How should we treat frozen shoulder? Ultrasound guided injection, landmark guided injection, hydrodilatation or surgery?

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Aims and objectives

To review the current literature on the management of frozen shoulder (adhesive capsulitis).

Images for this section:

Fig. 3: Ultrasound guided needle placement in the posterior glenohumeral joint.

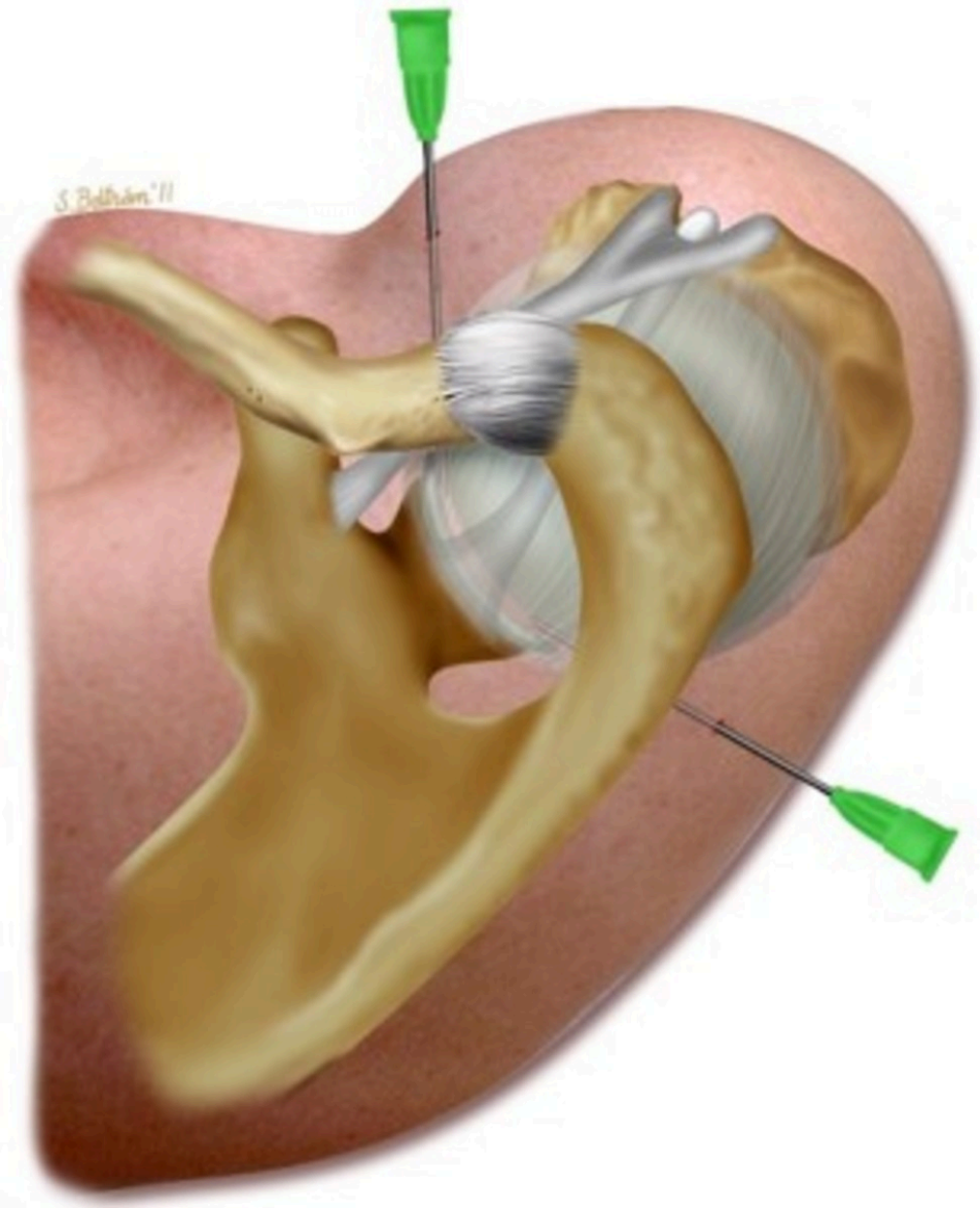

Fig. 4: Potential injection routes into the glenohumeral joint

Fig. 5: Posterior glenohumeral joint space injection

Methods and materials

Review of the literature

Pubmed Central, Scopus, Embase, Google Scholar and Cochrane

Key words

Frozen shoulder, Adhesive capsulitis, Injection, US guided injection, Corticosteroid, Hydrodilatation, Hydrodistension, Manipulation, Surgery and Treatment from 1958 to November 2017

These articles were assessed for

Type of procedure, technique of procedure, complications and the success rate for each procedure according to pain response and improvement in both movement and function.

A **traffic light system** was used to record the paper's quality see Fig 1

Key for abbreviations in tables:

SPADI Shoulder pain and disability index [31]

UCLA University of California at Los Angeles Shoulder score [32]

ASES American Shoulder and Elbow Surgeons Score [33]

SST Simple shoulder test - Zuckerman JD, Cuomo F (1993)

Constant Score [34]

Oxford Function Score [35]

EQ - 5D [36]

LMW Low molecular weight

GHJ Glenohumeral Joint

ROM Range of movement

PROM Passive range of movement

IA Intra-articular

SA Subacromial

SAB Subacromial bursa

Images for this section:

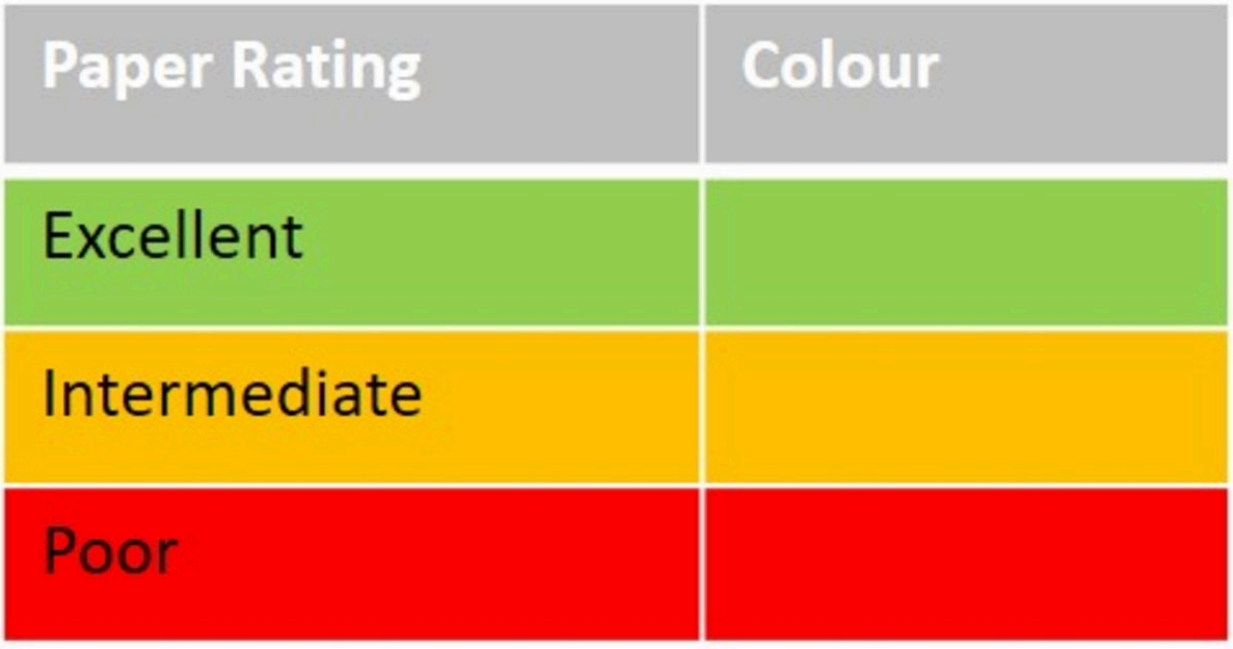

Fig. 1: Traffic light designation of papers

Results

The search revealed 340 relevant articles.

There were 12 meta-analysis and 17 comparative studies that fulfilled this papers remit

Placebo versus Intra-articular steroid injection

See figure 2 & 18

Blind versus guided glenohumeral joint injection

See figures 6 & 7

Most other papers report an accuracy of injection unguided of 42%. 10 of 24 GHJ injections. (Eustace 1997) [6].

Patel et al (2012) performed a cadaveric study showing that the accuracy rate in 2 surgeons who also performed US blind versus US guided injection, was between 65% vs 90% Surgeon A and 80% vs 95% Surgeon B.[7]

Tobola et al (2011) showed that blind shoulder injections by the anterior approach was superior to a posterior or supraclavicular approach (64.7% vs 45.7% vs 45.5%) in a study group of 109 patients as assessed by fluoroscopy following the procedure interpreted by a remote radiologist. In the anterior group it was 50% accuracy in the experienced group and 85.7% in the inexperienced group! [8]

Park et al (2012) showed that the patients who received US guided injections versus fluoroscopy guided injections of steroid and omnapaque showed no difference in pain or ROM at 6 weeks post injection. (injections given 2 weekly for 6 weeks however!) Patients preferred the US guided injection because of no radiation, lower cost and decreased procedure time.[9]

Hydrodilatation with/without steroid versus intra-articular steroid or placebo.

See figures 8 & 9

Site of steroid injection (Subacromial bursa, Glenohumeral joint)

See figures 10 & 11

Hydrodilatation Capsule preservation versus Capsule rupture

See figures 12 &13

Surgical Manipulation versus steroid injections

See figures 14 & 15

Meta-analyses

See figures 16 & 17

Images for this section:

Fig. 1: Traffic light designation of papers

Name Year	Study numbers	Type	Intervention	Control	Co intervention
Bal et al [1] 2008	40 in each group	Double blind randomised	IA 1 ml/40 mg methylprednisolone	IA 1 ml N/saline	12 week home exercise programme
Prestgaard et al [2] 2015	42 IA 40 IA and anterior interval (RI) combined 40 sham	Double blind randomised	IA RI 3.5 ml lidocaine 1% IA 1 ml/20 mg triamcinolone hexacetonide, 2.5 mls lidocaine 1%. IA and rotator interval(RI) 0.5 ml/20 mg triamcinolone hexacetonide, 3 mls lidocaine 1% in each site.	Sham 3.5 ml lidocaine 1% in both the RI and IA	None
Sharma et al [3] 2016	35 IA 34 IA with distension 36 TAU	Double blind Randomised	IA 20 mg triamcinolone, 3 mls lidocaine IA with distension 20 mg triamcinolone, 3 mls lidocaine N/saline 8 to 20 mls	Treatment as usual (TAU) i.e. NSAIDs, paracetomol, codeine, No oral steroids	None

Fig. 2: Placebo versus Intra-articular steroid injection 1

Name Year	Injection technique	Outcome measures	Follow up	Result	Study comments/problems
Bal et al 2008	Blind posterior approach Single injection	SPADI UCLA end-result score ROM (goniometer measure) Night pain (VAS 100)	2, 12 weeks	All measures improved in intervention group at 2 weeks. No difference at 12 weeks	
Prestgaard et al 2015	Posterior Ultrasound guided Single injection Syringe covered	Shoulder pain at 6 wks SPADI ROM Night pain EQ-5D Use of painkillers	3, 6, 12, 26 weeks	Intervention groups significantly improved at 6 and 12 weeks. No difference at 26 wks between groups	
Sharma et al 2016	Blind posterior approach Injection at 1, 7, 17 and 31 days (4 injections)	SPADI VAS PROM	4, 8 weeks SPADI 1 yr	Intervention groups improved in all scores at 4 and 8 wks. At 1 yr SPADI no difference	Control group did not receive injection

Fig. 18: Placebo versus Intra-articular steroid injection 2

Name Year	Study numbers	Type	Intervention	Control	Co Intervention
Lee et al [4] 2009	22 blind 20 US guided	Randomised	20mg triamcinolone 1.5 mls 2% lidocaine and 4 mls of N/saline originally followed by a weekly injection of LMW sodium hyaluronate 2.5mL for 5 more weeks.		Home exercises
Raeissadat et al [5] 2017	21 blind 20 US guided	Single blinded Randomised	1ml 1% lidocaine 3 mls iodinated contrast 1 ml distilled water 20mg triamcinolone was used.	Radiograph post injection	Naproxen 500mg for 5 days. Codman's exercises

Fig. 6: Blind versus guided glenohumeral joint injection 1

Name Year	Injection technique	Outcome measures	Follow up	Result	Study comments/problems
Lee et al 2009	Posterior. Blind group had US probe touching skin also. 6 injections	VAS daytime and sleeping ROM	Every wk for 6 wks	Improvement in the US group for 2 weeks. After this no difference	2 separate doctors. 1 injecting blind (with no experience of ultrasound guidance). 1 injecting US guided
Raeissadat et al 2017	Posterior 1 injection	VAS ROM Oxford function score	1, 4 wks	Accuracy 76% vs 90% (blind/US) Improvement in all parameters at 4 weeks but not significant except for extension in the US group	Same doctor did blind and US guided injections. Ultrasound not used in blind group.

Fig. 7: Blind versus guided glenohumeral joint injection 2

Name Year	Injection technique	Outcome measures	Follow up	Result	Study comments/problems
Buchbinder et al 2004	Anterior Fluoroscopy 1 injection	SPADI VAS ROM	3, 6, 12 weeks	significant improvement in pain, range of motion and function in the distension group at 3 weeks, maintained to 6 weeks compared to placebo.	Steroid and distension used ? which important
Gam et al 1998	Posterior. Confirmed by US 1 weekly injections for 6 weeks until pain stopped Up to 6 injections	VAS ROM Analgesic use	Weekly for 12 weeks	significant difference in ROM, except abduction in the distension group at 12 weeks. analgesic use was significantly less in the distension group	Multiple injections
Tveita et al 2008	Anterior Fluoroscopy 3 injections at 2 wkly intervals	SPADI VAS ROM	6 weeks post last injection	no difference in pain and disability scores between the groups.	Both distension groups really.

Fig. 9: Hydrodilatation with/without steroid versus intra-articular steroid or placebo 2

Name Year	Study numbers	Type	Intervention	Control	Co Intervention
Buchbinder et al [10] 2004	25 intervention 21 placebo	Double blind randomised Placebo controlled	7 ml of iodinated contrast agent 1ml/40 mg methylprednisolone up to 82 ml saline	7 ml of contrast agent	Home exercises
Gam et al [11] 1998	8 IA steroid 12 distension and IA steroid	Randomised	20mg triamcinolone or 19mls lidocaine 1% 20mg triamcinolone	None	Allowed analgesia
Tveita et al [12] 2008	33 IA steroid 36 distension and IA steroid	Randomised	4 mls of iodinated contrast 2 mls/20mg triamcinolone 4 mls 0.5% bupivacaine (total injection 10 ml) or 4 mls of iodinated contrast 2 mls/20 mg triamcinolone 4 mls 0.5% bupivacaine 10 mls N/saline (20 ml). Additional Contrast/bupivacaine to rupture capsule		Analgesia/ physiotherapy allowed but not prescribed.

Fig. 8: Hydrodilatation with/without steroid versus intra-articular steroid or placebo 1

Name Year	Study numbers	Type	Intervention	Control	Co Intervention
Rizk et al 1991	12 IA steroid and lidocaine 12 SAB steroid and lidocaine 12 IA lidocaine 12 SAB lidocaine	Randomised	Iml/40mg methylprednisolone 2 ml 1% lidocaine in steroid groups. ? lidocaine group	? lidocaine groups	Home exercise program and physiotherapy weekly for 11 weeks NSAIDs
Oh et al [13] 2011	37 GHJ 34 Subacromial space	Randomized	1ml/40 mg triamcinolone 4 ml lidocaine 2% 4 ml N/saline in either site	None	NSAIDs Stretching exercises
Shin et al [14] 2013	36 Subacromial 36 GHJ 36 GHJ and SA 36 Medication	Randomised	1ml/40 mg triamcinolone 4 ml lidocaine 2% Divided in 2 for both site injections Aceclofenac 100mg bd	Medication group	Home exercise program
Cho et al [15] 2016	34 Subacromial 34 GHJ 34 GHJ and SA	Randomised	1ml/40 mg triamcinolone 4 ml lidocaine 2%. Divided in 2 for both site injections	None	Home exercise program
Yoon et al [16] 2016	29 Subacromial 29 GHJ 28 GHJ distension	Randomised	1ml/40 mg triamcinolone 4 ml lidocaine 2% 5 ml N/saline for IA or SAB. Or 4 ml contrast 1ml/40 mg triamcinolone 4 ml lidocaine 2% 40 ml N/saline for distension	None	NSAIDs Stretching exercises

Fig. 10: Site of steroid injection (Subacromial bursa, Glenohumeral joint) 1

Name Year	Injection technique	Outcome measures	Follow up	Result	Study comments/problems
Rizk et al 1991	Blind GHJ Anterior approach SAB Lateral 1 injection weekly for 3 weeks	VAS ROM	Weekly for 11 weeks 15 weeks 6 months	Pain relief better in both steroid groups but at 11 weeks all made modest progressive improvement	No assessment of injection accuracy
Oh 2011	US guided. Posterior GHJ Lateral SAB	VAS ROM Constant score	3, 6, 12 weeks	Pain improved in both groups but significantly more in GHJ injection at 3 weeks. No statistical difference at 6 and 12 weeks Constant and ROM improved but no difference between groups	
Shin 2013	US guided Posterior	ASES function test VAS ROM	2, 4, 8, 16, 24 wks	Pain relief in injection groups significantly better at 16 wks. No significant difference at 24 wks Patient satisfaction, functional scores and ROM better in all steroid groups but not significantly	
Cho 2016	Blind Posterior	ASES function test VAS ROM SSV	3, 6, 12 wks	Significant improvement in all outcomes in IA and IA plus SA injections at 6 and 12 wks	No assessment of injection accuracy
Yoon 2016	Ultrasound directed Anterior Fluoroscopy for distension	VAS ROM Constant score SST	1, 3, 6 months	All scores better at 1 month in distension group. More rapid response with HD. No difference at 6 months.	Not truly guided injection Patient not blinded

Fig. 11: Site of steroid injection (Subacromial bursa, Glenohumeral joint) 2

Name Year	Study numbers	Type	Intervention	Control	Co Intervention
Kim et al [17] 2011	26 capsule ruptured 20 capsule preserved	Randomised Single Blinded (patients)	10 ml lidocaine 1% 1ml/40 mg triamcinolone 39 ml N/saline by pump injector	None	None
Lee et al [18] 2017	32 ia steroid 32 ia steroid and distension	Randomised	1 ml/40mg triamcinolone 3 mls of 1% lidocaine Or 1 ml/40mg triamcinolone 6 mls of 1% lidocaine Normal saline (Total 25+/-6 ml)	None	None

Fig. 12: Hydrodilatation Capsule preservation versus Capsule rupture 1

Name Year	Injection technique	Outcome measures	Follow up	Result	Study comments/problems
Kim et al 2011	Posterior US guided Pump injector with pressure sensor	VAS ROM	3 days, I month	Range of motion and decreased pain was enhanced in the capsule preserved group. (not significant)	
Lee at al 2017	Posterior US guided Capsule preservation on feel and US observation		3. 6. 12 weeks	Outcomes improved significantly but no difference between groups	

Fig. 13: Hydrodilatation Capsule preservation versus Capsule rupture 2

Name Year	Study numbers	Type	Intervention	Control	Co Intervention
De Carli et al [19] 2012	23 Surgery 21 GHJ steroid	Randomised	Manipulation and arthroscopic arthrolysis with subacromial bursectomy or IA 4 ml lidocaine 2% 1 ml/40 mg methylpredisolone	None	IA steroid - Intensive Physiotherapy Operative – sling for 2 weeks Active strengthening after 5 weeks
Mukherjee et al [20] 2017	26 Surgery 26 GHJ steroid	Randomised	Arthroscopic capsular release Or IA 3 ml lidocaine 2% 1 ml/40 mg methylprednisolone	None	Active and passive range of motion NSAID and tramadol

Fig. 14: Surgical Manipulation versus Steroid Injections 1

Name Year	Injection technique	Outcome measures	Follow up	Result	Study comments/problems
De Carli et al 2012	Posterior US Directed 3 injections at weekly intervals	Constant and Murley ASES UCLA SST ROM	Post treatment, 3, 6, 12 weeks 6 and 12 months	Both groups improved by 12 months. Surgical group worse at 3 weeks. The surgical group was better at 6 weeks. The GHJ injection group was better by 12 weeks	The 2 groups were not comparable in their pre treatment assessments or in the treatment regime especially following the intervention. The surgery included bursectomy. Pain not assessed.
Mukherjee et al 2017	Posterior. Blind Single injection	VAS (0-10) ROM Constant	4, 8, 12, 16 and 20 wks	Both groups improved in all outcomes. Surgical group significantly better in VAS from 8 wks and ROM improved.	No intensive physiotherapy offered post GHJ injection. Partial tendon tears (4) and SLAP lesion (1) also treated in surgical group! No pain scores recorded before 4 weeks.

Fig. 15: Surgical Manipulation versus Steroid Injections 2

Fig. 16: Meta-analyses

Article	Meta-analysis				
Roh 2012	Koh 2016				
Yoon 2013	Koh 2016				Wu 2017
Bal 2007	Koh 2016	Song 2014			
Ryans 2005	Koh 2016	Song 2014			
Carette 2003	Koh 2016	Song 2014	Greisser 2011		
Van der Windt 1998	Koh 2016			Shah 2007	
Dehghan 2013	Koh 2016				
Buchbinder 2004					Wu 2017
De Jong 1998	Koh 2016	Song 2014		Shah 2007	
Shin 2013	Koh 2016				
Oh 2011	Koh 2016	Song 2014			
Arslan 2001		Song 2014			
Bulgen 1984		Song 2014	Greisser 2011	Shah 2007	
De Carli 2011		Song 2014			
Jacobs 2009		Song 2014	Greisser 2011	Shah 2007	Wu 2017
Kivimaki 2001		Song 2014			
Gam 1998		Song 2014		Shah 2007	Wu 2017
Tveita 2008		Song 2014			Wu 2017
Lorbach 2010		Song 2014	Greisser 2011		
Rizk 1991		Song 2014	Greisser 2011	Shah 2007	
White 1996		Song 2014			
Lee 2009		Song 2014			
Quraishi 2007			Greisser 2011		Wu 2017
Dacre 1989			Greisser 2011		
Sharma 1993			Greisser 2011		
Winters 1997				Shah 2007	
Williams 1975				Shah 2007	
Richardson 1975				Shah 2007	
Park KD 2013					Wu 2017
Park SW 2014					Wu 2017
Mun SW 2016					Wu 2017
Lee DH 2016					Wu 2017
Sharma 2016					Wu 2017

Fig. 17: Meta-analysis articles used for most relevant papers

Conclusion

Placebo versus Intra-articular steroid injection

There is evidence for the use of intraarticular steroid giving benefit in the short term versus placebo.

Blind versus guided glenohumeral joint injection.

A guided injection is more accurate. Patients prefer ultrasound to fluoroscopy and there is the added benefit of no radiation, no claustrophobia, lower cost and decreased procedure time. Ultrasound guided injections confer added benefit especially in the first 2 weeks.

Hydrodilatation with/without steroid versus intra-articular steroid or placebo.

Distension with or without steroid has an additional benefit to steroid alone.

Hydrodilatation Capsule preservation versus Capsule rupture

It is not necessary to rupture the capsule during hydrodistension/hydrodilatation.

Site of steroid injection (Subacromial bursa, Glenohumeral joint)#

Treatment with intra-articular or subacromial subdeltoid steroid is of benefit in patients with capsulitis, but is superior in the intra-articular group in the short term.

Surgical Manipulation versus steroid injections

Both papers comparing surgical manipulation and IA steroid injections are flawed.

There is a place for surgical intervention but in view of the possible complications and need for general anaesthesia to perform this procedure this should be reserved for patients who not respond to IA steroid and hydrodilatation.

Overall Conclusions

- Corticosteroid injections in the short term are better than placebo and physiotherapy. Intra-articular injections are more beneficial than subdeltoid subacromial injections.

- A guided injection is more accurate and confer more benefit than blind injections in the first 2 weeks. They are preferred to fluoroscopic guided injections by patients.
- Distension with or without steroid has an additional benefit to steroid alone.
- There is a place for surgical intervention but in view of the possible complications and need for general anaesthesia to perform this procedure this should be reserved for patients who not respond to IA steroid and hydrodilatation.
- It should also be remembered that capsulitis can co-exist with Subacromial subdeltoid bursitis so this may also account for some of the response.

Personal information

Gina Allen is a specialist musculoskeletal radiologist and a practising sports physician.

A teacher at Green Templeton College University of Oxford she sees patients at St Lukes Radiology Oxford.

www.stlukesradiology.org.uk

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