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Research Article

X-RAY AND USG CORRELATION OF CASES OF FROZEN SHOULDER

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ABSTRACT

This prospective study was carried out in department of Radiodiagnosis, VIMS, RKM Seva Pratisthan, Kolkata from a period of March 2010 to June 2011. To evaluate the role of high resolution USG in adhesive capsulitis (AC). Total of 50 patients (29 male and 21 female) with clinical diagnosis of AC were evaluated by USG using 7.5 to 12 MHz linear array transducer with color power doppler facility and 3.5 to 5 MHz convex transducer for anterior labrum and glenoid rim and employing proper patient positioning optimum techniques and using standardized diagnostics criteria. In all cases proper history taking, clinical examination and supportive investigation were performed. Conventional radiograph were taken in all cases. Follow up study was divided according to clinical problems and its magnitude, consent of the patient and clinical course and treatment plan. Few cases were planned for other imaging modalities like CT scan and MR Imaging. Cases were planned for conservative management and evaluation of the course of the disease clinically and sonographically to establish a final diagnosis. Dynamic sonography was highly sensitive 100% and specific 100% for AC but most importantly USG excluded other pathologies like occult fracture of humeral head, supraspinatus tendon tear, long head of biceps tear, impingement syndrome which simulated AC. Color doppler revealed hypervascularity around the affected shoulder joint in infective and inflammatory conditions.

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INTRODUCTION

The shoulder is an important joint in the body distinguished by extreme range of motion thereby allowing humans to position their hands almost wherever desired. Hence pain or restricted movement of shoulder joint rank among the most common musculoskeletal problems that becomes a misery to our daily life. One of the most common causes of shoulder pain encountered in practice is “frozen shoulder”. The term “frozen shoulder” should be reserved for a well defined disorder characterized by progressive pain and stiffness of the shoulder which usually partially resolves spontaneously by about 18 months. The condition is particularly associated with diabetes, Dupuytren's disease, hyperlipidaemia, hyperthyroidism, cardiac disease, and hemiplegia. It occasionally appears after recovery from neurosurgery. The patient aged 40 to 60 years may give a history of trivial trauma followed by aching in the arm or shoulder. Apart from slight wasting shoulder looks quite normal, tenderness is seldom marked. The cardinal feature is a stubborn lack of active and passive movement in all directions. X-ray are the first mandatory step in investigation of a patient but it does not allow visualization of tendons, bursal components or soft tissue structures and thus remain normal

most of the time unless they show reduced bone density from disuse. Today USG is a primary diagnostic modality for investigating the rotator cuff diseases. It has the added advantage of offering a dynamic examination enabling an assessment of both range of motion and muscular coordination about the joint. Introduction of high linear array probes, tissue harmonic imaging, 2D matrix probe technology, extended field of view images, color Doppler sonography have extended the preview of Musculoskeletal USG. With these views in mind this study was undertaken to evaluate the usefulness of USG over X-Ray in detecting the lesions in frozen shoulder and enabling the clinician to arrive at a correct diagnosis with rapidity.

Aims and Objectives

- Evaluation of the patient clinically suspected to have frozen shoulder by X-ray, High resolution ultra sonography and color Doppler.
- Correlation of the X-ray and USG findings in the cases of frozen shoulder.
- Comparative evaluation of these two modalities in revealing the findings in frozen shoulder.

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MATERIAL AND METHOD

Thus prospective study of shoulder joint imaging was done in the department of Radio diagnosis and imaging, Ramakrishna Mission Seva Pratishthan, Vivekananda institute of Medical Science, Kolkata, from a period of March 2010 to June 2011. A number of patients 50 (29 male and 21 female) with symptoms related to shoulder joint pathology, were taken for this study. Age of the patients ranged from 20 years to 80 years. With clinical suspicion of various shoulder pathologies, these patients were referred to our department for radiographic and ultrasonographic examinations. Follow up study was done for confirmation of the pathology. The X-Ray and USG of those persons who are suffering from frozen shoulder were compared to see which modality revealed most findings.

Methods: Following methods were adopted for the study.

History

1. Name, age, sex were recorded.
2. CHIEF COMPLAINTS: (following points were asked for)

Pain

- Which shoulder?
- Onset – acute or gradual
- Duration
- Pain in any particular position
- Night pain or pain on rest

Limitation of movement or stiffness

- Which shoulder?
- Complete or partial
- Which movement / movements?
- Initial of abduction

History of instability

- Unilateral or bilateral
- Recurrent or not
- Any intervention or not

Any history of trauma or injury

1. Any history of surgery or injection.
2. Any significant medical history, like DM, HTN.
3. Past history of illness.
4. Occupational history
5. Previous investigation if any.

General Survey: Anemia, Neck gland, neck vein, Pulse, B.P. etc.

Clinical Examination

Observation

- Asymmetry of shoulder position,
- Abnormality in contour of shoulder girdle,
- Any muscle atrophy (particularly supraspinatus, infraspinatus and deltoid).

Palpation

Any tenderness over – anterior acromion, anterior and posterior glenoid margin.

Specific Test

- According to the clinical presentation – supraspinatus isolation test to evaluate the supraspinatus.
- Elicitation of Neer impingement sign (in case of suspected impingement syndrome)

X-Ray of Shoulder Joint

1. Antero-posterior view with 30 degrees caudal angulations,
2. Axillary view.

To look for

1. Joint alignment,
2. Joint space,
3. Bony changes,
4. Periarticular calcification.

Sonographic Examinations

Preparation: No special preparation was needed

Equipment: Ultrasound was done in all patients with high frequency (7.5 to 12 MHz) linear array transducer. Convex transducer (3.5 MHz) was used for evaluation of anterior labrum and anterior glenoid rim. LOGIQ 7, LOGIQ 5, ANTERAS, G-60 machines having color and power Doppler were used for sonography.

Patient Positioning: The patient was scanned while seated on a revolving stool that permits easy positioning during the scanning of the both shoulders.

Examination Techniques: Both shoulders were examined, starting with the asymptomatic or less symptomatic side. This allows comparison views. Normal and abnormal anatomy were always visualized in two orthogonal planes.



Image 1 AP View (Normal Shoulder)



Image 2 Trans Scapular Y- View (Normal Shoulder)



Image 3 X-Ray Normal transthoracic Lateral View



Image 4 X Ray Lateral View of Shoulder Normal



Image 5 X-Ray Showing Gross Osteoarthritis Left Shoulder and Soft Tissue Calcification

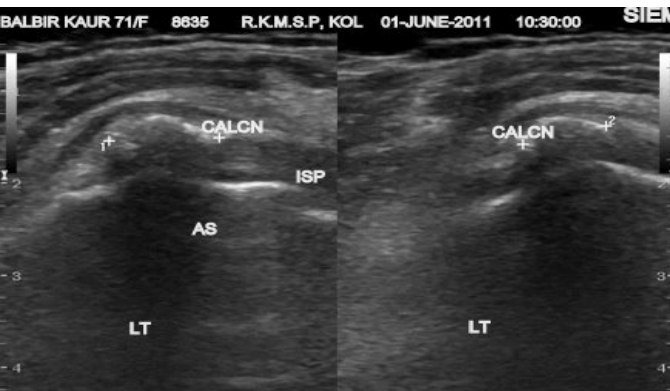


Image 6 USG Confirming Soft Tissue Calcification of The Infraspinatus Muscle

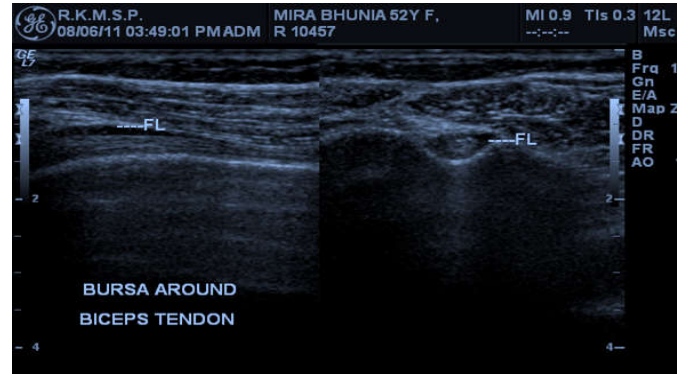


Image 7 Fluid Around Biceps Tendon In Biceps Groove And Also In Distention Of Biceps Tendon Sheath

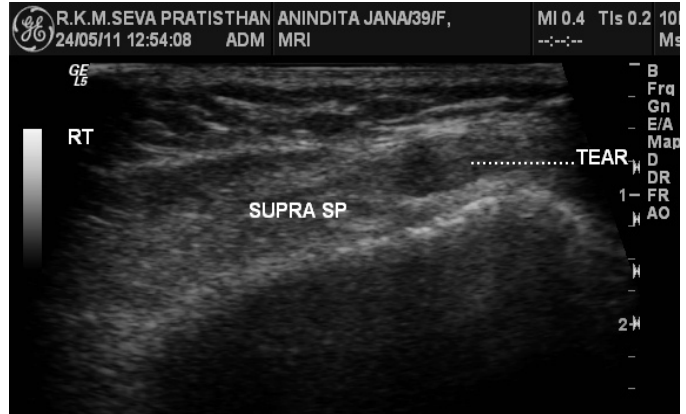


Image 8 USG Showing Partial Thickness Supraspinatus Tear



Image 9 MRI of the Same Patient Confirming The Partial Thickness Supraspinatus Tear

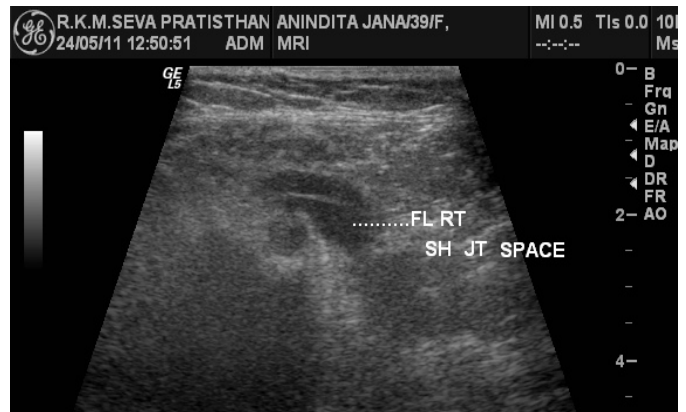


Image 10 Shoulder Joint Effusion

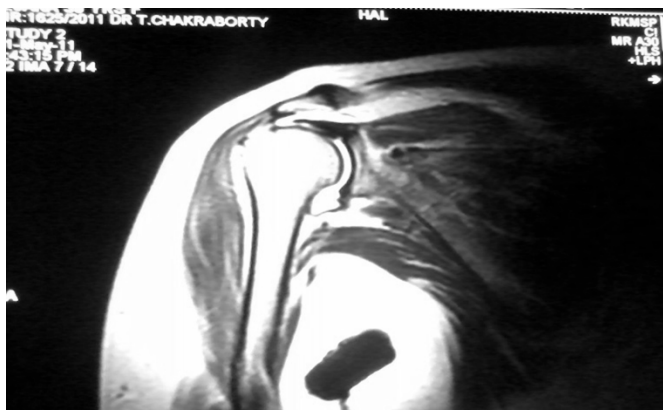


Image 11 MRI of The Same Pateint Confirming The Shoulder Joint Effusion

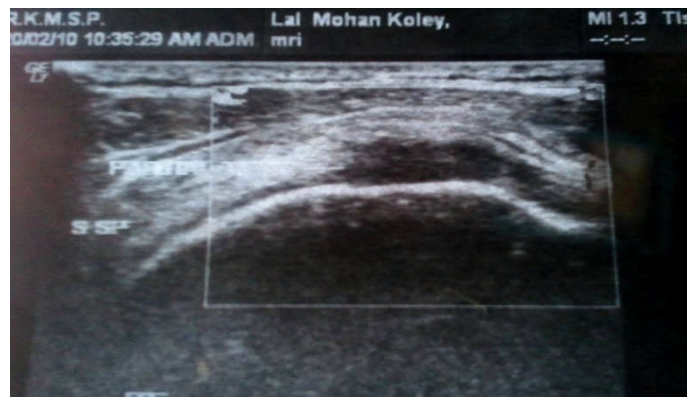


Image 15 Partial Thickness Tear of Supraspinatus Tendon (Right Side)

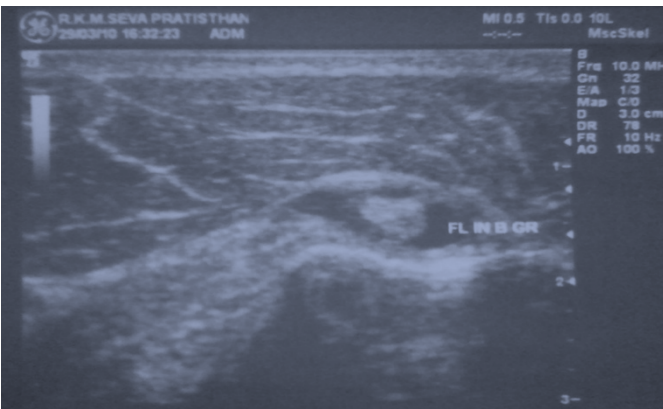


Image 12 Fluid In The Bicipital Groove



Image 16 Fluid in the Bicipital Tendon Sheath Seen In The Long Aixs View

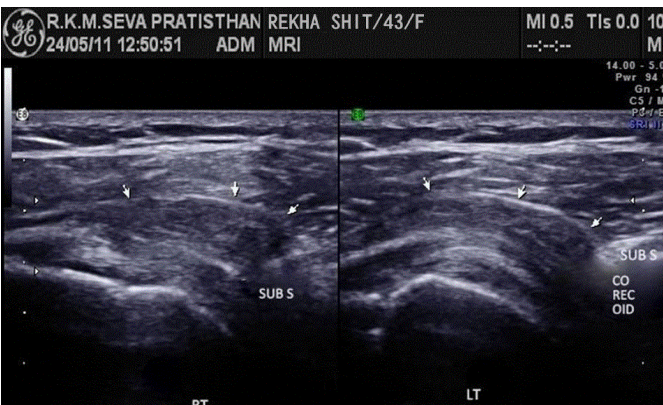


Image 13 USG Showing Thickened and Hetrogenous Appearance of Rt Subscapularis Tendon Compared With Lt Side Suggestive of Tendinitis



Image 17 Impingement of the Supprasinatus Tendon Under The Coracoacromial Arch Rt Side



Image 14 Full Thickness Supraspinatus Tear Rt Side

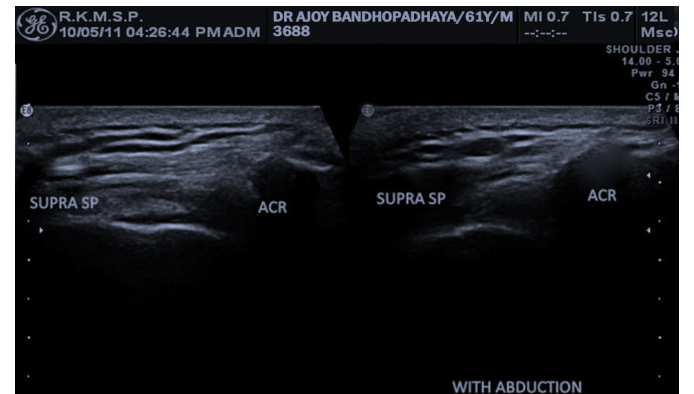


Image 18 Dynamic Study of Rt Shoulder Joint In Abduction In A Case of Adhesive Capsulitis



Image 19 Fluid in Bicipital Groove Suggestive of Ac

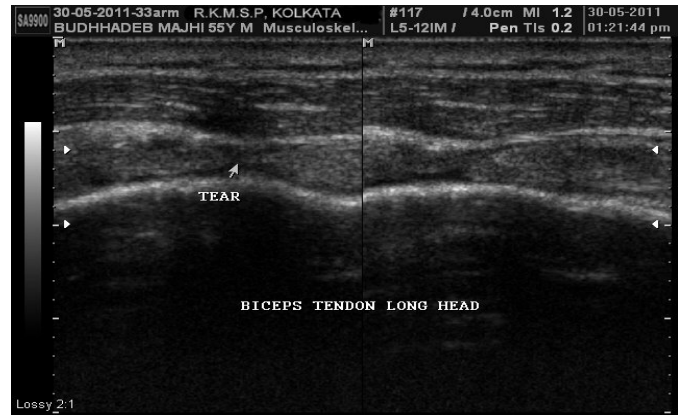


Image 23 USG Picture Showing Tear of Long Head of Biceps of Right Shoulder



Image 20 Huge Inflammatory Collection in The Subdeltoid Region (Lt Side) Communicating With Left Shoulder Joint



Image 24 USG Picture Showing Dislocated Biceps Tendon from Biceps Groove



Image 21 USG Showing Fluid In Supraspinatus And Subscapularis Tendon In A Patient Suspected To Have Frozen Shoulder Diagnosis of Rotator Cuff Tendinopathy Was Made (Rt Side)



Image 25 Fluid in Infraspinatus Tendon Right Side

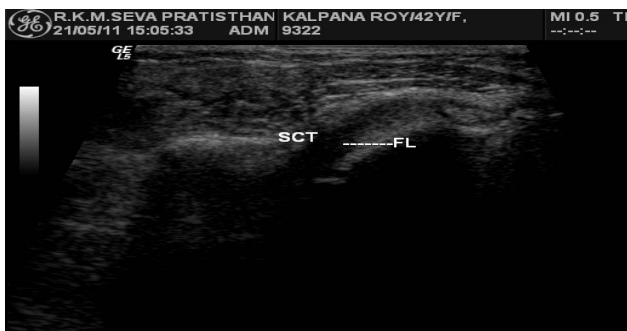


Image 22



Image 26 Posterior Glenoid Labral Tear In Same Patient As Above



Image 27 Free Fluid in Sub Acromial Sub Deltoid Bursa Rt Side



Image 28 Bony Irregularity of The Humeral Head Which Was Occult on Radiograph

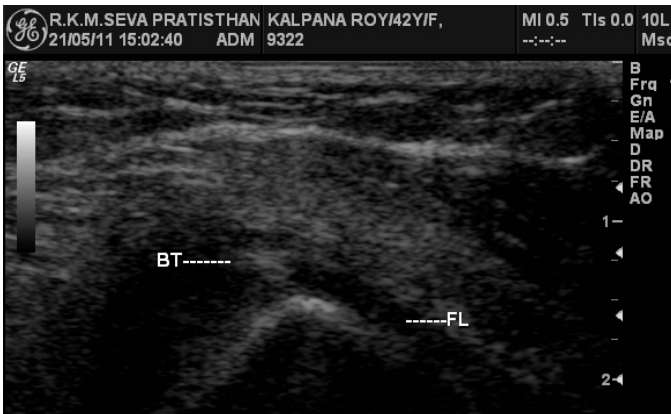


Image 29 Loss of Fibrillary Pattern of Biceps With Fluid Accumulation In The Biceps Tendon Sheath-Bicipital Tendonitis

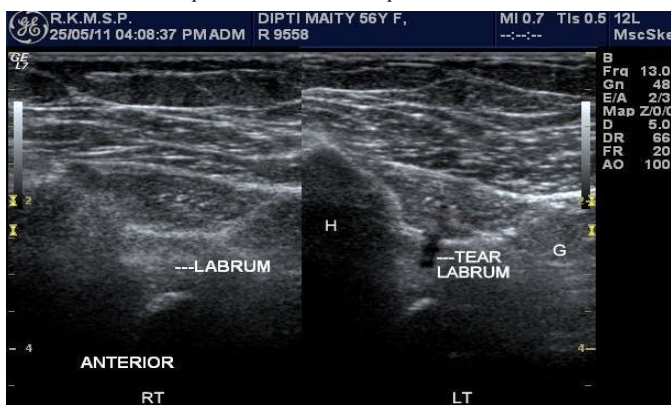


Image 30 USG Showing Tear Anterior Glenoid Labrum Lt Side and Compared With The Normal Glenoid Labrum on The Right Side



Image 31 MRI Showing Focal Area of Hyper Intensity In Stir Sequence With Sclerotic Margin In Greater Tuberosity of Right Humrus-Degenerative / Post Traumatic



Image 32 Cervical Spondylosis in a Patient Who Presented with Shoulder pain



Image 33 Fracture and Irregularity of Humeral Head Which Was Occult in the Conventional Radiograph



Image 34 Ct Scan of The Same Patient Confirming The Fracture

RESULTS AND ANALYSIS

Clinical status

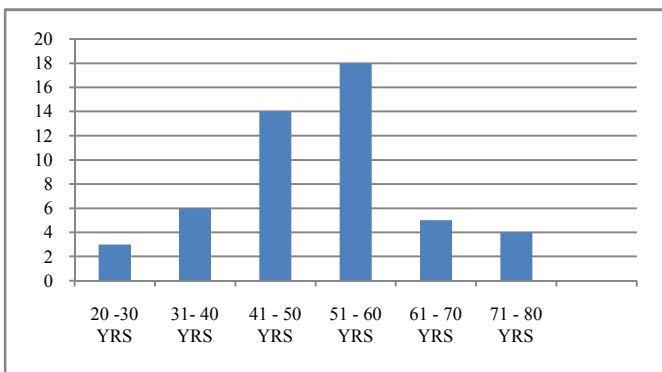
Age

Table 1 Age Incidence of Patients Having Shoulder Joint Related Complaints

Sl.No	Age Range (Year)	No. of cases	Percentage
1	20-30	3	6.0%
2	31-40	6	12.0%
3	41-50	14	24.0%
4	51-60	18	36.0%
5	61-70	5	10.0%
6	71-80	4	8.0%

Table 1

Most patients who present with shoulder joint related complaints were between 50 -70 years. However those with associated previous history of trauma presented at younger age



Bar Diagram 1 The Age Incidence of The Patients

Lesions	20-30 yrs	31-40 YRS	41-50 yrs	51-60 yrs	61-70 yrs	71-80 yrs	Total	%
Cirvical Spondylosis	---	---	---	---	1	---	1	2.0%
Adhesive Capsulitis	---	5	10	14	3	5	37	74.0%
Tears of Rotator Cuff Impingement Syndrome	---	1	1	2	---	---	4	8.0%
Inflammatory Collection and Abscesses	---	---	1	---	---	---	1	2.0%
Osteoarthritis and Degenerative Conditions	---	---	---	---	---	1	1	4.0%
Laberal tears and Others	---	---	---	1	1	---	2	4.0%
Rotator cuff Tendinopathy	---	---	1	---	---	---	1	2.0%
Trauma	1	---	---	---	1	---	2	4.0%
Total	---	2	11	21	16	---	51	100.0%

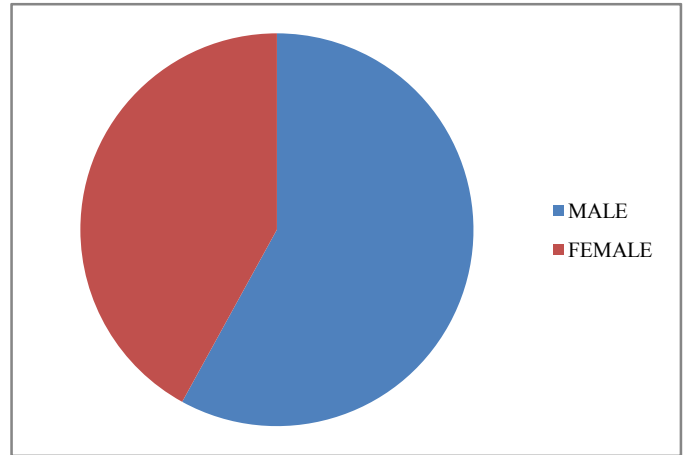
Table: 2

*The total is coming 51 as the person with Osteoarthritis also had AC.

Sex Distribution of Patient with Shoulder Pain

Total Number of Pateints	Male	Female
50	29	21

Table 3

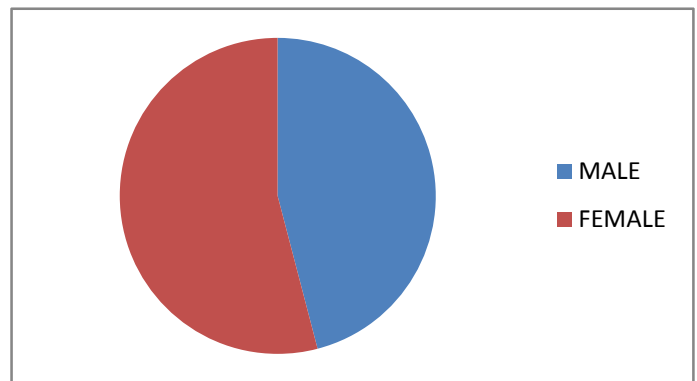


Pie Chart 1 Showing Sex Distribution of Shoulder Joint Related Complaints

Sex Distribution of Patients with AC

Total Number of Patients	Male	Female
37	17	20

Table 4



Pie Chart 2 Showing Sex Distribution of Patients with AC

Though the preponderance of shoulder pain is high in male, AC is slightly more common in female

Associated Histories of Patients with Frozen Shoulder (of 37 Patients)

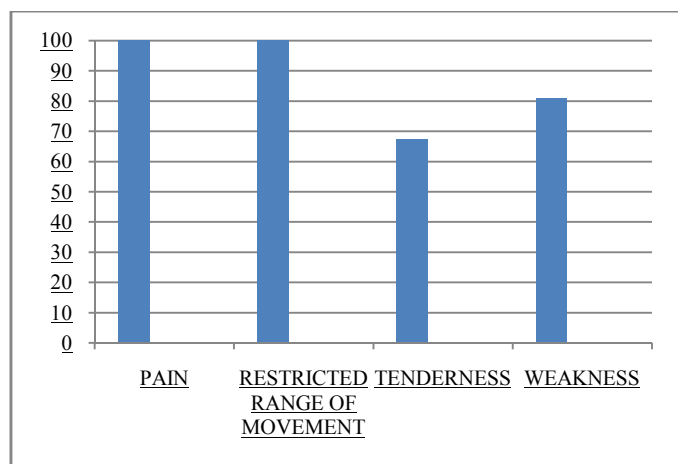
History	No of Patients
Diabetes	4
Previous Surgery	2
Neuropathies	1
Previous trauma	6

Table 5

Frequancy of Symptoms in Frozen Shoulder

Sl.no	Symptoms / Sign	No. of cases	Percentage
1	Pain	37	100.0%
2	limitation of Movement of Shoulder Especially Abduction & External Rotation	37	100.0%
3	Localise Tenderness	25	67.5%
4	Weakness	30	81.0%

Table 6



Bar Diagram: 2 Trends of Various Signs and Symptoms of Patients with AC

AC, X-RAY and USG Correlation

Out of the 37 patients who were finally diagnose AC, X-Ray reveled gross osteoarthritic changes in only one. In another patient with AC who also had an associated fracture humeral head, conventional radiography could not detect it. It was detected on USG and confirmed on CT. In all the other 35 cases the X-Ray was normal USG showed the following:

Limitation of sliding movement of supraspinatus under acromian during abduction	35 cases
Fluid distention of biceps tendon sheath	35 cases
Increased vascularity of the muscles of rotator interval	35 cases

In The 1 Patient with Associated Osteoarthritis

X-Ray showed	<ol style="list-style-type: none"> 1. Osteophytes from inferior lip of glenoid labrum. 2. Narrowing of gleno humeral joint space. 3. Soft tissue calcification 4. Subcondral sclerosis of glenoid.
USG showed	<ol style="list-style-type: none"> 1. Fluid in the biceps tendon around bicipital groove. 2. Calcification of infraspinatus muscle. 3. Limitation of sliding of supraspinatus tendon under acromian. 4. Increased vascularity of rotator cuff muscles

The osteophytic liping since it was located in the inferior lip of glenoid labrum could not be appreciated well on the USG and nor could the subcondral sclerosis be well appreciated on USG.

In The 1 Patient with Associated Fracture Humeral Head

X-Ray	Occult
USG	<ol style="list-style-type: none"> 1. Showed the fracture humeral head confirmed by CT. 2. Limitation of sliding movement of supraspinatus under acromian during abduction. 3. Fluid distention of biceps tendon sheath. 4. Increased vascularity of the muscles of rotator interval

DISCUSSION

Sonographic Evaluation and X-Ray Correlation of adhesive Capsulitis

50 Patients who had shoulder related complaints and were clinically suspected as AC. On sonographic examination 37 patients were diagnosed as AC. Out of them 37 was treated conservatively 1 patients had associated full thickness tear of supraspinatus tendon and had to be treated operatively. 2 patients had partial thickness tear of supraspinatus tendon and 1 among them had also effusion of gleno humeral joint. 1 patient

had a posterior glenoid labral tear along with and occult fracture of humeral head undetected on radiograph associated with fluid in infraspinatus tendon. 1 patient had tear of anterior glenoid labrum. 2 patients had impingement syndrome among them 1 of them had SA/SD bursitis and sub scapularis tendonitis. 1 patient had a tear of long head of biceps, 1 had dislocated biceps tendon. 1 patient who came with clinical diagnosis of AC came out to be rotator cuff tendinopathy. 1 patient had an abscess which was communicating with the right shoulder joint. 1 patient had gross osteoarthritis left shoulder associated with AC. 1 patient had associated fracture head of humerus which was occult on radiograph but detected on USG and confirm on CT. And only 1 patient who came with clinical diagnosis of AC came out to be cervical spondylosis.

Correlation of Mild Fluid, Distention of The Biceps Tendon Sheath And Rotator Cuff Tear

During USG examination of the 37 patient with AC. All of them had fluid distention of biceps tendon sheath, 37 patients showed continuous limitation of sliding movement of the supraspinatus tendon underneath the acrmion during arm abduction and 35 of them demonstrated increased vascularity of the soft tissue structures in the rotator cuff interval and around the bicipital tendon in the biceps groove. So in a nut shell.

ADHESIVE CAPSULITIS :

Clinical diagnosis = 50
 Sonographic diagnosis =37
 Final diagnosis = 37(Associated osteoarthritis, 1 associated fracture humeral head)
 Sonographic sensitivity, specificity, PPV and NPV were 100%, 100%,100% and 100% respectively.

Adhesive Capsulitis

Ryu *et al* in their study showed sensitivity and specificity of dynamic sonographic examination to diagnose AC were 91% and 100% respectively. Present study shows sensitivity and specificity of 100% and 100% respectively.

Diagnosis of AC is usually clinical but sonographic examination is important to exclude other pathologies clinically simulating AC or AC with underline other pathologies, both of which have important prognostic implications. In the present study 1 had osteoarthritis and soft tissue calcification associated with AC, 1 had associated fracture humeral head along with AC, 1 had cervical spondylosis, 2 impingement syndrome, 1 rotator cuff tendinopathy, 3 supraspinatus tendon tear, 1 tear of long head of biceps, 1 anterior glenoid labral tear and 1 posterior glenoid labral tear occult fracture of humeral head associated with fluid in infraspinatus tendon. 1 patient had an inflammatory collection which was communicating with shoulder joint. Thus sonography helps in planning of management.

AC shows a slight predilection for premenopausal women. Though it affects both sexes equally there may be a history of prior immobilization, but in many cases there is no obvious antecedent cause. Some time it is often difficult to distinguish clinically between AC and impingement syndrome. In some unquestionable AC marks the underlying and possibly precipitating rotator cuff tear. So proper diagnosis has important implications. AC can be diagnose arthrographically

but USG can diagnose this entity non invasively based on characteristic restriction in range of movement.

Sex Distribution of AC

From Pie chart 2 we can see that 20 patients in the study group of 37 with AC were female. From Table2 we can see that maximum cases of AC were in the age group of 40 to 60 years –both of which supports the statement of Ronnie Ptasznik....It shows a predilection for perimenopausal women.

However there are some pitfalls in USG

1. It is user dependent.
2. Due to tendon anisotropy if the direction of the USG beam is not perpendicular to the muscle or tendon, the muscle can appear hypoechoic and mimics some inflammatory collection or tear.
3. USG of shoulder is technically difficult to master. However all this problem is overcome with the experience of the sonographer and in experienced hand USG is a sensitive and specific test to detect AC.

X-Ray is a test to detect only the bony lesion and in AC was there are only soft tissue changes, X-ray comes out almost normal except mild osteoporosis which may occur late in the disease, due to disuse of the arm. However to detect osteoarthritis features like osteophytic lippings, subchondral sclerosis narrowing of joint spaces plain films are the main stay of diagnosis though USG can identify osteoarthritis changes which include narrowing of joint space, osteophytes and intraarticular loose bodies. The USG technique has to be confirmed by other modalities like CT scan. The USG technique is difficult to master and location of the osteophytes can affect the detectability on USG. Eg An acromial spur can be easily detected by USG where as spur in inferior aspect of articular margin of glenoid can be difficult to detect.

Role of USG in Excluding Other Pathologies Which Mimic Ac Clinically

From Table 2 it is seen that 4 patients had rotator cuff tear which was diagnose by USG. The X-Ray of these persons were normal. Among these 4 one had also shoulder joint effusion which was absolutely undetected on X-Ray. 2 had impingement syndrome. 1 was diagnosed in real time USG while actively abducting the arm and another patient with impingement syndrome.

Pathologies	No. of patients	X – RAY	USG Findings
Rotator cuff tear	4	N	Demonstrated the tear.
Glenohumeral joint effusion	1 Patient with Rotator cuff tear had effusion	N	USG demonstrated the effusion.
Rotator Cuff Tendinopathy	1	N	Fluid in subscapularis, supraspinatus and biceps tendon. Loss of fibrillary pattern of biceps tendon.
Anterior glenoid Labral Tear	1	Inconclusive/ N	USG demonstrated Anterior Glenoid labral tear with the torn labrum.
Posterior glenoid Labral Tear	1	N	Demonstrated the hypoechoic cleft in the triangular Posterior Labrum.
Fluid Collection in Infraspinatus	The same patient with Posterior Labral tear.	N	Fluid in infraspinatus.

Fracture	2 (1 with Posterior Labral Tear and 1 with AC)	Occult	Cortical irregularity Demonstrated.
Impingement Syndrome	2	N	Diagnose Impingement in arm abduction in real time USG. In another 1 demonstrated collection in SA/ SG Bursa and subscapularis tendinopathy.
Inflammatory collection	1	Osteoporosis around humeral head. Slight widening of glenohumeral joint space.	Demonstrated the inflammatory collection under the deltoid muscle communicating with the right glenohumeral joint and increased vascularity in the tissue surrounding the collection on color Doppler.

Thus the above table supports the following studies

Brennek and Morgan 1992 reported good results for full thickness tear- sensitivity and specificity 93 %.

In case of partial thickness tear Holsbeeck *et al* supported sensitivity and specificity of 94 %.

Pattern *et al* in their study showed that 42 fractures detected sonographically were not detected in initial radiographs.

Study by Azzoni R, Cabitza P *et al* with 200 consecutive patients sonography proved to be safe, accurate and useful in measuring the subacromial space and comparable to what is obtained when radiography is used alone (Azzoni R *et al* 2004).

Study by Ronnie Ptasznik 2001 which stated that powered doppler is more sensitive to changes in perfusion at micro vascular level and can depict soft tissue hyperemia presented in rotator cuff tendinitis.

Jon A Jacobson 2002 who stated that posterior labrum is more easily identified appearing hyperechoic and triangular. The anterior labrum is more difficult to visualize and may require and arm abduction and Axillary screening approach.

Borsa *et al* 2005 concluded that dynamic USG seen to be a promising means for measuring glenohumeral joint laxity replacing stress radiography for the purpose.

Cardinal *et al* 2001 who stated the diagnosis of septic bursitis can be suspected when the bursa become distended by complex effusion containing debris and separation. And almost any joint can be aspirated under USG guidance for gram stain, culture and sensitivity.(Cardinal *et al* 1998, Joseph G Craig 1999)

CONCLUSION

- The present study showed that high resolution USG is a very useful modality for diagnosis of AC, and it confidently excludes other associated pathologies.
- AC generally occurs in premenopausal women. It is predisposed by condition like Diabetes mellitus, previous history of trauma surgery, associated history of Neuropathies.
- Color Doppler is very useful in detecting increased vascularity in the muscles of the rotator cuff which is seen in patients of AC.

- USG is a highly and specific tool for diagnosing fluid distention of the biceps tendon sheath, thickening of coracohumeral ligament and diminished excursion of supraspinatus muscles which occur in AC.
- Rotator cuff pathologies is more common than non Rotator cuff lesion. In shoulder joint related problems among RC pathologies partial thickness tear is more common than full thickness tear. Incidence of RC pathologies increases with increasing age of patients.
- Sonography can diagnose many occult fracture and joint effusion not detected by plain radiography.
- High resolution USG is also highly sensitive and specific for diagnosing rotator cuff pathologies. Though it is less sensitive it is highly specific for diagnosis of labral tear.
- Though HRUS is a very efficient modality in detecting shoulder joint lesion it has some limitation like operator dependencies, experience of the operator, long learning and it also needs cooperation of the patients.
- Thus in developing countries like India where containment of health care cost and accessibility to health to all are more important factors, in view of the above summary it can be said that X-ray ,high resolution Ultrasonography and Doppler can be regarded as the primary modalities of imaging for most of the shoulder pathologies.
- X- Ray can better demonstrate bony lesion, fractures, calcification, lysis and sclerosis of bone, narrowing of joints space, osteophytes, subcondralsclerosis, and subcondral cysts.
- Even in cases where there are very subtle, subcondral fractures it can be missed in X-Ray and CT scan is a better modality in detecting it.
- In frozen shoulder where most of the findings are in soft tissue USG is a more sensitive and specific method for diagnosing AC.
- Thus it is concluded that USG is a better tool than X-Ray for diagnosing AC

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