderness
- Loss of movement
- Loss of power
- + impingement sign



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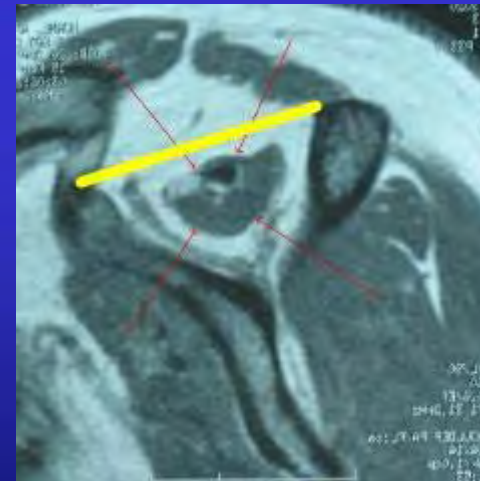


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RADIOLOGY

- Xray
- Ultrasound
- MRA



TREATMENT OPTIONS

NON OPERATIVE

- Cortisone injections
- PRP injections
- NSAIDs
- Physio
- Activity modification

OPERATIVE

- Arthroscopic surgery
- Open/miniopen surgery
- Grafts
- Superior capsular reconstruction
- RTSR



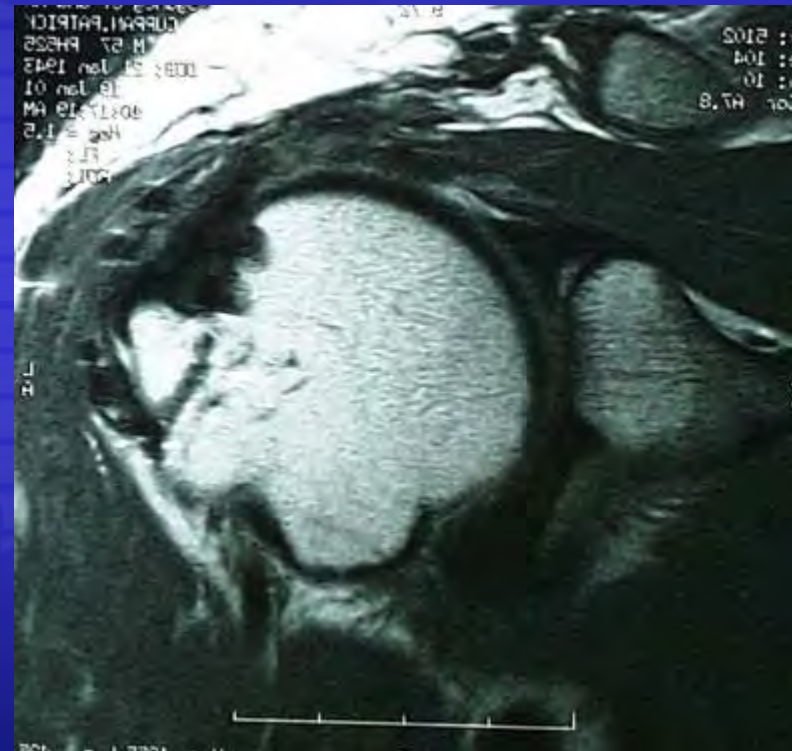
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WHO NEEDS SURGERY

- Young patients
- Active patients
- Poor ROM
- Significant power loss



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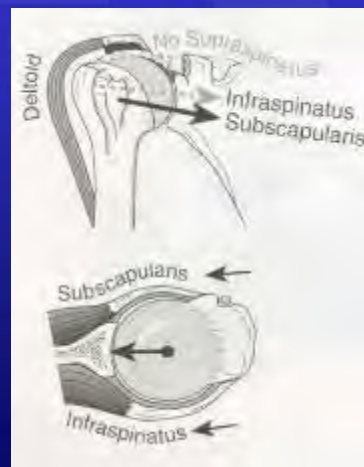


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WHO NEEDS NONOPERATIVE TREATMENT

- Older patients
- Low demand patients
- Balanced force couples



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RESULTS OF NON OP TREATMENT

- ITOI (clin orthop 275;165, 1992)
83% good or excellent
- BROWN (JBJS 31B; 423,1949)
87% good
- TAKAGISHI (J. jpn orth assn 52; 1978)
44% good
- HAWKINS (clin orthop 321;178,1995)
58% satisfactory

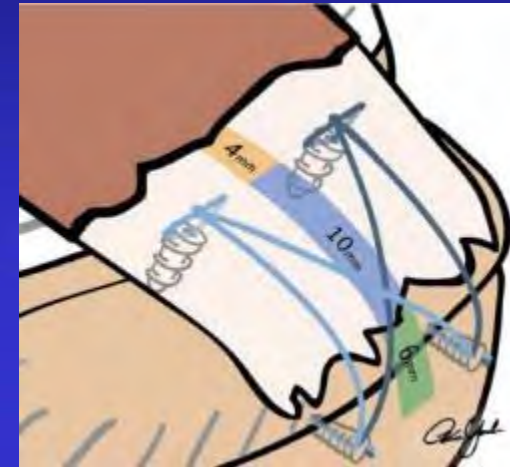


Conclusion – the smaller the tear the better the outcome

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ARTHROSCOPIC SURGERY

- Single row
- Double row
- + acromioplasty
- + biceps surgery

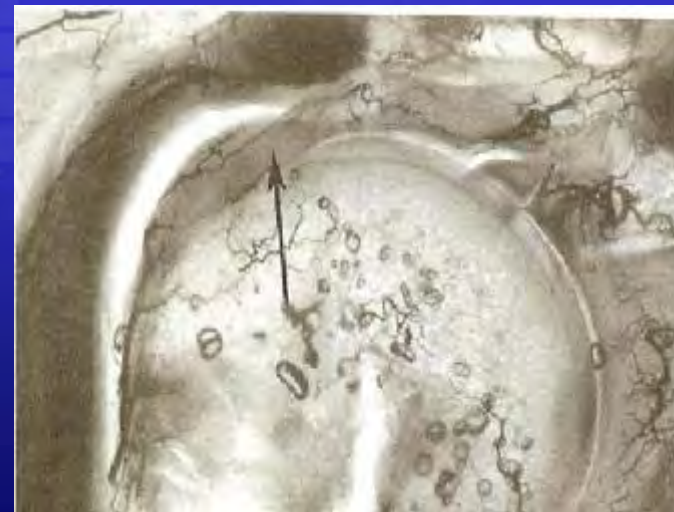
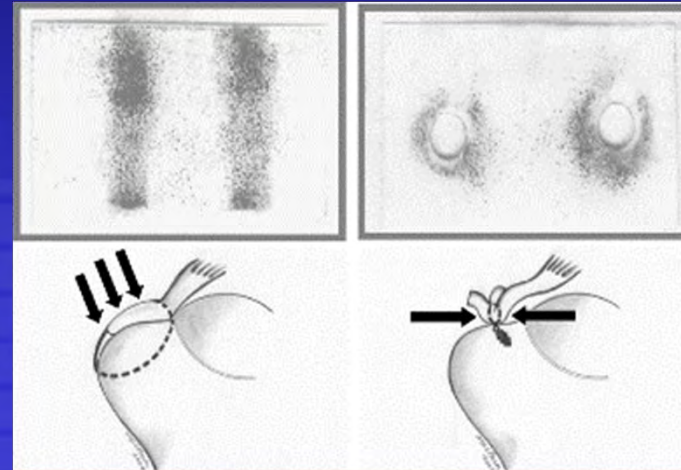


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ARTHROSCOPIC ISSUES

- Single row vs double row
- Vascular issues



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RESULTS

- ~ 60 % heal
 - ~ 90% have good/excellent results
 - Shoulders are NEVER normal
- Poor results
- Smokers
 - Diabetics
 - Larger tears
 - Chronic tears
 - Older patients



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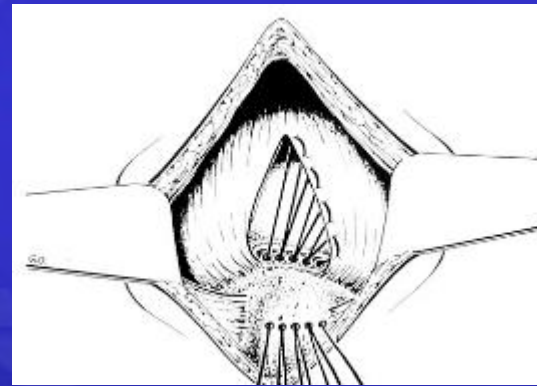
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RESULTS OF OPERATIVE TREATMENT

- SONNABEND (jses 3;201, 2002)
710 open cases only, 88% patients satisfied
- BOILEAU (arth 23;4 , 2007)
597 arthroscopic cases only, 94% excellent results, but only 75% of cuffs repaired on arthrogram

Operative treatment fails because of failure of RC healing capacity – POOR BIOLOGY



Conclusion – 80% to 90% patients happy but RC repair is intact in only 60% to 80% of cases with the smaller tears having good technical repairs and the larger tears more likely to fail



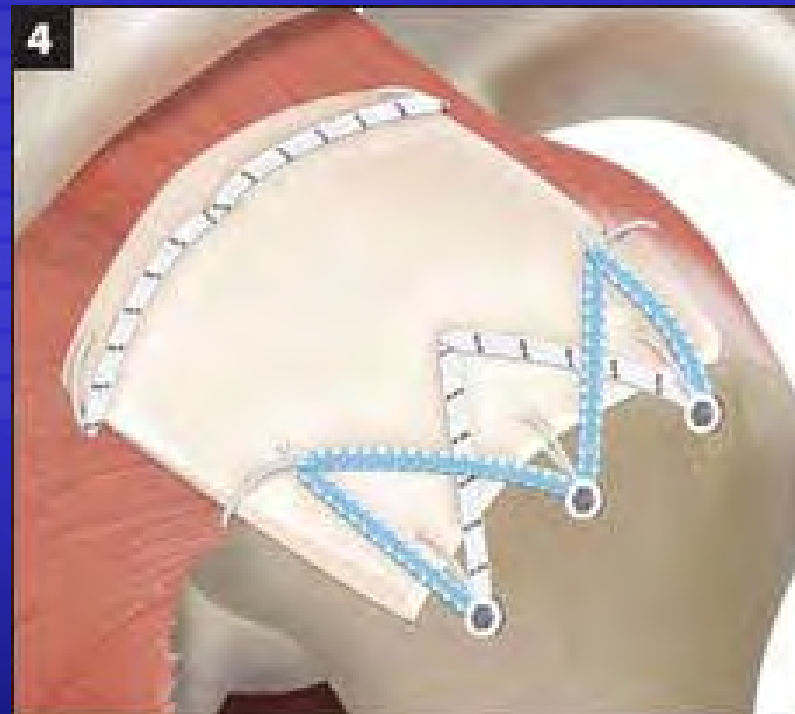
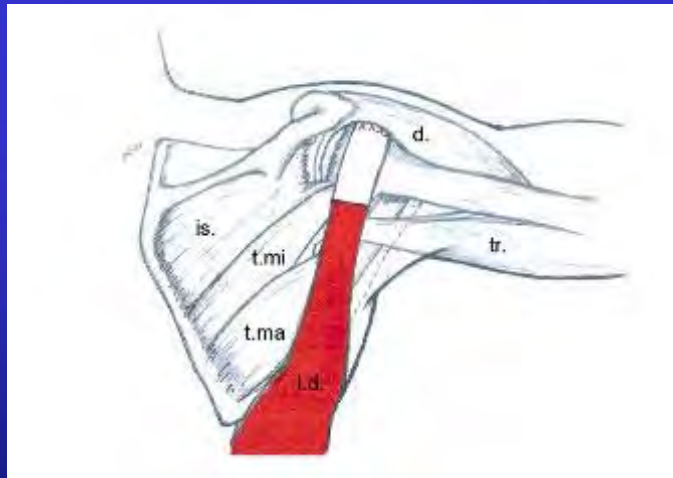
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OPEN/MINI OPEN SURGERY

- +/- graft
- LD transfer



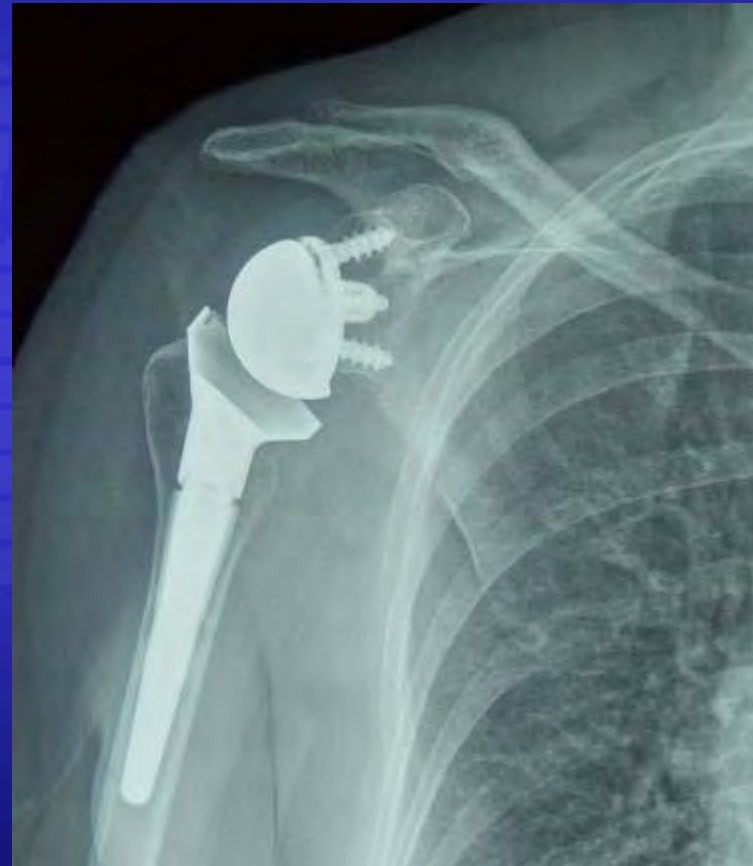
SUPERIOR CAPSULAR RECONSTRUCTION

- Younger patients
- Massive tear
- Recurrent tears



REVERSE TSR

- Massive tears
- Older patients
- Significant pain and functional loss

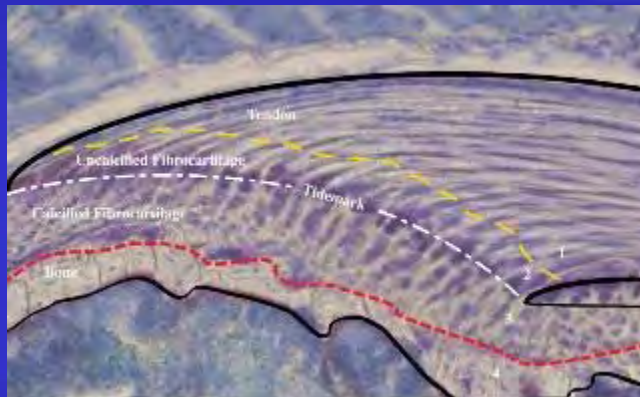


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TENDON HEALING



Encourage mineralisation of calcified fibrocartilage layer

- Structural strength – 50% normal
- Material quality – 10% to 20% normal

**SHOULD
PATIENTS GO
BACK TO
HEAVY WORK
OR SPORTS???**

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THE FUTURE

BIOLOGICALLY ACTIVE SUBSTANCE

- PRP
- Growth factors (BMPs & other GFs)
 - Direct insertion
 - Gene therapy
- Stem cells

DELIVERY METHOD

- Inject SA space – GF disappear too quickly
- Inject tendon – can damage healing tendon
- Use scaffold - technically difficult & FB reaction



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THANK YOU



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