THE ROTATOR CUFF
the science behind the disease

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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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Shoulder Surgery
ANATOMY
ANATOMY

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TENDON ULTRASTRUCTURE

2 components
- Cells
  - Tenocytes
  - Tenoblasts
- ECM
  - Collagen (70%) mainly T1
  - Elastin
  - Proteoglycans
  - GAGs
  - water
TENDON ULTRASTRUCTURE
MUSCLE ULTRASTRUCTURE
BIOMECHANICS
balance force couples
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
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.

<table>
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<tr>
<th>AUTHOR</th>
<th>NUMBER OF SHOULDERS</th>
<th>MALES</th>
<th>FEMALES</th>
<th>AGE (YEARS)</th>
<th>FULL-THICKNESS RUPTURES (%)</th>
<th>AGE OF YOUNGEST WITH FULL-THICKNESS RUPTURES</th>
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<td>Codman and Ackerson (1934)</td>
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<td>18–93</td>
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<td>Fukuda (1986)</td>
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**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
Yamamoto (JSES 2015)

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

Risk Factors

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

“I’ll have to do some x-rays to be sure, but I’m guessing you dislocated your shoulder.”
PATHOLOGY

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

BIOLOGICAL
- complex
- Tendon inflammation
- Tendon/muscle degeneration
PATHOLOGY

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

Flat
Curved
Hooked
PATHOLOGY

CRITICAL SHOULDER ANGLE

- > 35° RC tear
  - ↑ superior shear force to RC
  - Requires 44% more SS muscle activity
  - Causes SS overload
- < 20° OA

CSA > 38° 15X higher risk of retear after RC repair
? Lateral acromionectomy
SYMPTOMS

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

- wasting
- RC tenderness
- Loss of movement
- Loss of power
- + impingment sign
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
WHO NEEDS SURGERY

- Young patients
- Active patients
- Poor ROM
- Significant power loss
WHO NEEDS NONOPERATIVE TREATMENT

- Older patients
- Low demand patients
- Balanced force couples
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
ARTHROSCOPIC SURGERY

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

• Single row vs double row
• Vascular issues
RESULTS

- ~60% heal
- ~90% have good/excellent results
- Shoulders are NEVER normal

Poor results
- Smokers
- Diabetics
- Larger tears
- Chronic tears
- Older patients
RESULTS OF OPERATIVE TREATMENT

- SONNABEND (jse s 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
OPEN/MINI OPEN SURGERY

- +/- graft
- LD transfer

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SUPERIOR CAPSULAR RECONSTRUCTION

- Younger patients
- Massive tear
- Recurrent tears
REVERSE TSR

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

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

Encourage mineralisation of calcified fibrocartilage layer

SHOULD PATIENTS GO BACK TO HEAVY WORK OR SPORTS???
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
THANK YOU