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Case Series

Radiology Section

Role of MRI in a Series of Cases with Biceps Injuries of the Shoulder

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ABSTRACT

Dislocation and injury of the biceps is associated with acute and chronic trauma, degenerative changes, repetitive microtrauma, or injuries associated with recurrent and neglected cases of shoulder dislocation. The cases of displaced biceps injuries are relatively rare (only 1/6th of all rotator cuff injuries). The dislocation of biceps is manifested with pain and restriction of movements. The X-ray shoulder is not of much help in this condition barring for ruling out the fractures of humerus and scapula. Ultrasound is an important tool in the dislocation and shows empty bicipital groove which raises the suspicion of the soft tissue injures. Ultrasound is a problem solving tool when the equivocal findings in MRI (Magnetic Resonance Imaging) in other muscular injuries also. MRI is the modality of choice in these conditions. The bone and anatomy is better visualised on the T1WI images and the pathology is better visualised on the PDFS (Proton Density Fat Saturation) and the STIR (Short Tau Inversion Recovery) images. The role of Non Contrast Computed Tomography (NCCT) is important in associated suspicious bony abnormalities as highlighted in the article. The biceps region is a hidden area and challenging on arthroscopy due to poor visualisation of the extra-articular tendon part. MRI study helps the orthopaedicians for better management of the hidden areas. This series highlights the role of each modality in the diagnosis and management of the biceps lesions.

Keywords: Acromioclavicular joint, Glenohumeral dislocation, Rotator cuff tears

INTRODUCTION

The biceps pulley is a capsuloligamentous complex which acts to stabilise the long head of the biceps tendon in the bicipital groove. It comprises of coracohumeral ligament, superior glenohumeral ligament, distal attachment of tendon of the subscapularis muscle and is located within the rotator interval between superior edge of tendon of subscapularis muscle and anterior edge of tendon of the supraspinatus muscle [1]. The Long Head of Biceps Tendon (LBT) lies within this anatomical area. Various challenges are encountered in the clinical and arthroscopic evaluation of this region therefore it is important to highlight the importance of radiological and imaging assessment [2].

Rotator interval is a triangular space located between the tendons of superior border of the subscapularis and the anterior border of the supraspinatus muscles. It is a passage for the LBT after its origin from the scapula [3-6]. It represents a defect in the rotator cuff due to the protrusion of the coracoid process between the tendons of supraspinatus and infraspinatus muscles. This portion of the Glenohumeral Joint capsule lacks reinforcement of overlying rotator cuff muscles.

The origin of superior Glenohumeral Ligament (GHL) is from the superior glenoid tubercle and its insertion is at the superior margin of tendon of the subscapularis muscle. It blends with the fibers of the subscapularis tendon at the lesser tuberosity. It forms a U shaped “sling” which crosses below the biceps tendon and inserts into the lesser tuberosity, where it blends with the Coraco-Humeral Ligament (CHL) [4].

The LBT is surrounded by the CHL superiorly and the superior GHL anteriorly, forming a sling like band [7].

The protocol chosen in this case series is oblique coronal, oblique sagittal fat saturated and axial sections of T1WI, T2WI, STIR, PDFS imaging sequences. A 1.5-T MR imager and a dedicated shoulder surface coil were used. The patients forearm kept in supine position with the shoulder in neutral position.

Biceps pulley lesions can be due to degenerative changes, repetitive microtrauma, acute trauma, glenohumeral dislocation or rotator cuff tear injuries [8-10].

The dislocation of the LBT is relatively rare and seen in only 16% of the rotator cuff injuries [9].

The biceps pulley lesion can be divided into four groups, in Group 1 lesions were defined as isolated superior GHL lesions, Group 2 have additional partial articular side supraspinatus tendon tear, Group 3 as Group 1 with additional partial articular side subscapularis tendon tear, and Group 4 as Group 1 along with partial articular side tears of both the supraspinatus and subscapularis muscles tendons [7].

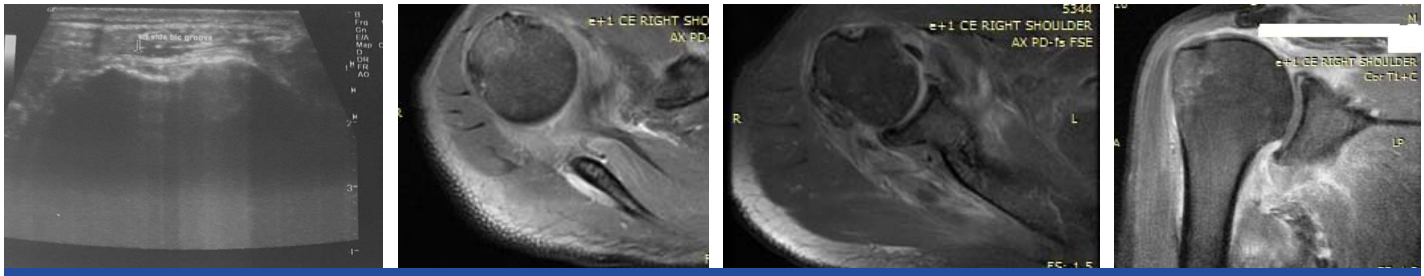
In this series, we highlight the radiological approach for diagnosis of the lesions of displaced biceps pulley injuries.

CASE 1

A 59-year-old male presented to the outpatient services of Orthopaedics Department with the complaint of pain, restriction of motion and inability to lift the right shoulder. Patient was an aviator by profession and had a history of trauma during sudden ejection from the aircraft in an exercise 10 years back. On clinical examination the patient had tenderness at the anterosuperior aspect of the shoulder. The patient was unable to resist examiners physical pressure from superior aspect to the arm when the arm was abducted with internal rotation of the wrist (positive Jobe's test) [11].

X-ray shoulder was normal. On ultrasound shoulder, there was empty bicipital groove, suggesting displaced LBT [Table/Fig-1a] with hypoechoic areas at the rotator cuff muscles suggesting oedema.

MRI shoulder revealed complete tear of the supraspinatus tendon with retraction of the torn ends [Table/Fig-1b]. Medial displacement of the LBT from the bicipital groove noted displacing into delaminated subscapularis tendon suggestive of intra-articular dislocation with complete disruption of superior GHL [Table/Fig-1c]. Superior migration of the humeral head with reduced acromion-humeral distance was also seen [Table/Fig-1d]. Anteriorly there was involvement of the anterior interval. Posteriorly there was extension into the conjoint tendon. Thickening of the muscles comprising rotator cuff and their tendinous insertion suggest rotator cuff tears were noted. Fraying of their fibers with abnormal hyperintensity is seen on PDFS images. Circumferential tear of the labrum is observed with anteroinferior and posteroinferior extensions. Posteriorly there



[Table/Fig-1]: (a) Ultrasound axial section of humerus showing empty bicipital groove suggesting displaced long head of biceps tendon; (b) Axial PDFS image showing complete tear of supraspinatus tendon; (c) Axial PDFS image showing medial dislocation of the long head of biceps tendon with complete tear of the superior glenohumeral ligament. (d) Coronal PDFS image shows cranial migration of the humerus with areas of hyperintensities at the greater tuberosity and supraspainatus tendon. The inferior ligament is thickened with hyperintense signal. There is also hyperintensities at the inferior glenoid labrum. (Images left to right)

was periosteal stripping and bony deformity. There was thickening of the middle and inferior GHLs.

The patient was managed arthroscopically with repair of the torn tendons of the supraspinatus, Superior Gleno-Humeral Ligament (SGHL) and replacement of the displaced head of humerus and LBT followed by physiotherapy and exercise.

CASE 2

A 45-year-old female presented to the Family clinic and later referred to the Orthopaedics center with the complaint of pain, restriction of motion and inability to lift the right shoulder. There was a history of fall three years back during sweeping which was managed conservatively. On clinical examination the patient was having tenderness at the superolateral aspect of the shoulder. Jobe's test was found positive.

X-ray shoulder was normal. On ultrasound shoulder, there was empty bicipital groove suggesting displaced LBT [Table/Fig-2a].

On MRI examination there was complete tear of the supraspinatus tendon from its humeral attachment with retraction and laxity of the fibers [Table/Fig-2b]. Cranial displacement of the humeral head was seen [Table/Fig-2c]. Cortical irregularity is seen along the lateral aspect of the humeral head and the greater tuberosity.

LBT is subluxated medially. There is rupture of the CHL and SGHL with partial tear of the distal subscapularis muscle. Moderate joint effusion is also seen [Table/Fig-2d].

The supraspinatus tear was repaired arthroscopically with recreation of the anatomical re-establishment of the biceps pulley. On follow up examination the patient retrieved the painless movements of the shoulder gradually.

CASE 3

A 36-year-old male presented to the Orthopaedics center with the complaint of pain, restriction of motion and inability to lift the right shoulder. There was a history of fall during a basket ball match about two years back which was managed conservatively. On clinical examination the patient was having tenderness at the anterolateral aspect of the shoulder. Jobe's test was found positive.

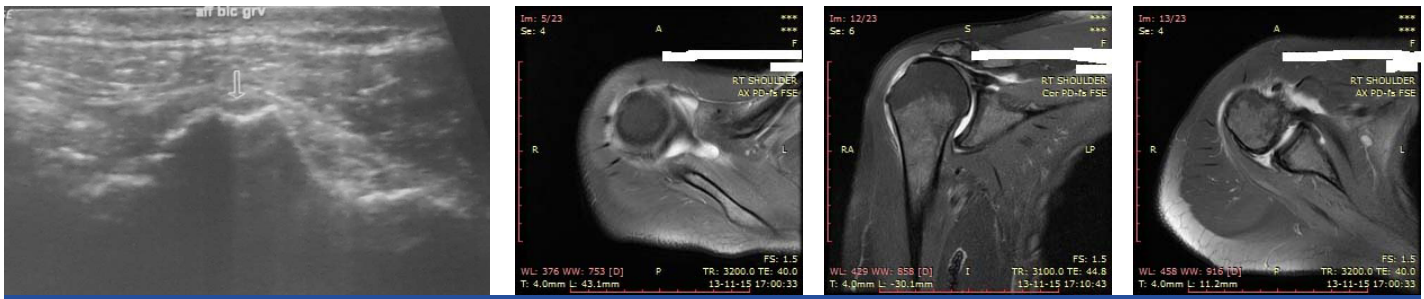
X-ray shoulder was normal. On ultrasound shoulder, there was atrophic LBT with irregularity at its anterior aspect suggesting tear in the transverse humeral ligament [Table/Fig-3a].

On MRI examination there was complete tear of supraspinatus tendon from its anterior insertion seen with retraction of fibers with thinning and fraying of the remaining tendon [Table/Fig-3b].

Superior migration of humerus is noted [Table/Fig-3c]. There is disruption of the SGHL- medial CHL complex with partial tear of the subscapularis tendon with medial extra-articular dislocation of the biceps tendon [Table/Fig-3d]. There was bone marrow oedema seen at the subscapularis insertion with small subchondral cyst seen at posterosuperior aspect.

Thickening of the Inferior Gleno-Humeral Ligament (IGHL) was seen both anteriorly and posteriorly.

Moderate joint effusion was seen. Acromioclavicular joint arthrosis was also noted.



[Table/Fig-2]: (a) Ultrasound axial section of humerus shows empty bicipital groove suggesting long head of biceps dislocation; (b) Axial PDFS image showing complete tear of the supraspinatus tendon from its humeral attachment with fluid and hyperintense signal; (c) Coronal PDFS image showing cranial displacement of the humeral head and complete tear of the supraspinatus muscle from the humeral attachment is noted; (d) Axial PDFS images showing medial sublaxation of the long head of biceps tendon. There is rupture of the CHL and SGHL with partial tear of the distal subscapularis muscle. (Images left to right)

[Table/Fig-3]: (a) Axial ultrasound humerus shows irregularity at the anterior aspect of the long head of the biceps tendon with mild atrophy of the tendon; (b) Axial PDFS image shows complete tear of supraspinatus tendon from its anterior insertion seen with retraction of fibers; (c) Coronal PDFS image shows cranial dislocation of the humeral head with hyperintensity along subscapularis tendon along with fluid suggests tear; (d) Axial PDFS image shows partial tear of the subscapularis tendon, medial extra-articular dislocation of the biceps tendon with disruption of the SGHL- medial CHL complex. (Images left to right)

The supraspinatus, SGHL and CHL tears were repaired arthroscopically. Patient was advised for follow up with physiotherapy rehabilitation for three months. On follow up patient had marked improvement in movements and relief from the pain.

CASE 4

A 77-year-old male presented to the Orthopaedics center with the complaints of pain, restriction of motion and inability to lift the right shoulder. There was no past history of any trauma or fall. On clinical examination the patient was having tenderness at the lateral aspect of the shoulder. Jobe's test was found positive.

X-ray shoulder was normal. On ultrasound shoulder, there was empty bicipital groove suggesting displaced long head of biceps tendon [Table/Fig-4a].

There is complete tear of supraspinatus tendon from its anterior insertion seen with retraction of fibers; rest of the supraspinatus tendon appeared thin and frayed [Table/Fig-4b].

Cranial dislocation of humerus is noted [Table/Fig-4c].

There is disruption of the SGHL- medial CHL complex with partial tear of the subscapularis tendon with medial extra-articular dislocation of the biceps tendon. Marked fluid is noted anterior to the subscapularis tendon [Table/Fig-4d]. Moderate joint effusion was also seen. Acromioclavicular joint arthrosis was also noted. Subarticular cysts were noted in the greater tuberosity with marginal osteophytes in the glenoid and head of humerus. Marked hyperintense signals are seen in the subscapularis muscle on T2WI, PDFS and STIR sequences.

The patient refused for surgery and hence was managed conservatively. On follow up patient had mild improvement in movements and relief from the pain from physiotherapy was observed.

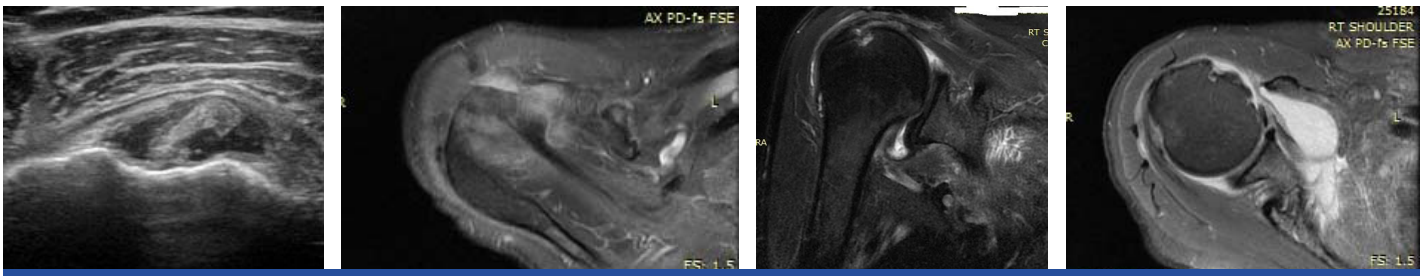
CASE 5

A 68-year-old male referred to the Orthopaedics center from a peripheral centre when not relieved by conservative managements for the complaint of pain, restriction of motion and inability to lift the right shoulder. There was history of fall from a tree about three years back. The patients took local remedies for the problem and neglected the condition. Clinical examination revealed loss of muscle bulk of the right arm at its anterior aspect [Table/Fig-5a], there was regional tenderness at anterior aspect of the shoulder along with a small palpable nodular mass in the anterior aspect of arm. Jobe's test was found positive.

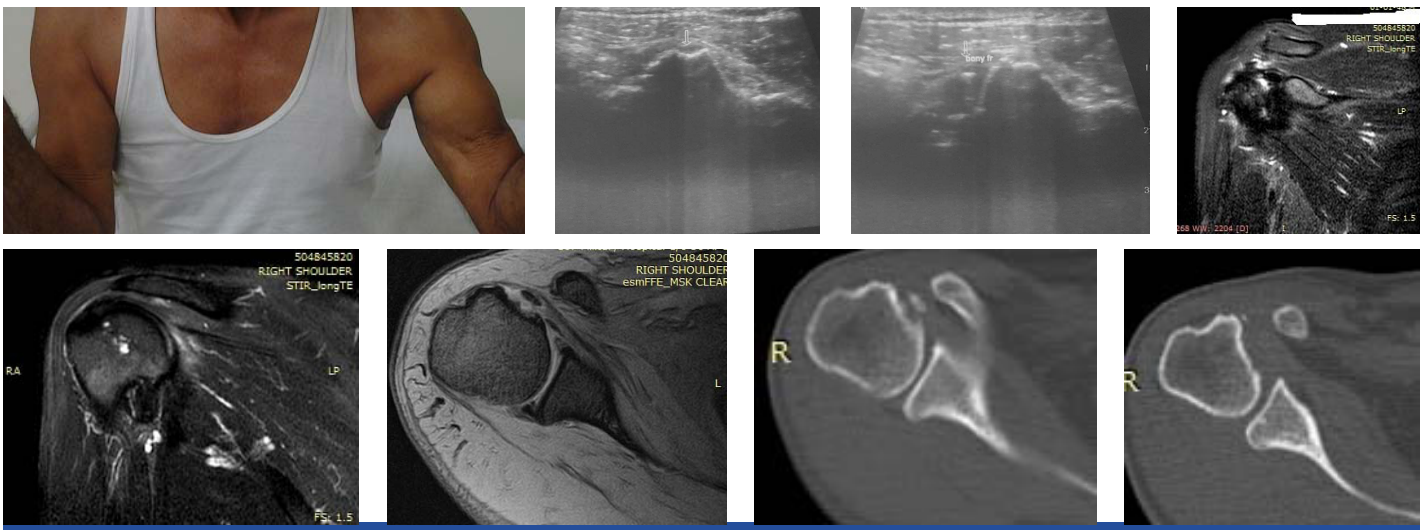
The X-ray shoulder appeared normal. On ultrasound examination, the LBT was absent in the bicipital groove [Table/Fig-5b]. Multiple small bony fragments were seen at the anterior aspect of the humerus likely loose bodies or fractures. Cortical irregularities were also noted at the anteromedial aspect of the humerus [Table/Fig-5c].

On the MRI examination areas of high signal intensity were noted on STIR and PDFS MR sequences over the anterior fibers of distal supraspinatus muscle and myotendinous junction suggestive of partial tear [Table/Fig-5d].

Area of high signal intensity on STIR and PDFS sequences were noted in the distal subscapularis muscle and tendon suggesting complete tear [Table/Fig-5e]. Atrophy and degeneration of the proximal tendon with complete tear along with anteromedial displacement of the distal tendon fragment was seen in the long head of biceps at the bicipital groove [Table/Fig-5f]. The acromioclavicular joint (AC joint)



[Table/Fig-4]: (a) Axial ultrasound humerus shows anteromedial displacement of the long head of biceps tendon with increased amount of surrounding fluid; (b) Axial PDFS image shows complete tear of supraspinatus tendon from its anterior insertion seen with retraction of fibers; (c) Coronal PDFS images show cranial dislocation of the humeral head with hyperintensity along subscapularis tendon along with fluid suggests tear. Hyperintense foci were also noted at the greater tuberosity. There was thickening and hyperintensity of the LBT and IGHL; (d) Axial PDFS image shows disruption of the SGHL- medial CHL complex with partial tear of the subscapularis tendon with medial extra-articular dislocation of the biceps tendon. (Images left to right)



[Table/Fig-5]: (a) Showing the flattening and atrophy of the biceps muscle on the right side; (b) Axial ultrasound humerus shows empty bicipital groove; (c) Axial ultrasound shoulder joint shows loose bodies with cortical irregularities; (d) Coronal STIR image shows tear of supraspinatus tendon from its anterior insertion. Areas of hyperintense foci are also seen in the subscapularis that suggests tear; (e) Coronal STIR image shows tear of subscapularis tendon; (f) Axial PDFS image showing medially displaced LBT with hyperintensity in the tendon and irregular cortical surface of head of humerus. Areas of high signal intensity are seen at the subscapularis tendon; (g) Axial NCCT image showing a fracture at the lesser tuberosity and a small bony fragment just anterior to the medial aspect of the bicipital groove; (h) Axial NCCT image showing a fracture at the lesser tuberosity and a small bony fragment just anterior to the medial aspect of the bicipital groove. (Images left to right)

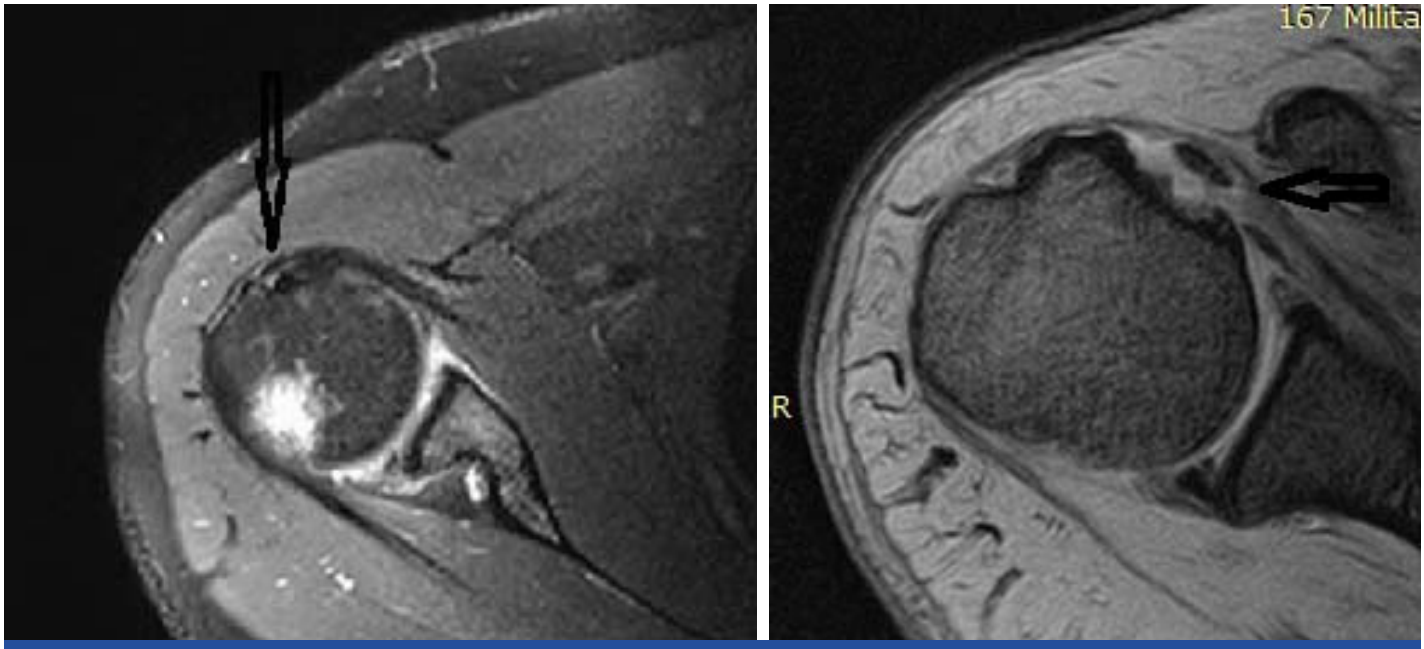
shows areas of altered signal intensity and irregularity suggest arthritic changes.

On the NCCT correlation chip fractures were noted at the lesser tuberosity of humerus including the bicipital groove [Table/Fig-5g,h].

The patient was managed arthroscopically with repair of the tendon of the supraspinatus and subscapularis tendons along with repair of the small bony fractures. On follow up examination there was gradual painless improvement of the range of movements.

DISCUSSION

The above series shows that the clinical examination and Jobe's test were 100 percent sensitive for supraspinatus and rotator cuff tear however the specificity is questionable; as all the five cases had pain and restriction of movements however the Jobe's test was not able to distinguish between the supraspinatus and subscapularis tear. Inspection is also important tool especially in cases of atrophy and complete tear of the LBT as seen in the case 5 [Table/Fig-5a]. Palpation also gives an additional idea of the tendon thickening or underlying muscular pathology and these tools helps the radiologist for better planning and acquisition of the MRI. The tenderness on palpation gives the idea of impact of the injury. As per the study of Sandstrom CK et al., the radiograph shoulder is important for the fractures and dislocations of the proximal humerus, injuries of the glenohumeral joint, and fractures involving the glenoid fossa and scapular neck but did not mentioned its importance in soft tissue injuries [12]. However in this study, the radiograph shoulder was found least sensitive for identifications of soft tissue injuries among these cases. As per Miller TT and Adler RS study, sonography was able to diagnose both partial tears and retracted ruptures of the distal biceps tendon in a group of seven patients [13]. In this study more specifically the ultrasound of shoulder and the humerus at the bicipital groove had very high sensitivity (100 percent) and found useful in all the cases. The use of ultrasound in these cases can minimise the use of MRI if the availability is limited as seen in the case of government establishments and public sector units. The ultrasound was equally helpful for bony pathology as seen in the case 5 [Table/Fig-5c]. The role of NCCT is in the problem solving cases, as due to radiation exposure and poor sensitivity for the soft tissues it is advisable to keep reserved for the equivocal and problem solving cases. The role of NCCT in small fractures is important and its use on suspicion can help to give additional diagnosis for the better management of the patient. MRI has very important role and found to be the most sensitive and specific tool in the cases. The supraspinatus tear was almost associated with all the cases with dislocation of LBT. The subscapularis tear were also seen in about 2/5th of the cases and seen suspiciously while reading MRI for



[Table/Fig-6]: (a) Axial PDFS image of a different patient with normal LBT shows a Hills Sachs lesion at the humerus with normal looking LBT in the bicipital groove (black arrow); (b) Axial PDFS image of one of the patient described in this study shows a medially displaced LBT appears as a large low signal dot (black arrow) at 1 o'clock position from the humeral head. This finding was consistent in all the cases in the series on fluid sensitive fat saturated sequences on axial section; (Images top to bottom).

Case number	Presenting complaints	Clinical examination	X-ray	Ultrasound shoulder	MRI findings
1	Pain and restriction of movements following an injury 10 years back	Tenderness at the anterosuperior aspect of the shoulder, Jobe's test positive	Normal	Empty bicipital groove with adjacent muscular hypoechogenicity suggests oedema and fluid	Habermeyer Type IV injury, irregularity at head of humerus, superior migration of the humeral head, labral tear, thickened MGHL and IGHL
2	Pain and restriction of movements following a fall three years back	Tenderness at the superolateral aspect of the shoulder, Jobe's test positive	Normal	Empty bicipital groove	Habermeyer Type IV injury, tear in the subscapularis, cortical irregularity at the greater tuberosity and superior migration of the humeral head
3	Pain and restriction of movements following a fall two years back	Tenderness at the anterolateral aspect of the shoulder, Jobe's test positive	Normal	Suggests tear of the transverse humeral ligament	Habermeyer Type IV injury IGHL thickening, Acromiocalvicluar arthrosis and superior migration of the humeral head
4	Pain and restriction of movements	Tenderness at the lateral aspect of the shoulder, Jobe's test positive	Normal	Empty bicipital groove	Habermeyer Type IV injury, Acromiocalvicluar arthrosis, cyst at the greater tuberosity and superior migration of the humeral head
5	Pain and restriction of movements following a fall three year back	Atrophy of biceps, palpable mass over the biceps tendon, Tenderness at the anterior aspect of the shoulder, Jobe's test positive	Normal	Empty bicipital groove, cortical irregularity and small free bony fragments noted	Habermeyer Type IV injury, complete tear and degeneration of LBT and subscapularis muscle

[Table/Fig-7]: Demonstrating the result of various clinical and radiological examinations in the cases.

dislocation and injury of LBT. The irregularity of the cortical surface and cyst at greater tuberosity of the humerus are also associated with injury in LBT. The chip fracture at the lesser tuberosity of the humerus should be looked suspiciously for thickening LBT injuries. The presence of a large dot at 1-2 o'clock position to the head of humerus in the axial images were seen in all the cases studied and found consistent with Habermeyer Type IV LBT lesions of the right side, more precisely on the fluid sensitive fat suppressed sequences. The findings has been demonstrated in [Table/Fig-6a,b] with absence of the sign in the former having normal LBT and presence in the later having Type IV abnormality. This finding has not been described in earlier studies however the remaining MRI features has been found in previous studies [7,14]. The final results of this radiological study have been tabulated in the form of [Table/Fig-7].

CONCLUSION

Since the findings in the cases of trauma to LBT can present both in the form of soft tissue and bony abnormalities the use of multiple modalities simultaneously help in better diagnosis and is more informative to the clinicians for repair. Proper diagnosis is an essential requirement for the better management. It should be done with multimodality approach to prevent therapeutic failure and recurrence.

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