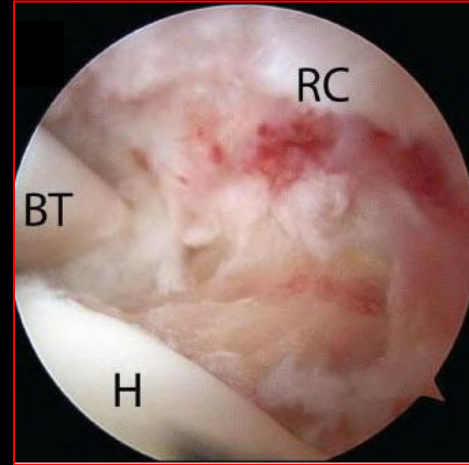
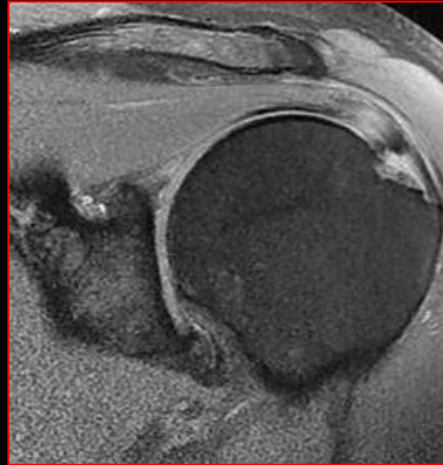


# Partial Thickness Rotator Cuff Tears



Craig M Ball

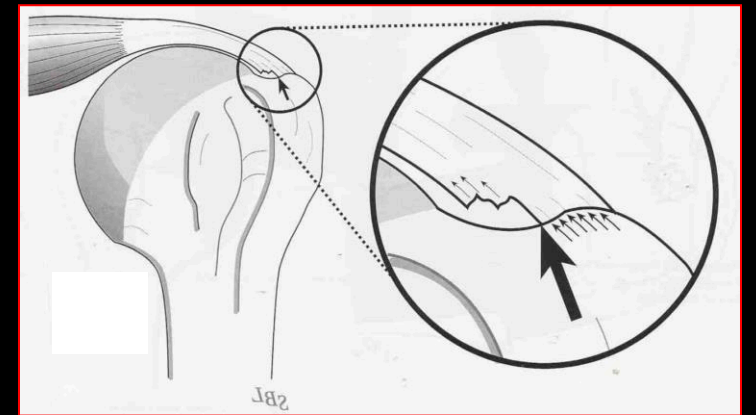
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# Introduction



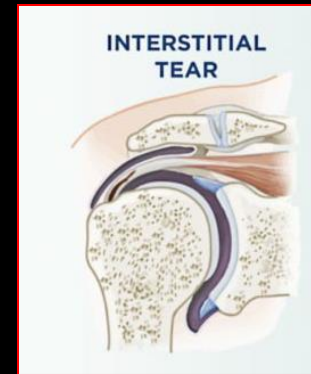
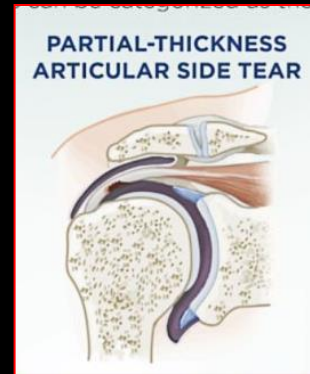
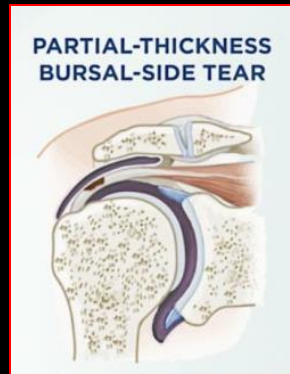
- Partial thickness rotator cuff (RC) tears a common source of shoulder pain and dysfunction
- Compared to full thickness RC tears, incidence is reported to be 2 to 3 times higher, which increases with age
- Often reported that partial thickness RC tears tend to be more painful  
*Fukuda. J Shoulder Elbow Surg 2000; 9: 163-168*
- Symptoms thought to be due to the non-physiological tension created within the remaining intact RC fibres  
*Ellman. CORR 1990; 254: 64-74*



# Types of Tears

- According to different structural characteristics partial thickness RC tears can be divided into 3 subgroups:

- 1) Bursal sided
- 2) Articular sided
- 3) Intratendinous



- Tend to be the result of several different pathophysiologic mechanisms involving both intrinsic and extrinsic factors

*Mehta et al. Clin Sports Med 2003; 22: 791-812*

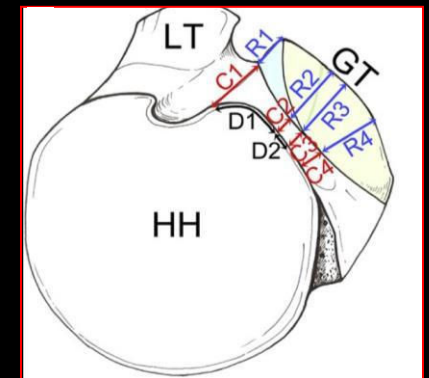
- Data on the specific aetiology of partial thickness RC tears is lacking

# Classification

- Classification system derived from anatomy of the supraspinatous tendon based on tear location and depth as measured during shoulder arthroscopy  
*Ellman. CORR 1990; 254: 64-74*

Location	Grade
Articular surface	I < 3mm deep
Bursal surface	II 3-6mm deep
Interstitial	III > 6mm deep

- Grade III tears represent > 50% of the tendon thickness
- Important to remember that up to 30% of the tissue on the articular side may be taken up histologically by the superior capsule (% of RC thickness greater on bursal side)  
*Nimura et al. J Shoulder Elbow Surg. 2012; 21: 867-872*



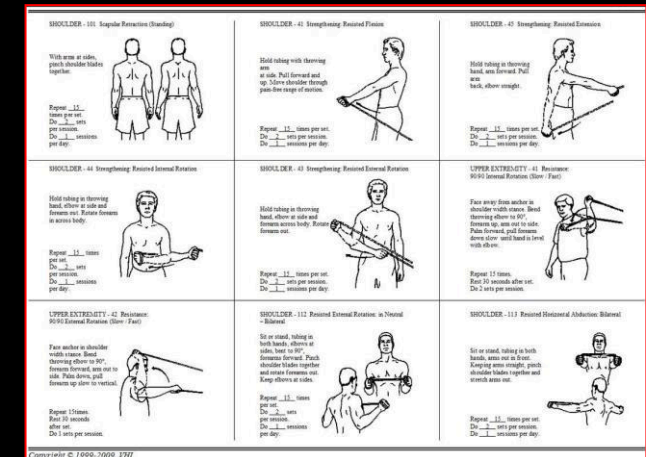
# Treatment

- Initial treatment almost always non-operative, and includes activity modification, analgesia/NSAID's, subacromial cortisone injections, and a targeted stretching and RC/scapula stabiliser strengthening program

- At least at short to mid-term follow-up non-operative treatment can be successful in many patients  
*Edwards et al. Int J Sports Phys Ther 2016; 11: 279-301*

## In Addition

- Delayed surgical treatment following a 6 month period of non-operative treatment does not appear to lead to worse clinical outcomes  
*Kim et al. Am J Sports Med 2018; 46:1091-1096*

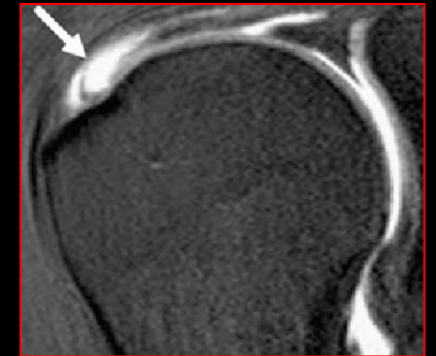


# Non-Operative Treatment

- More likely to be successful with non-traumatic tears involving  $< 50\%$  of the tendon thickness in the non-dominant extremity
  - more likely representative of intrinsic age related degeneration of the tendon
- In patients with traumatic lesions involving  $> 50\%$  of the tendon thickness, especially when the dominant extremity is involved, non-operative treatment is more likely to fail

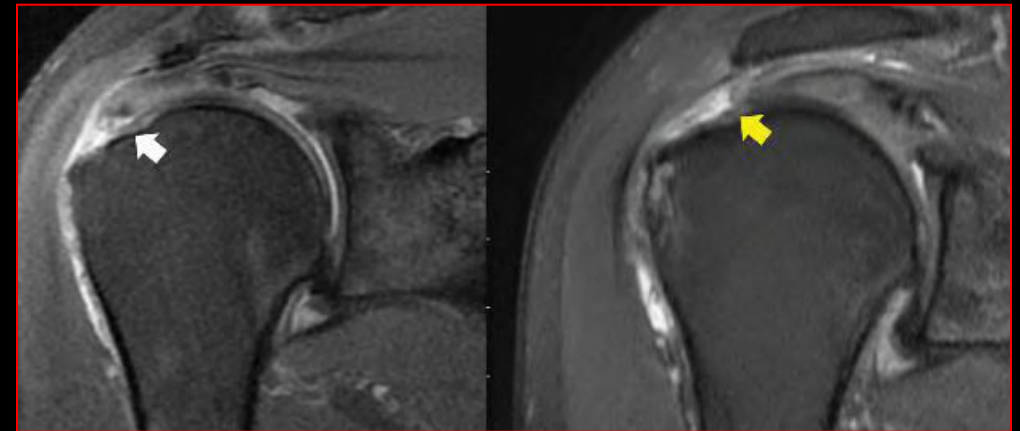
*Lo et al. Open Access J Sports Med. 2018; 9: 191-197*
- Dominant extremity disease has previously been demonstrated to be a factor related to symptomatic RC disease progression

*Mall et al. J Bone Joint Surg (Am) 2010; 92: 2623-2633*



# Healing and Progression

- Biomechanical studies have shown that in the presence of a partial thickness RC tear the strain patterns within the remaining RC are altered, potentially predisposing the tissue to tear propagation and/or completion  
*Andarawis-Puri et al. J Biomech 2009; 42: 158-163*
- Supported by clinical and natural history studies

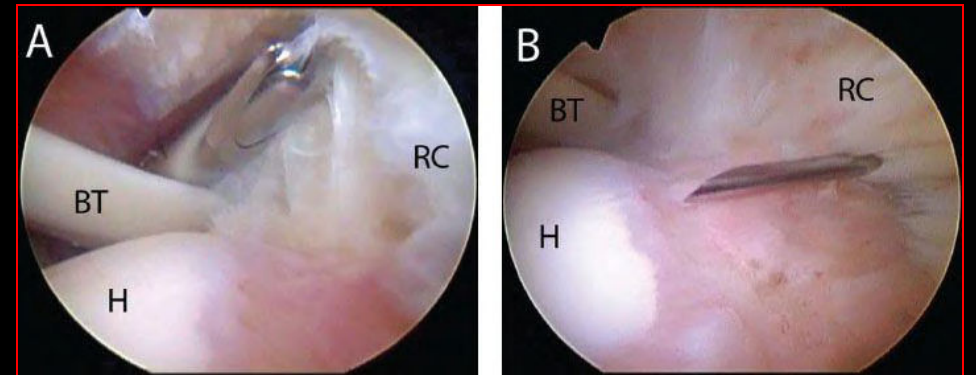


## In Addition

- Histologic studies have shown no active repair at the site of injury, suggesting limited potential for spontaneous healing of partial thickness RC tears  
*Wolff et al. JAAOS 2006; 14: 715-725*

# However

- Whilst partial thickness RC tears do alter the strain behavior of the residual intact RC tendon, they do this only after  $> 50\%$  of the tendon thickness is torn  
*Mazzocca et al. Am J Sports Med 2008; 36: 110-116*



## Therefore

- Despite early studies reporting high rates of tear progression, most recent studies report tear size increase in  $< 30\%$  of patients  
*Kim et al. Knee Surg Sports Traumatol Arthro 2017; 25: 2073-2080*
  - only tears involving  $> 50\%$  tendon thickness are likely to progress
- Full thickness tears have a much higher rate of tear enlargement rate



# Operative Treatment

- Typically indicated for patients with persistent symptoms of pain and disability who have failed conservative management
- Many different approaches to operative treatment of partial thickness RC tears have been reported

Treatment Options
Isolated acromioplasty
Tear debridement with or without acromioplasty
Transtendinous repair
Conversion to full thickness RC tear followed by repair

- Results vary considerably in the literature, making it difficult to draw definitive conclusions on best management

# Arthroscopic Evaluation

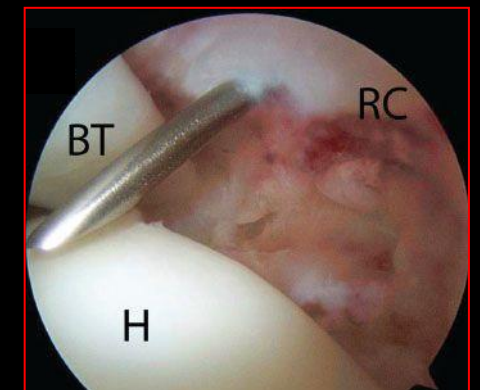
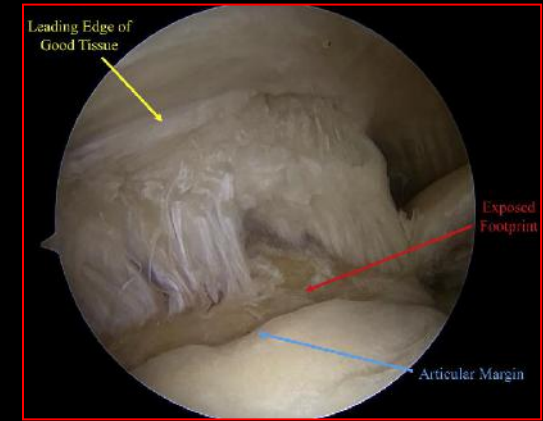
- Tips for arthroscopic evaluation:

- 1) Debridement of tear until normal tendon fibres are identified will help define true extend of tear

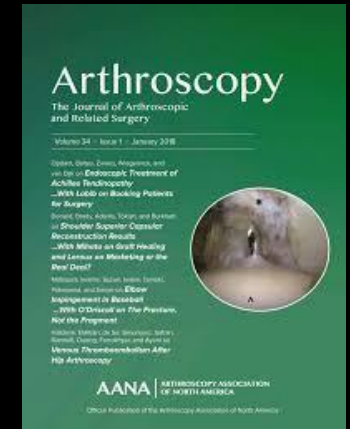
- 2) Extent of tear estimated based on exposed bone on greater tuberosity  
- every 1mm of bone exposed represents a 10% tear of the insertion  
*Porat et al. J Shoulder Elbow Surg 2008; 17: 729-731*

- 3) Percutaneously insert spinal needle into articular sided partial thickness (PASTA) tears and pass a monofilament suture to allow identification and evaluation of tear site from SA space

- 4) Need high index of suspicion for intrasubstance tears



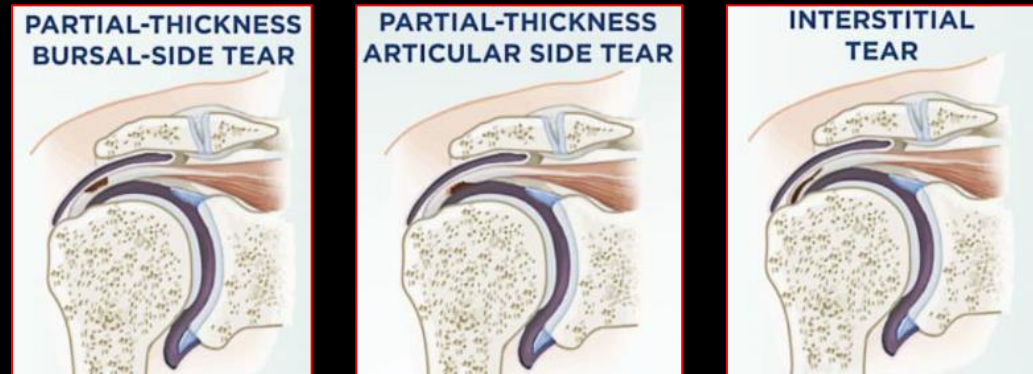
# The Literature



- Traditional practice has been to debride partial thickness tears < 50% of tendon thickness and repair high grade tears > 50%  
- data to support any particular management approach is variable and limited  
*Strauss et al. Arthroscopy 2011; 27: 568-580*
- Arthroscopic transtendon repair, takedown and repair, and transosseous repair have all been reported to be effective, with a rate of good to excellent outcomes scores ranging from 86% - 94% regardless of tear type  
*Vap et al. Arthroscopy 2018; 34: 75-81*
- For tears < 50% of the tendon thickness, successful results after debridement with or without concomitant SA decompression have also been reported

# However

- Previous lack of consensus in the literature likely the result of small patient numbers and the inclusion of all tear patterns in assessment
- Recent evidence suggests that outcomes influenced by tear type (bursal vs articular vs interstitial)



## Therefore

- Need to consider the different partial thickness RC tears as different pathologic entities requiring different treatment strategies and having potentially different outcomes

# Bursal Sided Tears

- Tears that involve the bursal side of the RC are often associated with changes in the CAL and undersurface of the acromion

*Kim et al. Am J Sports Med 2013; 41: 2041-2047*

- Positive correlation between grade of CAL degeneration and the presence of bursal sided tears suggests extrinsic impingement important in aetiology

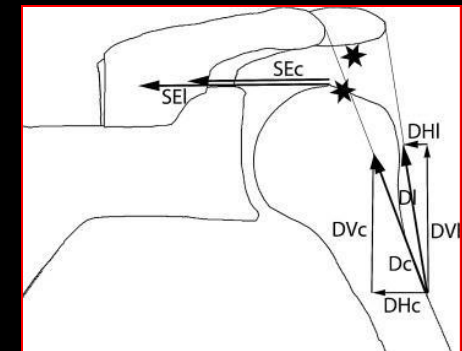
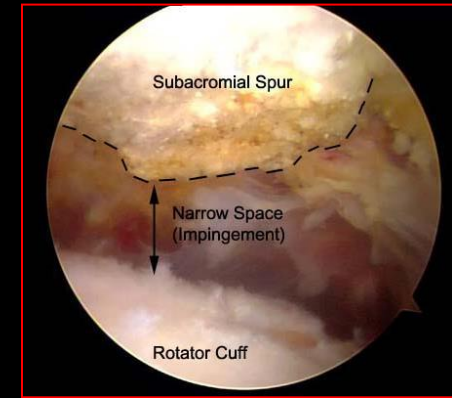
- CAL release and acromioplasty important part of treatment

- not the case for articular sided or interstitial RC tears

*Kanatli et al. J Shoulder Elbow Surg 2016; 25: 1824-1828*

- Newer parameters such as critical shoulder angle, acromial index, and greater tuberosity angle may also be more valid and real risk factors

*Cunningham et al. J Shoulder Elbow Surg 2018; 27: 1415-1421*



# Treatment

- Due to extrinsic impingement bursal sided tears are more likely than articular sided tears to undergo surgical treatment (non-operative treatment more likely to fail) and these tears are more likely to progress

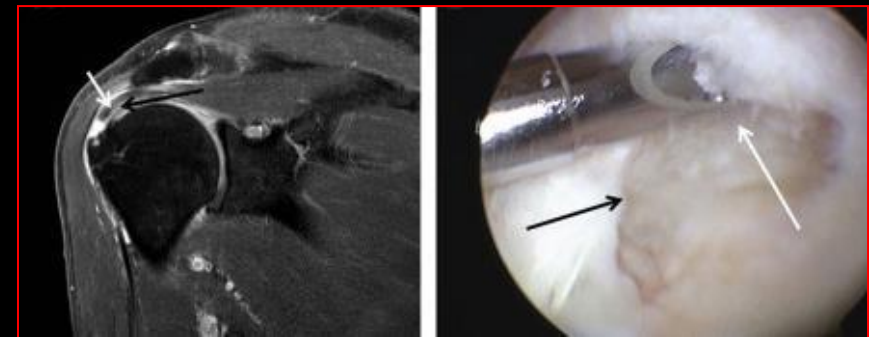
*Camurcu et al. J Shoulder Elbow Surg 2019; In Press*

- Inferior outcomes and higher failure rates after debridement and SAD alone

*Cordasco et al. Am J Sports Med 2002; 30: 257-260*

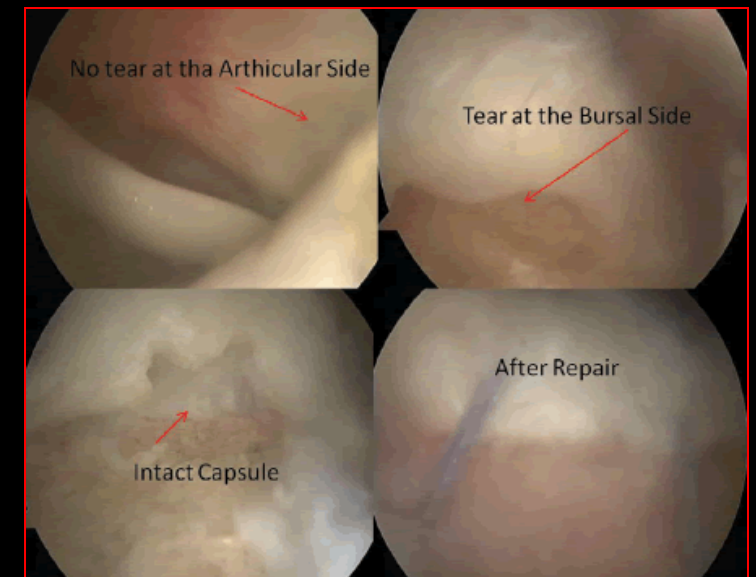
- Debridement and SAD alone may not provide satisfactory outcome even for Grade II tears, and most authors now recommend repair for all tears  $> 25\%$  of tendon thickness

*Katthagan et al. Knee Surg Sports Traum Arthro 2018; 26: 113-124*



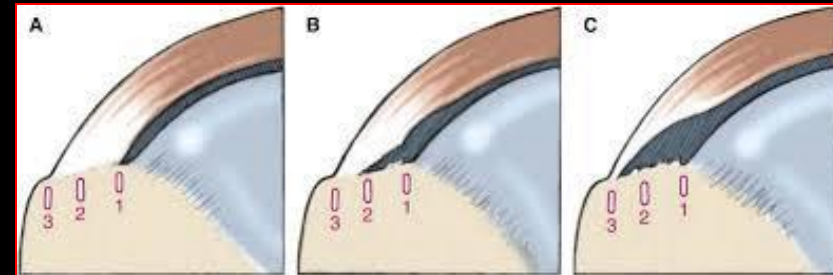
# Technique

- Arthroscopic SA decompression and in-situ repair preserving intact articular sided tendon fibres and superior capsule
  - bursal tissue less able to heal and requires articular tissue including superior capsule for support
- This approach will generally yield successful clinical and radiologic outcomes  
*Xiao et al. J Shoulder Elbow Surg 2015; 24: e41-e46*
  - prefer both medial and lateral anchors to try and restore anatomic footprint
- Some data to suggest that tear completion in bursal sided partial thickness RC tears may yield less successful outcomes with a higher re-tear rate  
*Kim et al. Arthroscopy 2015; 31:2191-2198*



# Articular Sided Tears

- Majority of symptomatic partial thickness RC tears are partial articular surface tendon avulsion (PASTA) lesions
- Traditional approach has been to recommend debridement for Ellman grade I and II tears and repair for Ellman grade III (> 50% tendon thickness) tears, without any difference in outcomes reported between repair techniques  
*Strauss et al. Arthroscopy 2011; 27: 568-580*

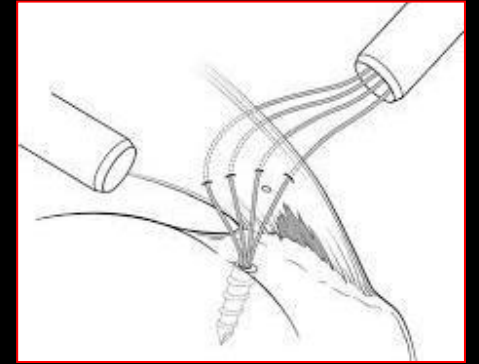


## However

- Most treatment algorithms fail to consider the variability in width of the supraspinatous footprint, or the multifactorial pathogenesis, pathomorphology, and patient specific factors involved in PASTA lesions



# Treatment



- Limited data to support any particular treatment approach

## However

- Long term results of tendon debridement even for Ellman grade II lesions have shown dissatisfying clinical and radiologic results  
*Kartus et al. Arthroscopy 2006; 22: 44-49*
- Significantly better outcomes following tendon repair regardless of tear grade  
*Plachel et al. J Shoulder Elbow Surg 2019; In Press*

## Therefore

- Currently little role for tear debridement alone, except in overhead throwing athlete (where it is a different entity)  
*Cordasco. Arthroscopy 2018; 34: 82-83*  
*Borbos et al. Int J Orthop 2019; 6: 1032-1038*

# Technique

- Both transtendon repair and takedown and repair have been shown to have comparable clinical outcomes, but are biomechanically different (initial repair strength better following transtendon repair)

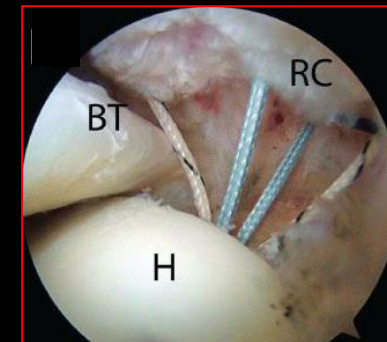
- PASTA bridge uses a lateral row to take stress off the construct and prevent it being pulled medially by using the medial anchors as pivot points

*Hirahara et al. Arthroscopy Tech 2017; 6: e1645-1652*



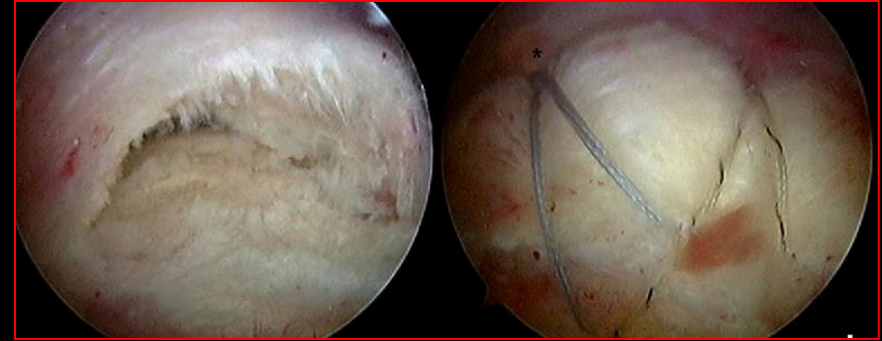
- Single row mattress in situ repair has also been reported to provide excellent functional outcomes at long-term follow-up

*Rossi et al. Arthroscopy 2019; 35: 698-702*



# However

- Histopathologic studies suggest that the residual tendon tissue in PASTA lesions is of poor quality
- Transtendon repair may therefore leave degenerative thin bursal sided fibres at the repair site, which may increase the risk of poor healing, re-rupture, postoperative stiffness, and pain
  - completion of tear and repair may therefore be more prudent
- Concern also that bursal layer of tendon may become overextended and unbalanced, especially if the articular layer is significantly retracted



Yamakado et al. Arthroscopy 2011; 27: e34-e35

Shin. Arthroscopy 2012; 28; 25-33

# In Addition

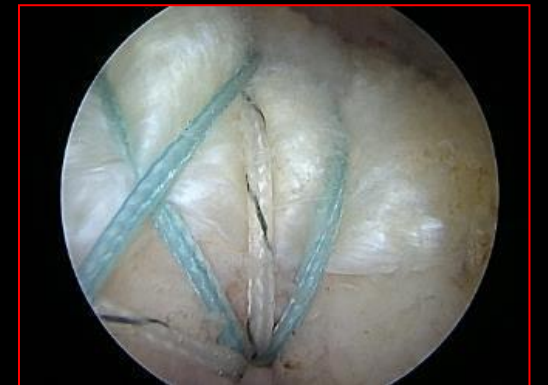
- Recent systematic reviews report that transtendinous repairs are associated with more pain and worse function during first 3 months, with the authors suggesting that tear completion and repair should be the preferred option as comparative studies have not demonstrated any long term advantage of transtendinous repair over tear completion and repair

*Sun et al. J Orthop Surg 2015; 10: 84*

*Jordan et al. Orthop & Trauma: Surg & Res 2018; 104: 829-837*

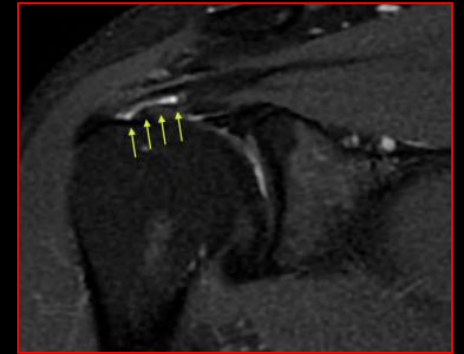
- Also appears to be no increase in re-tear rate following takedown and repair with re-tear rate comparing favourably with that after repair of full thickness RC tears

*Ono et al. Adv Orthop 2016; 7468054*

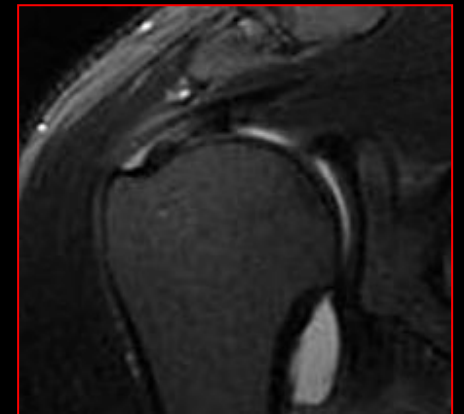


# Interstitial Tears

- More difficult to diagnose than articular or bursal sided tears
- Differing incidence between cadaveric and clinical studies suggests true incidence of interstitial tears may be much higher  
*Fukuda. J Shoulder Elbow Surg 2000; 9: 163-168*



- Difficult to diagnose due to concealed nature
  - sensitivity of USS and MRI 26.7% and 63.6% respectively  
*Uchiyama et al. J Shoulder Elbow Surg 2010; 19: 837-846*
- Sole characteristic finding on MRI is presence of high-intensity signal defect within the tendon on T-2 weighted images (should be correlated with arthroscopic findings)  
*Kim et al. J Shoulder Elbow Surg 2018; 27: 487-492*



# Interstitial Tears

- Pathogenesis likely due to shearing forces within a degenerate tendon
- Most patients will have fibrillation and dimpling of the tendon surface
- Probing to determine tendon thickness and the balloon test is helpful to detect the weak area of the tendon



- Clinical and radiologic outcomes of interstitial tears treated with arthroscopic repair after tear debridement is generally excellent

*Park et al. Am J Sports Med 2015; 43: 415-422*

*Kim et al. J Shoulder Elbow Surg 2018; 27: 487-492*

# Technique

- After confirmation of tear site a window is made through the bursal surface in line with the tendon fibres to confirm defect  
*Uchiyama et al. J Shoulder Elbow Surg 2010; 19: 837-846*
- Detachment of bursal surface then undertaken to allow debridement of defect
- Articular surface and superior capsule can be left intact, but if tissue of poor quality then better to complete tear and perform mattress double row RC repair incorporating both leaves of tear
- Extrinsic impingement not related to primary pathology of interstitial tears



# Future Options

- Use of USS guided PRP injections has been reported to show a positive effect on improving symptoms in patients with partial thickness RC tears  
*Zafarani et al. Arch Bone Joint Surg 2017; 5: 328–331*
  - addition of sodium hyaluronate may yield an even better clinical outcome  
*Cai et al. Med Sci Sports Exercise 2019; 51: 227-233*
- Intratendinous injection of autologous MSC's and/or tenocytes also shown to be feasible, safe, and effective with evidence of regeneration of tendon defect  
*Jo et al. Stem Cells 2018; 36: 1441-1450*
- Other authors have advocated bio-augmentation for these types of tears  
*Bokor et al. Muscles Ligaments Tendons J 2016; 6: 16-25*
  - potential for highly porous collagen implant to induce new tendon like tissue formation and an environment conducive to healing





# Summary

- Arthroscopy has improved the accuracy of diagnosis of partial thickness RC tears, but there remains a lack of understanding regarding aetiology and natural history
- Despite their high prevalence the treatment of partial thickness RC tears has also remained controversial
- Currently there remains no significant clinical evidence supporting more complex surgical techniques over take down and standard RC repair
- While the excitement for newer technologies is currently on the rise, there is little clinical evidence to support their use routinely

