ROTATOR CUFF PATHOLOGY

Anatomy, biomechanics ,treatment selection

JEROME GOLDBERG

Examination & Non operative treatment

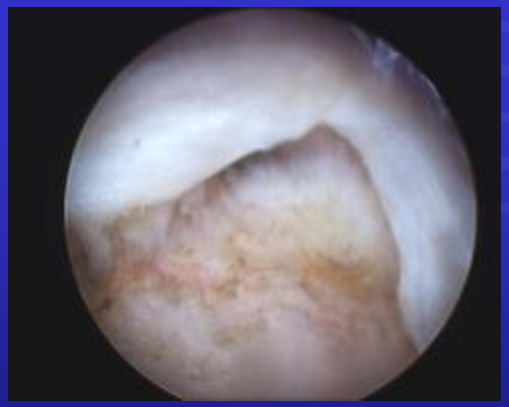
MEL CUSI

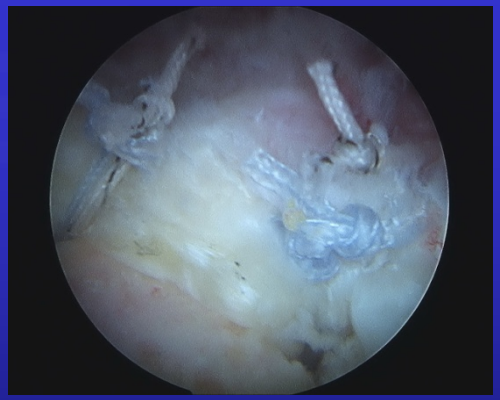
Operative management

IVAN POPOFF

Use of biologics

JEROME GOLDBERG





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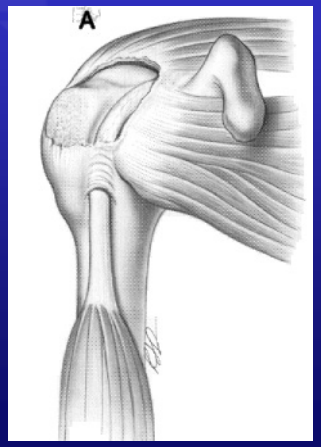
What do we know

- 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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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[47] (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Neer (unpublished) (1965, 1973)	212	—	40–85	7	40–50
Satterlee and Dalsey[59] (unpublished) (1988)	62	—	—	9	—

RESULTS OF NON OP TREATMENT

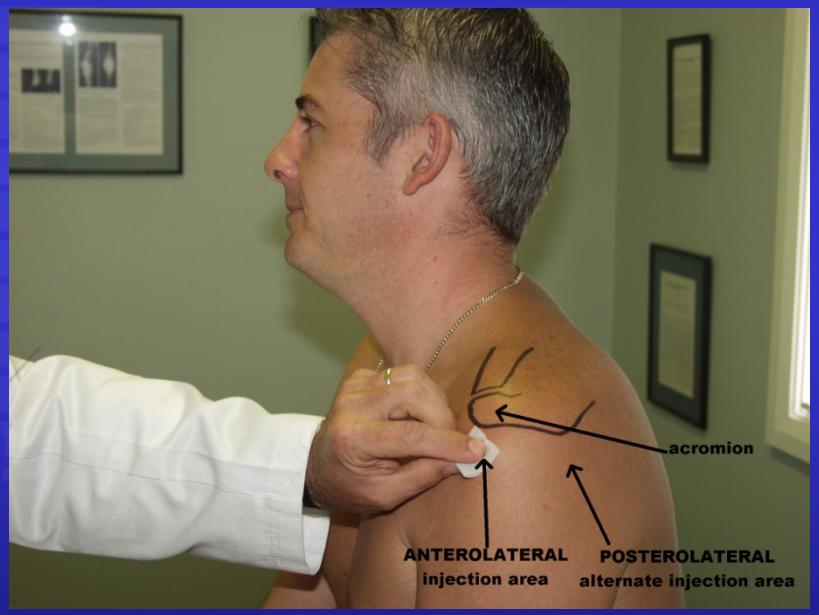
- ITOI (clin orthop 275;165, 1992)

  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

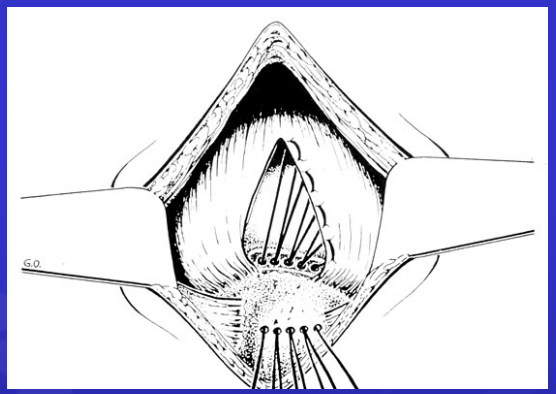


Conclusion – the smaller the tear the better the outcome

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

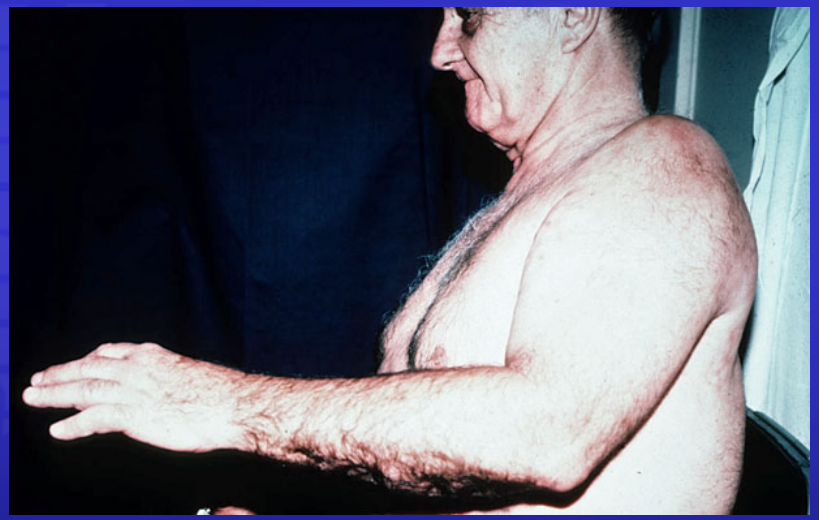
Operative treatment fails because of failure of RC healing capacity – POOR BIOLOGY



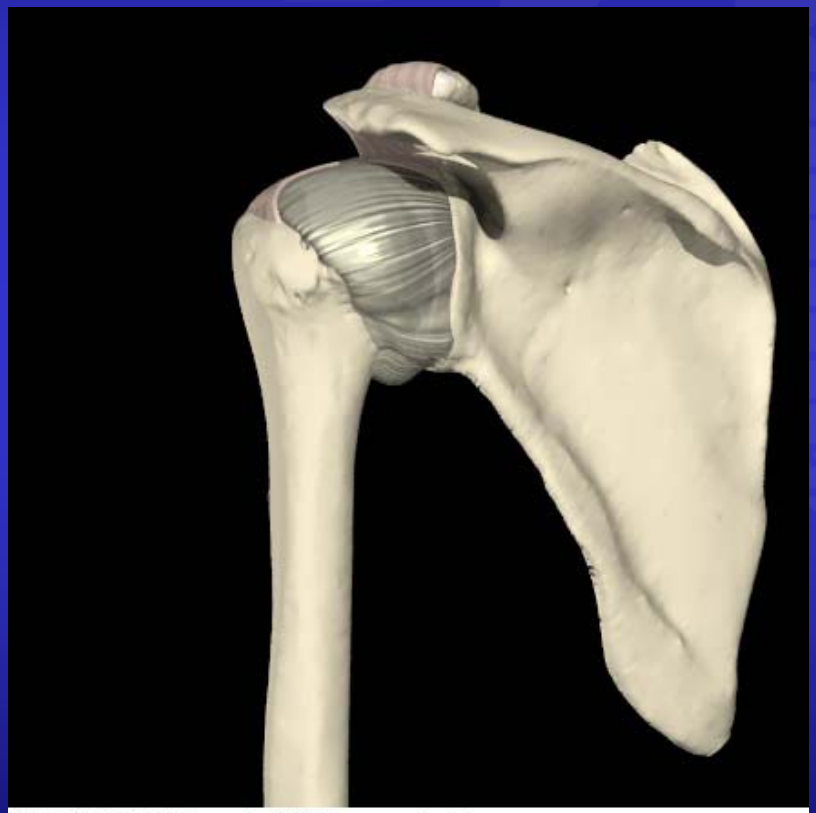
Conclusion – 80% to 90% patients happy but RC repair is intact in only 60% to 80% of cases with the smaller tears having good technical repairs and the larger tears more likely to fail

SEVERAL STUDIES HAVE BEEN UNABLE TO DETERMINE WHO WILL BENEFIT FROM NONOP TREATMENT BASED ON

- Rotator Cuff strength
- Symptom duration
- Functional impairment



PATHOANATOMY



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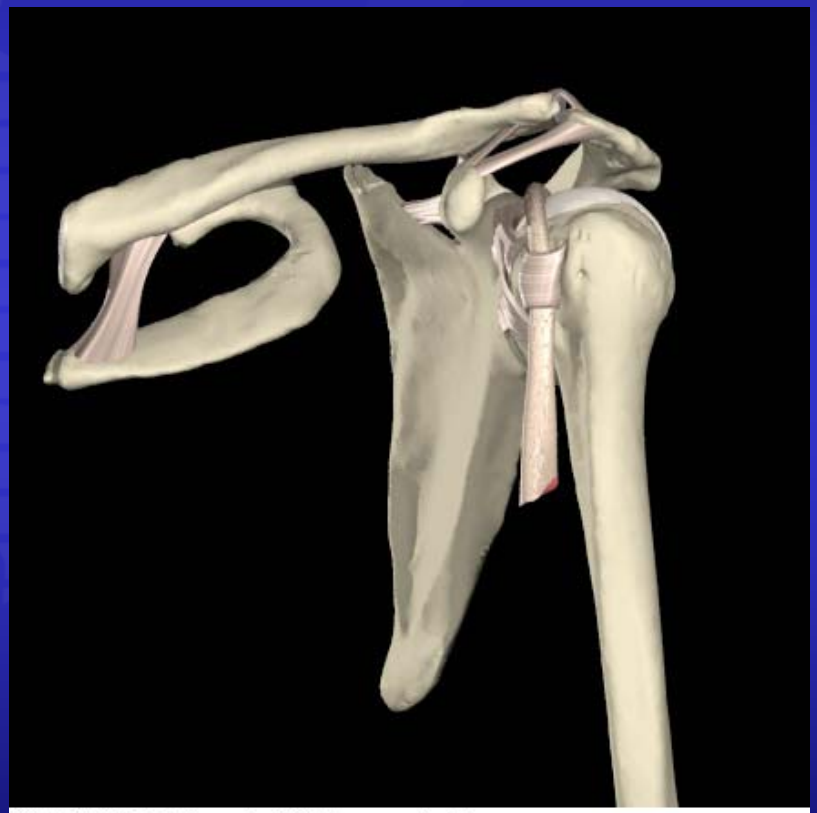

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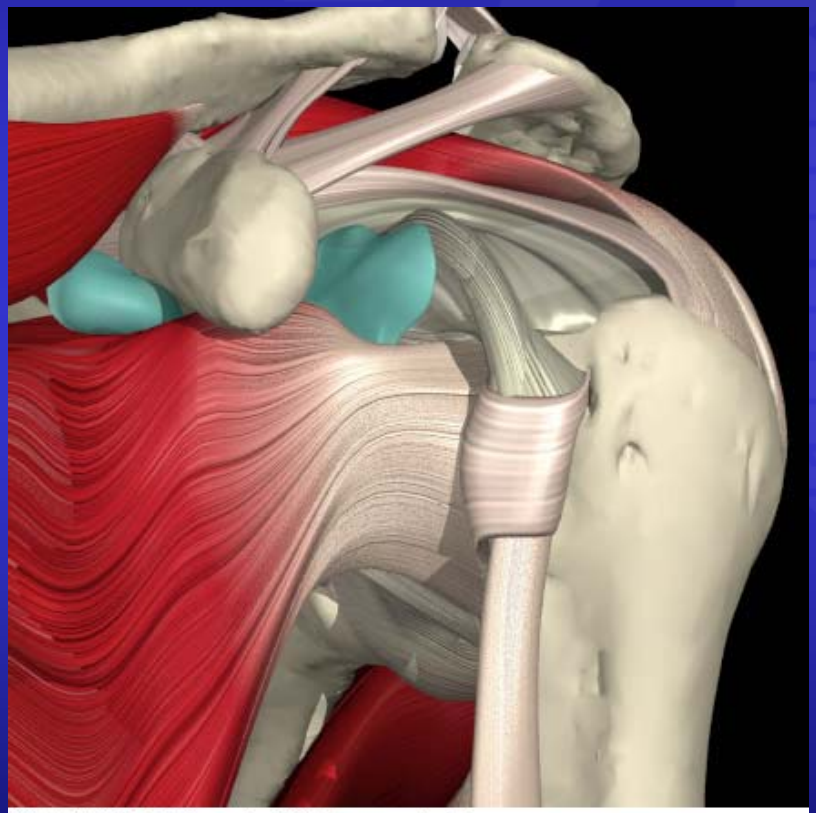
PATHOANATOMY



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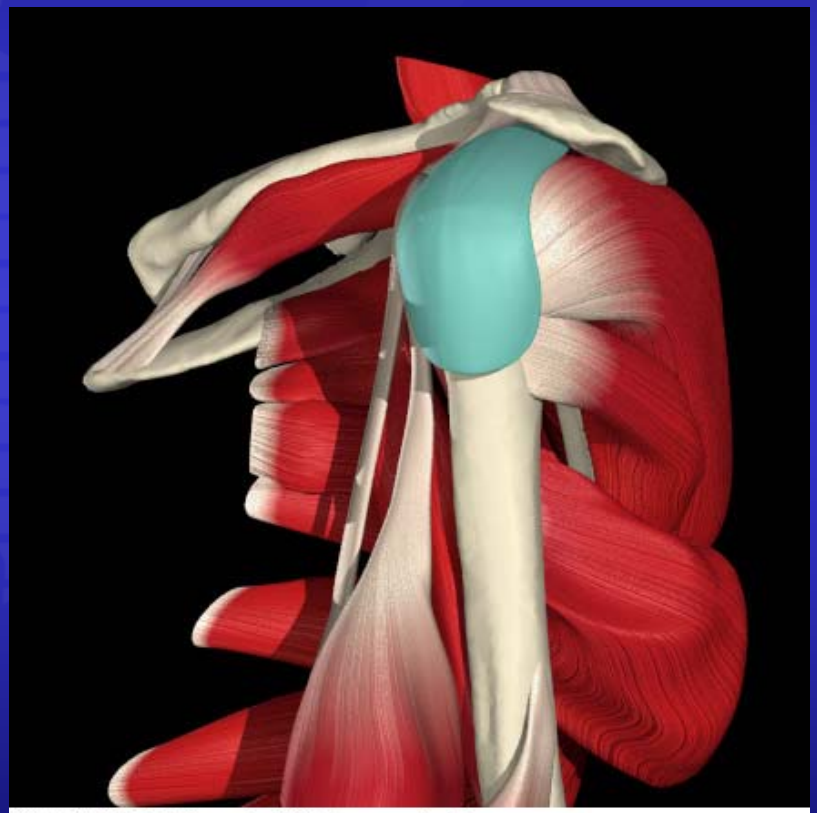

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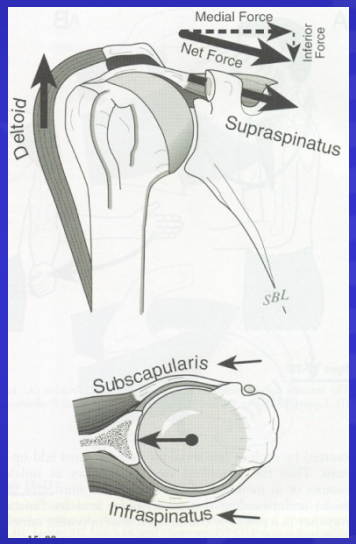
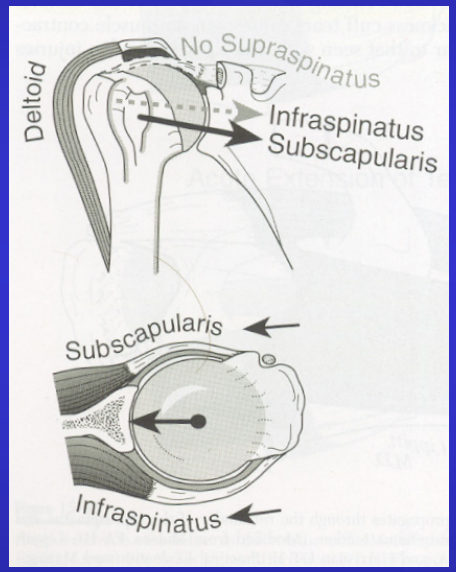
PATHOANATOMY
important concept





An intact subscapularis and infraspinatus can hold the humeral head inferiorly against the glenoid even if supraspinatus is torn, and allow the deltoid to elevate the arm

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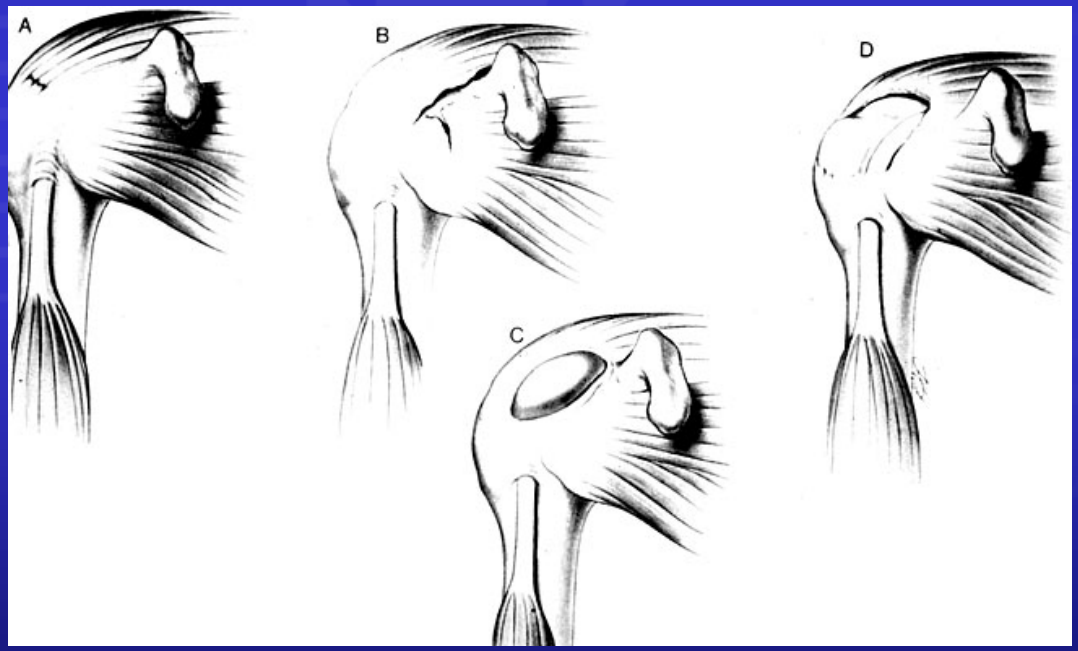
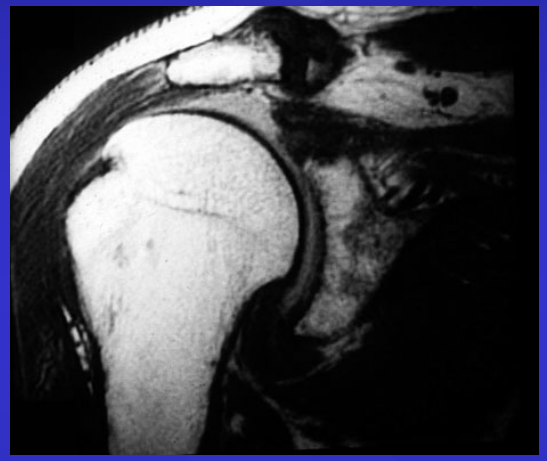
BIOMECHANICAL RATIONALE FOR TREATMENT OF ROTATOR CUFF TEARS

- S. Burkhart Arthroscopy 10 (1) 4, 1994

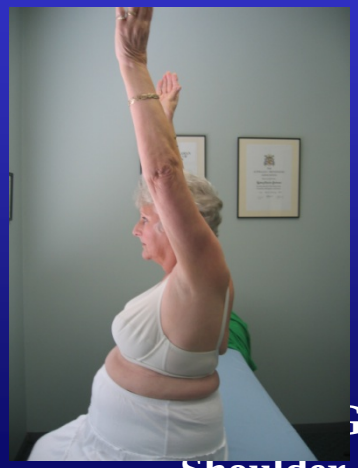


“FUNCTIONAL” ROTATOR CUFF TEAR

- Anatomically deficient
- Biomechanically intact



Patient has a RC tear but has no pain and good function



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TEAR IS NOT THE CAUSE OF PAIN !!!!

PAIN CAUSED BY

- Impingement
- Edge of tear instability
- Synovitis
- Capsulitis
- Biceps / s.l.a.p.

LOSS OF FUCTION CAUSED BY

- Tear location and to a lesser extent tear size
- Loss of force couples where humeral head cannot be kept centered in glenoid

Important to note that tears can get bigger with time especially if they are large and there is a high demand on the shoulder

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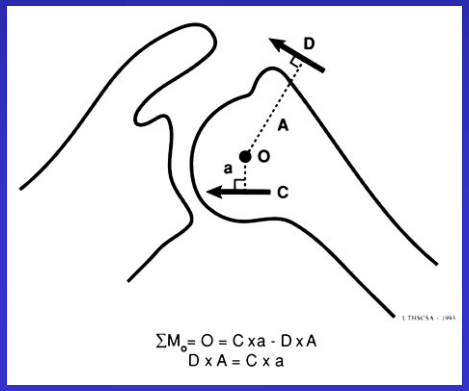
FORCE COUPLES KEEP HUMERAL HEAD CENTRED IN GLENOID

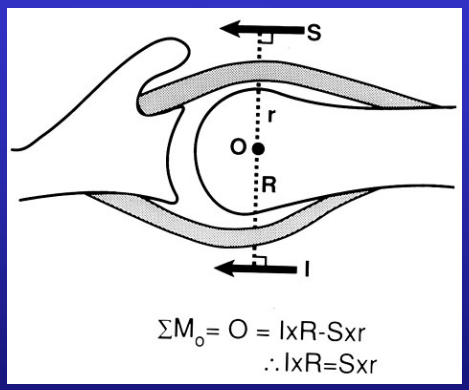
CORONAL PLANE

- Deltoid (D)
- Inferior part of Rotator Cuff (C)
  - subscap and infraspinatus



TRANSVERSE PLANE (most important)

- Subscapularis (S)
- Infraspinatus & T. Minor(I)



Force couples keep humeral head against glenoid or maintain a STABLE FULCRUM

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ROTATOR CUFF CABLE

- Cable area 3 x as thick as rotator cuff

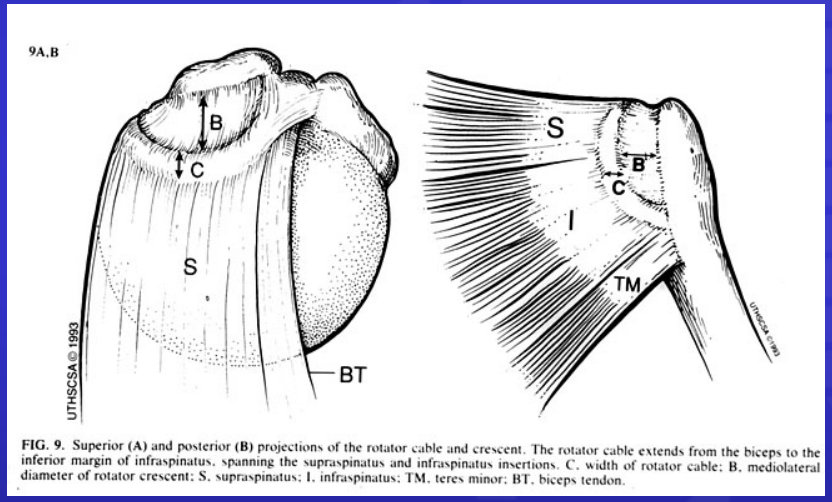
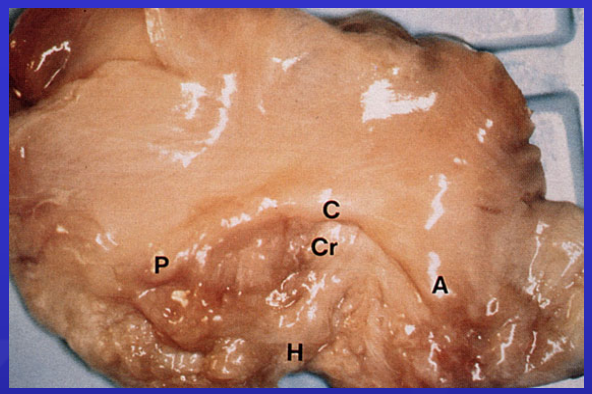


FIG. 9. Superior (A) and posterior (B) projections of the rotator cable and crescent. The rotator cable extends from the biceps to the inferior margin of infraspinatus, spanning the supraspinatus and infraspinatus insertions. C, width of rotator cable; B, mediolateral diameter of rotator crescent; S, supraspinatus; I, infraspinatus; TM, teres minor; BT, biceps tendon.

- Thickening acts as suspension bridge and reduces risk of tear extending

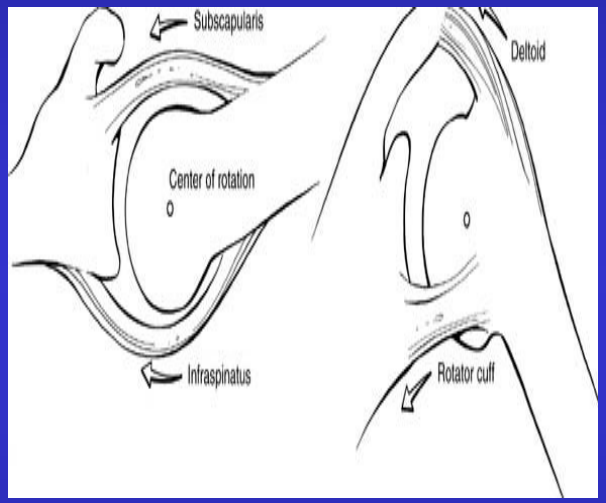


Providing the RC tear remains inside the cable the supraspinatus can function to keep the humeral head adjacent to the glenoid

These tears however can increase in size especially if there is a high demand on the shoulder

A STABLE FULCRUM KINEMATIC PATTERN MUST EXIST

- Location of tear is more important than size
- Tears involving supraspinatus plus a portion of infraspinatus fit this pattern providing the tear is within the RC cable
- Rest of infraspinatus balances subscapularis and pulls the humeral head inferiorly and into the glenoid



Providing subscapularis and most of infraspinatus is intact, and the tear of supraspinatus is within the cable, the humeral head remains in position adjacent to the glenoid and the deltoid can elevate the arm – A STABLE FULCRUM

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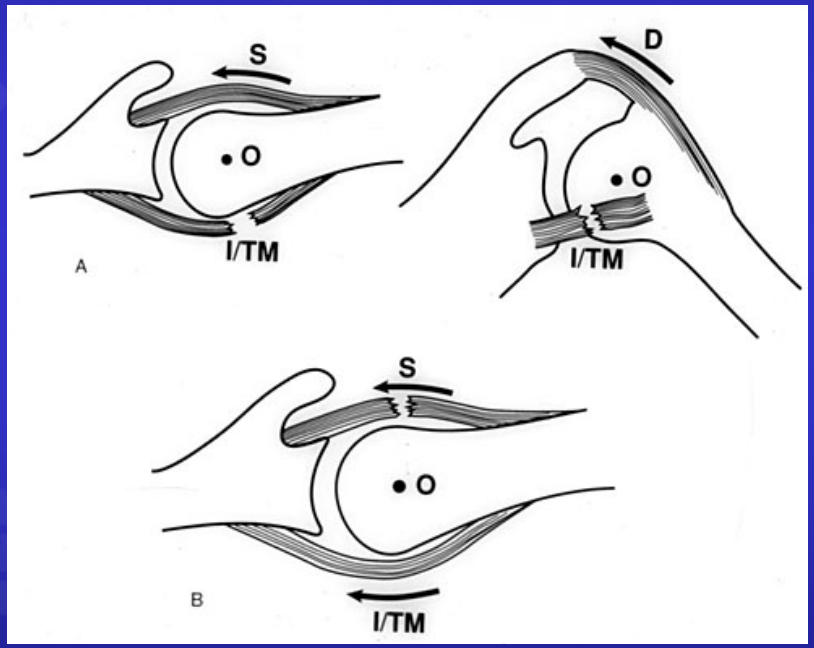
CLINICAL IMPLICATIONS

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

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

if pain relief can be achieved



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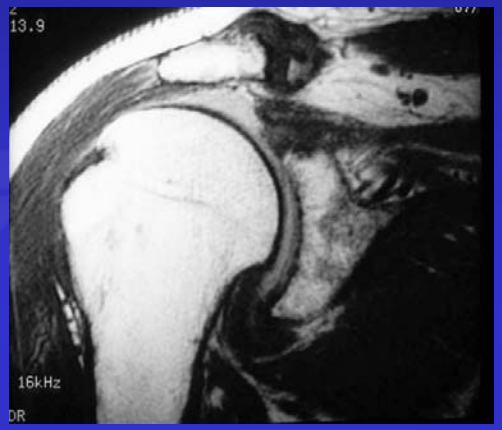
ABSOLUTE SURGICAL INDICATIONS

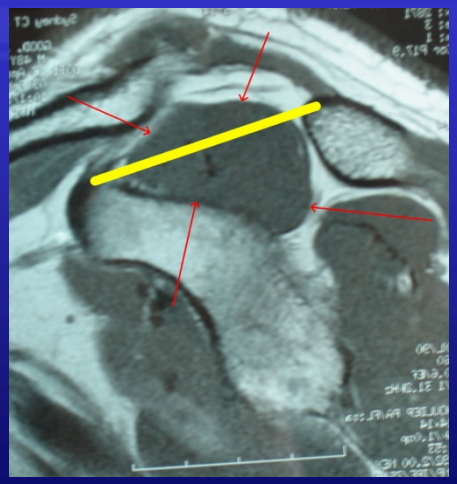
- Young patient (less than 50 years) - tear is likely to get bigger
- Patient involved with heavy or overhead occupation – tear likely to get larger
- Following dislocation in older patient (usually large tears)
- Acute & very large tears – NO ER POWER

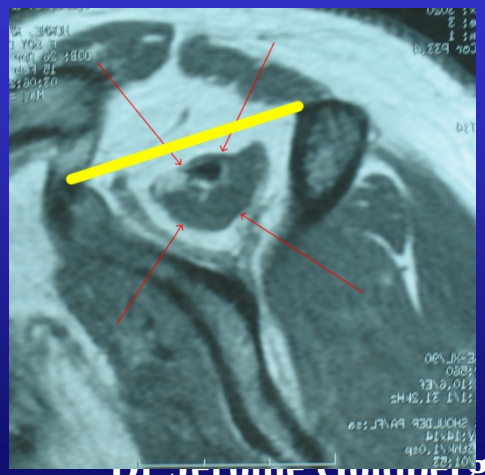
NEEDS SURGERY WITHIN 1 MONTH

RELATIVE SURGICAL INDICATIONS

- Older patient (50 yrs plus) based on loss of e.r. power & function, plus MRI – **force couples disrupted**
- Chronic and large tear in older patient with disability and good quality RC on MRI and failure of conservative treatment
- Failed non operative management







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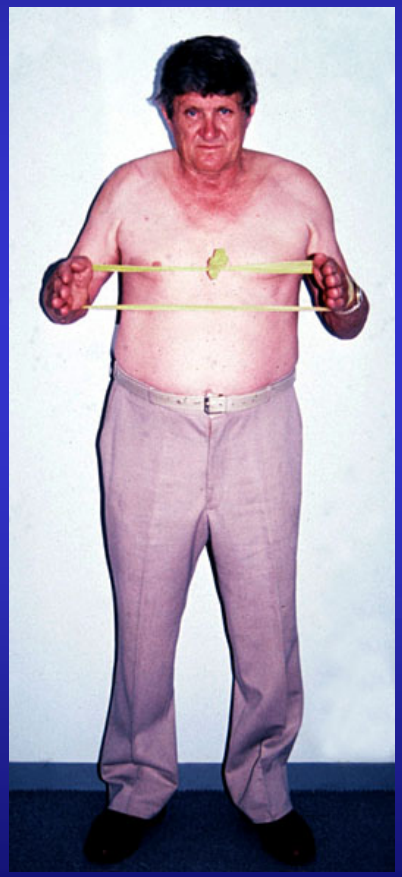
NONOP INDICATIONS

- Patients over 50 years with small tears and low demand on shoulder and with **force couples intact**
- Patients older than 65 years with RC tear and good function even if **force couples not intact**
- Large tears with poor quality RC

Providing force couples are intact and patient not too young non op treatment is likely to be successful



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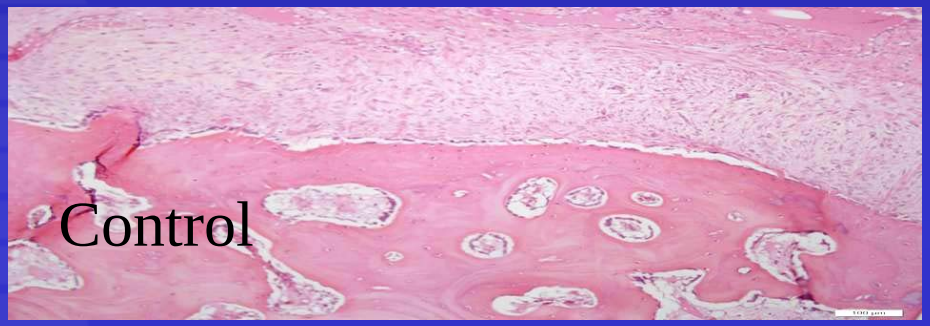
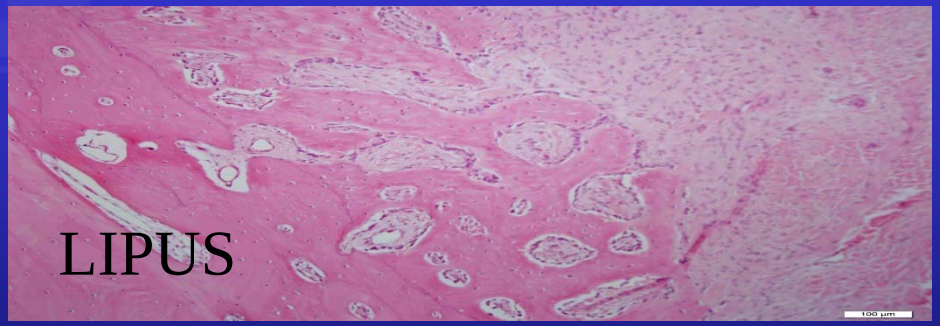
BIOLOGICAL ENHANCEMENT OF TENDON TO BONE HEALING

- Ultrasound
- Growth factors

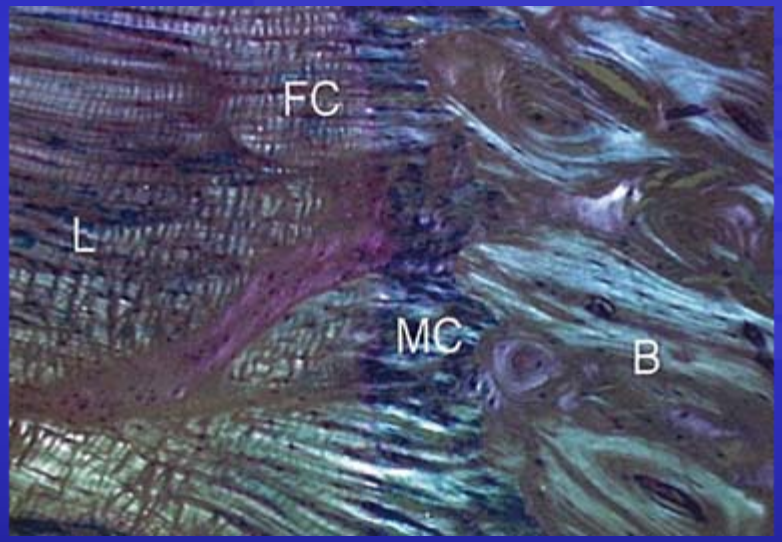




Background: Tendon–Bone Healing

• Healthy tendon-bone insertion site – 4 gradually transitional zones (direct-type insertion)

• These zone are not recreated following surgery resulting in mechanically weaker interface



L = Ligament

FC = Unmineralized Fibrocartilage

MC = Mineralized Fibrocartilage

B = Lamellar Bone

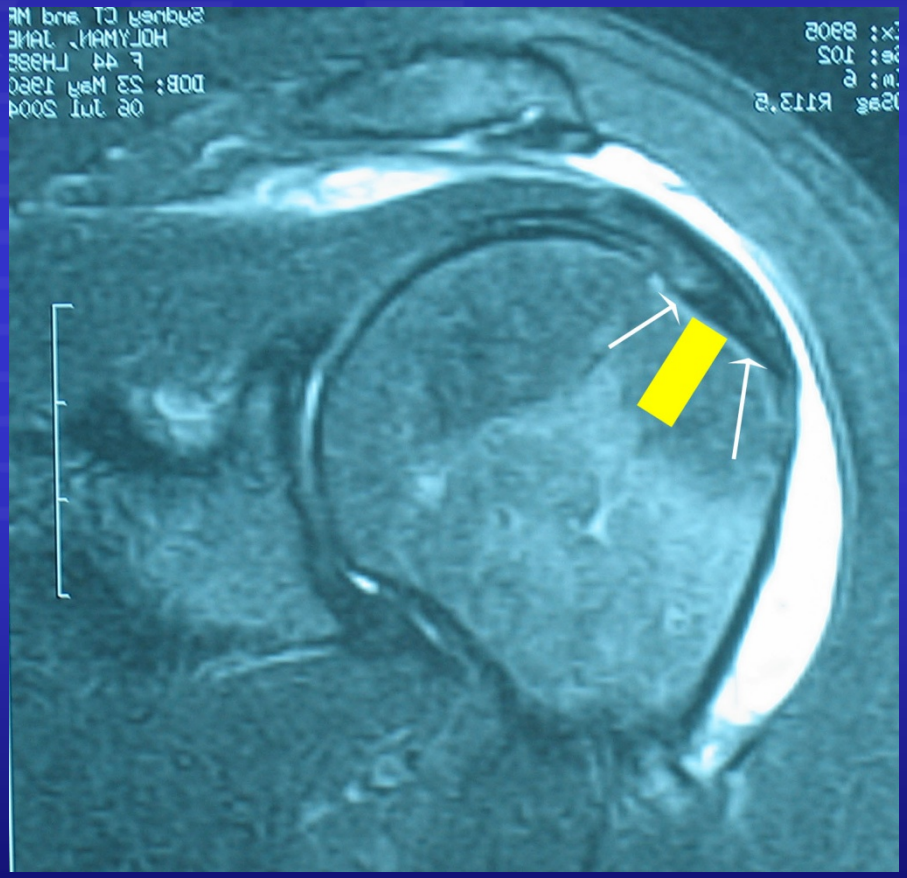
Direct-type ACL insertion in a sheep (Alcian Blue stain, polarized light, x100 original magnification) [1]

1. Walsh, WR (ed.) 2005. *Repair and Regeneration of Ligaments, Tendons, and Joint Capsule*

Background

- Rotator cuff surgery has seen vast improvements with advances in surgical technique, new instrumentation, surgical hardware and understanding of mechanical issues related to fixation
- Biological improvements in tendon bone healing represent a new focus to help augment outcomes in shoulder rotator cuff surgery
- Delivery of biologically active material to site of healing and keeping it there is a significant problem

WATER LAWN OR FEED THE SOIL



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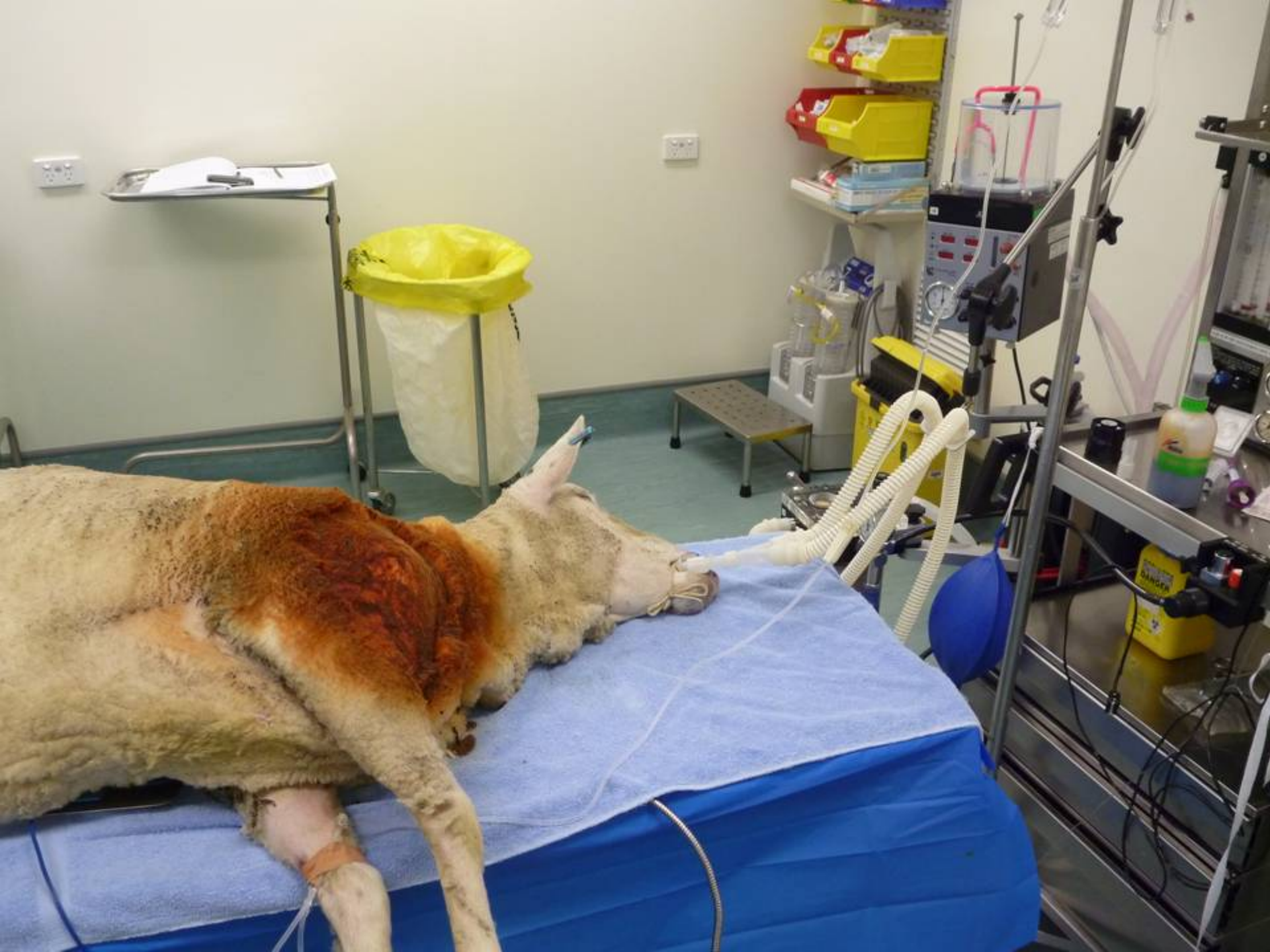

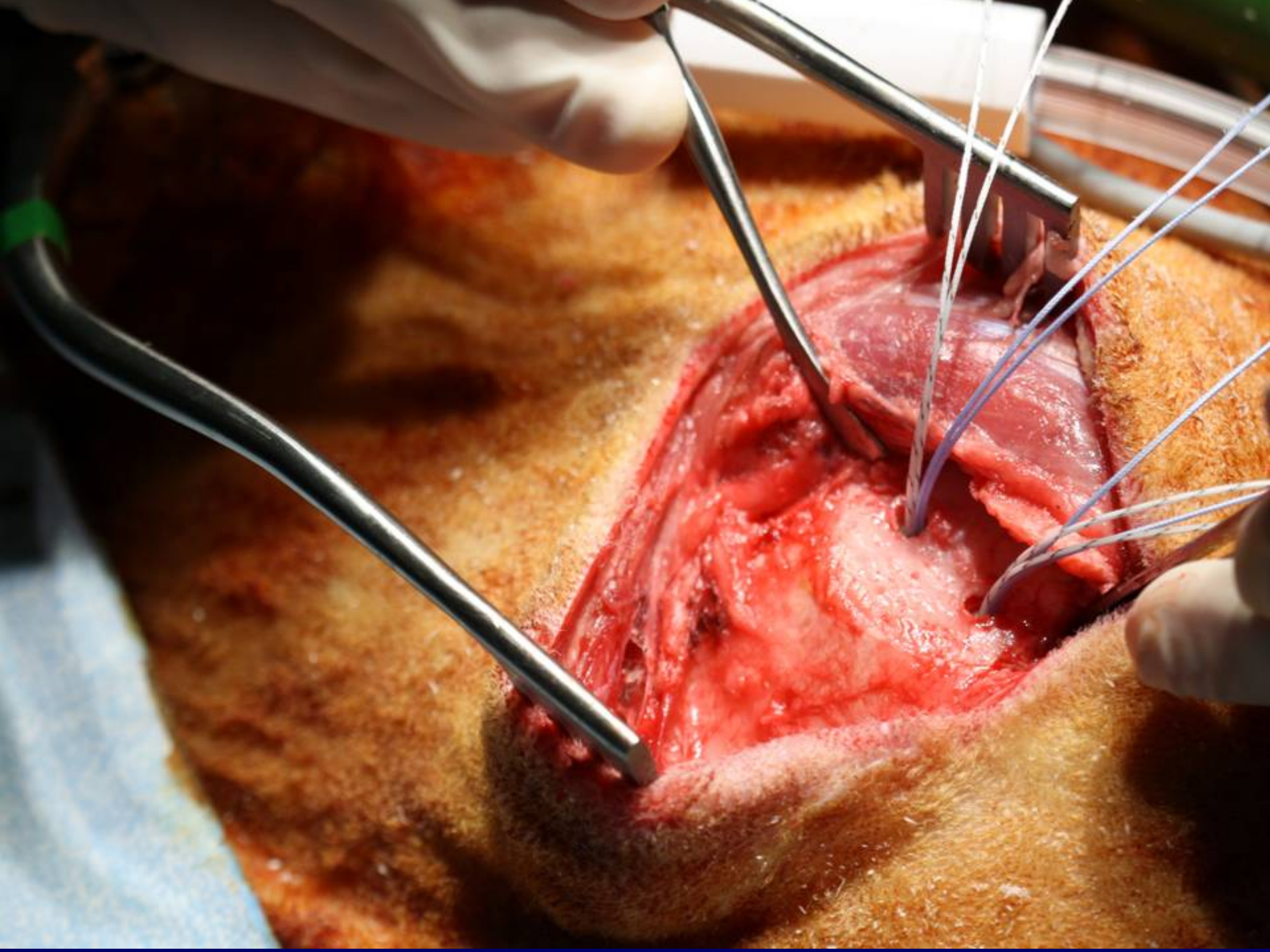

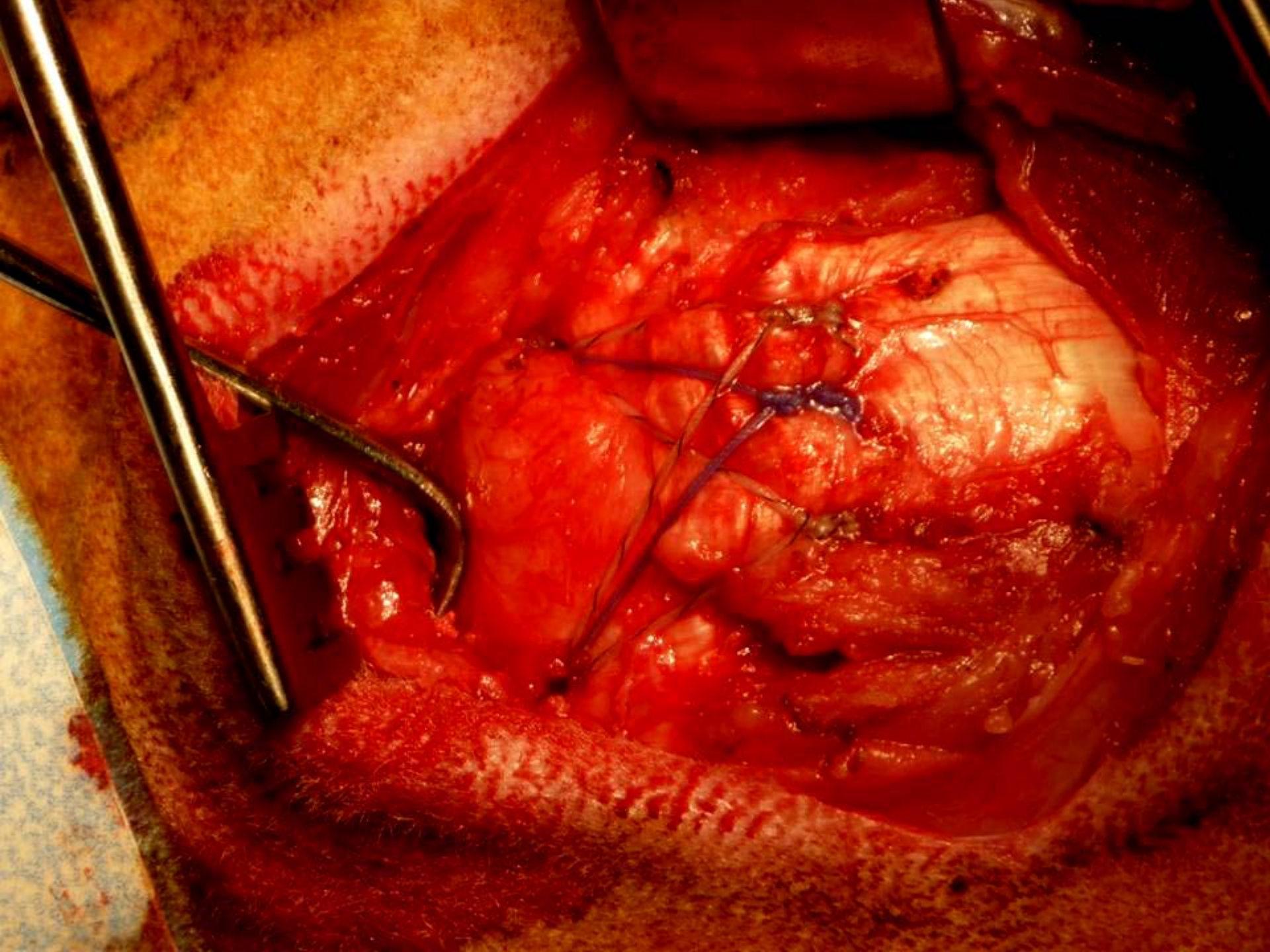

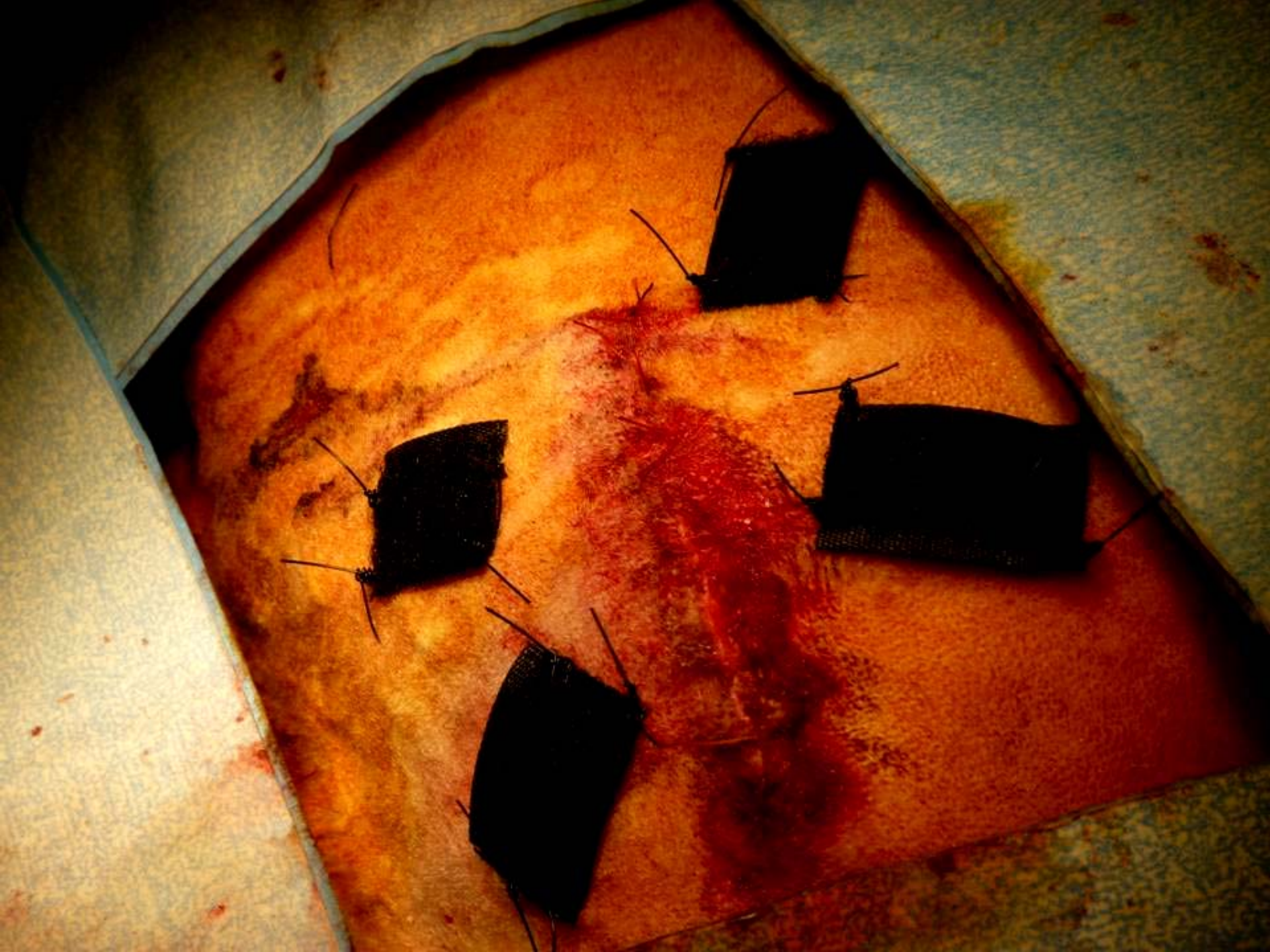

LIPUS daily for 20 minutes until sacrifice at 4 weeks

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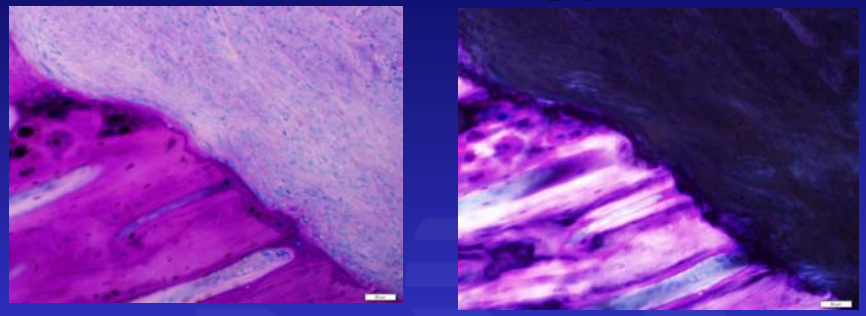
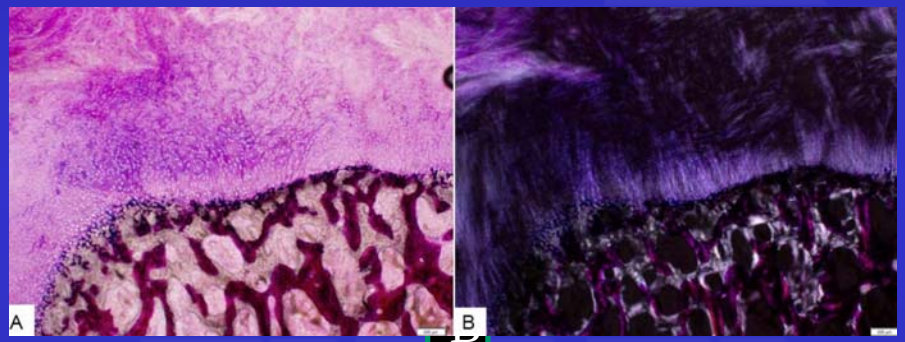
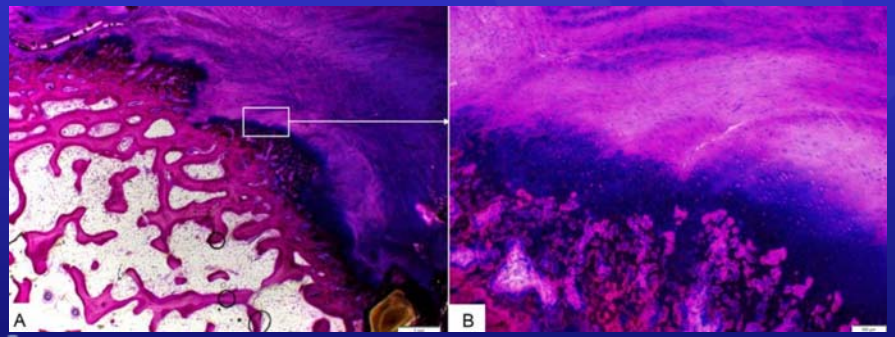
Results: Histology



Control group: Image B (x2) shows Image A (x2) under polarized light



DBM group: Image B (x2) shows Image A (x2) under polarized light



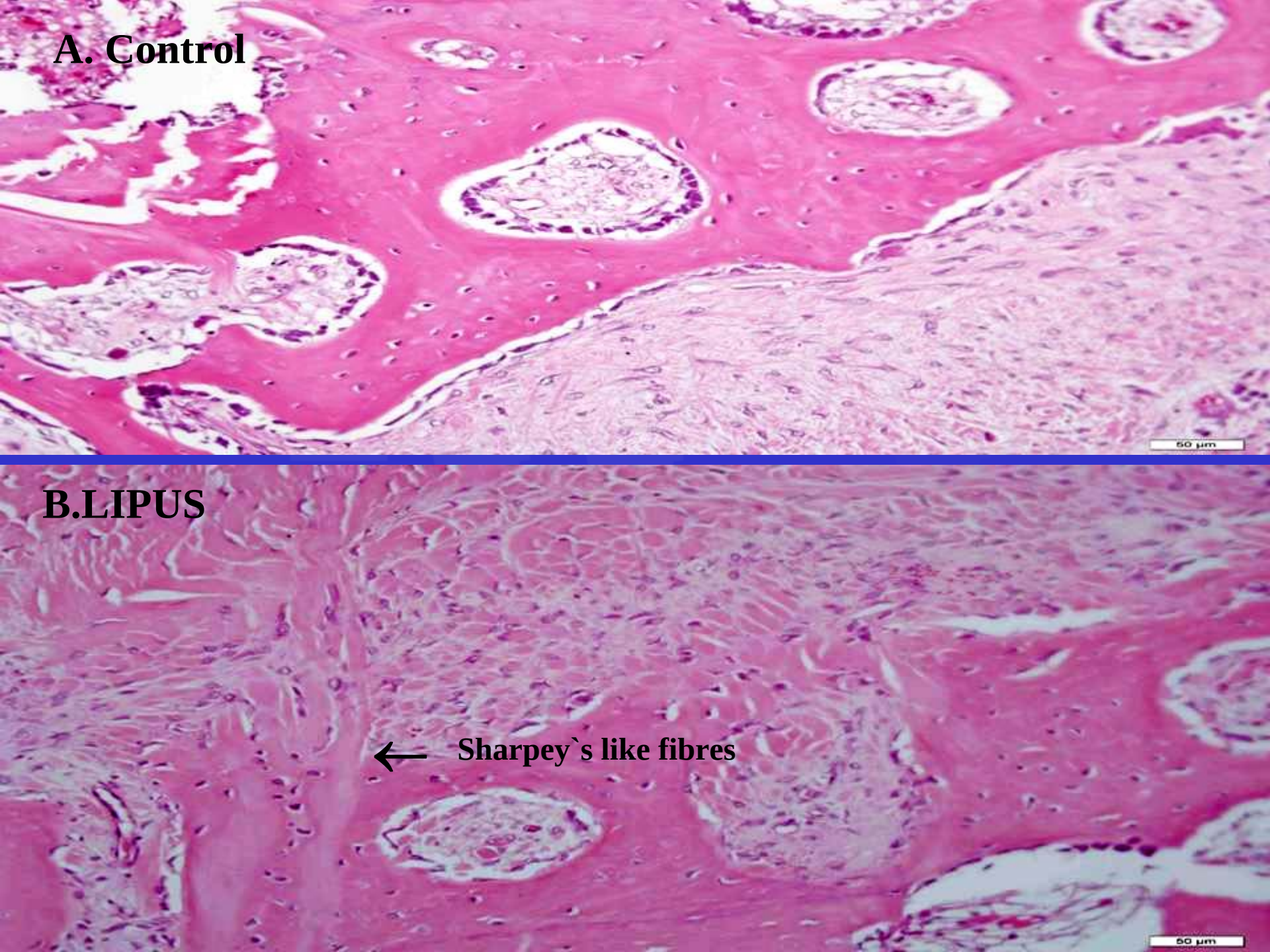
DBM group: Image A (x2) Image B (x20). Rounded chondrocytes stained blue

Control Group

- Highly disorganised collagen fibres
- Very small areas of clustered chondrocytes

DBM Group

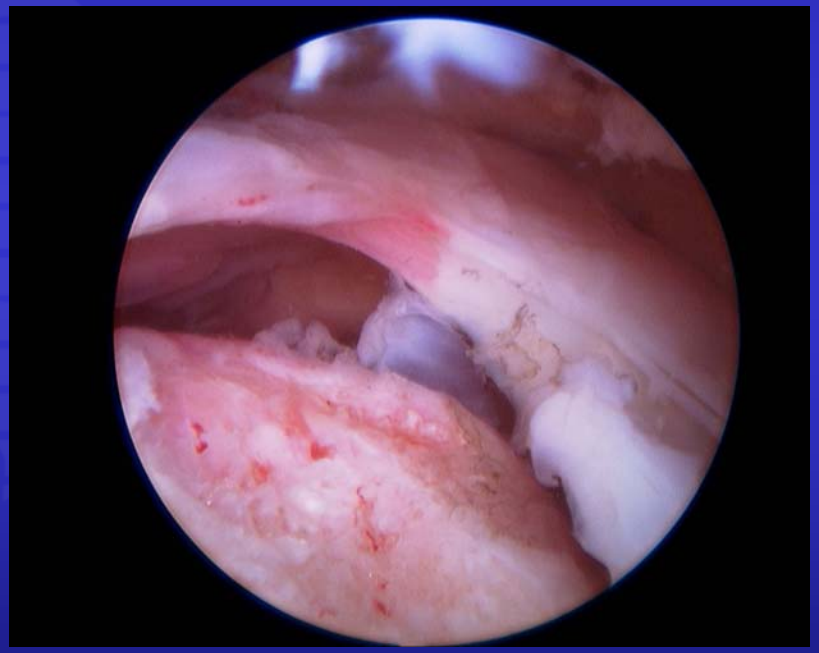
- Well organised collagen fibre orientation
- Rounded chondrocytes orientated in the direction of insertional collagen fibres
- DBM particles resorbed with loose trabecular bone within DBM holes


A. Control
50 µm
B.LIPUS
Sharpey`s like fibres
50 µm

CONCLUSIONS

DBM & LIPUS have a positive biological effect on initial tendon-bone healing

- increased presence of fibrocartilage at T-B interface
- increased collagen fibre orientation (tendon midsubstance)



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