



Value of Coraco-Humeral Ligament Thickness in Early Detection of Adhesive Capsulitis in Diabetic Patients Using MRI

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ABSTRACT:

BACKGROUND:

Adhesive capsulitis is a common illness-causing scapula-humeral pain with decrease in range of movement in the shoulder joint. MRI gives clear images about the joint capsule, the coraco-humeral ligament (CHL), and any associated pathology.

OBJECTIVE:

To study value of MRI for early diagnosis of adhesive capsulitis in diabetic patients through recognition of increased thickness of CHL.

PATIENTS AND METHODS:

Fifty-four adult participants were included in this study, 33 were females and 21 were males, their mean age 45.5 (age range 22-67 years), divided into 2 groups. The patient group included 34 diabetic patients (24 female and 10 male) with a mean age of 51.0±9.0, with first complain of shoulder pain, stiffness ± limitation in range of movement for about 8 to 12 weeks in duration, MR images were interpreted and analyzed from an oblique sagittal and coronal T1 WM-TSE. The control group included 20 healthy cases (9 female and 11 male) with a mean age of 43.0±11.4.

RESULTS:

A statistically significant difference in CHL thickness between the diabetic patients and the control group, mean CHL thickness in diabetic patients is 2.80±0.71mm (range 1.18-4.20) in comparison with 1.78±0.29mm (range 1.20-2.20) in control group. In the patients group, female were more affected than male (70.9% to 29.4% respectively) when compared to the control group (female 45.0%, male 55%). The study also shows a statistically significant difference in the rotator interval between the diabetic cases (mean 1.62±0.18cm) and control cases (mean 1.90±0.26cm). The best cut-off value of CHL thickness is (2.15mm) with a sensitivity of 91.2% and specificity of 90.0%.

CONCLUSION:

A significantly positive correlation was found between CHL thickness, rotator interval, and adhesive capsulitis. Thus, MRI study for CHL thickness in early adhesive capsulitis in diabetic patients can be sensitive and specific.

KEYWORDS: Coraco-Humeral ligament, Adhesive Capsulitis, Diabetic Patients, MRI.

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INTRODUCTION:

Adhesive capsulitis (Frozen Shoulder) is a common illness-causing scapula-humeral pain with a decrease in range of movement in the shoulder joint ⁽¹⁾. In 1934, Codman defined the diagnosis of “frozen shoulder”, while in 1945, Neviasser used the term “adhesive capsulitis”. The current agreement regarding the description of frozen shoulder comes from the American

Shoulder and Elbow Surgeons and states it is “a condition of uncertain etiology characterized by significant restriction of both active and passive shoulder motion that occurs in the absence of a known intrinsic shoulder disorder” ⁽²⁾. Usually, the first structure to be affected in early adhesive capsulitis is the Coraco-humeral ligament (CHL) in the roof of the rotator cuff interval, leading to

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limitation of external movement due to CHL contraction⁽³⁾.

In the advanced stage, further glenohumeral joint capsule thickening and contraction develop, causing more limitation in range of movement in all directions⁽⁴⁾. The incidence in the general population is thought to be 3-5%. Patients with diabetes are more vulnerable to having frozen shoulders than normal individuals, also, they respond less to treatment and physical exercise than others⁽⁵⁾. In general, adhesive capsulitis can be divided into two main types: primary (idiopathic) and secondary type; Secondary adhesive capsulitis can be due to many risk factors: Diabetes mellitus disease, Stroke, Thyroid disorders, Shoulder injury, Parkinson disease, Cancer, Complex shoulder pain syndrome⁽⁶⁾.

Adhesive capsulitis is diagnosed initially with physical examination, but other radiological diagnostic imaging is helpful, like x-rays, shoulder the US, and MRI can be used to assess and delineate the internal structures. These also are helpful to exclude other causes of pain and stiffness⁽⁷⁾. MRI is the gold standard radiological evaluation and provide an important extra diagnostic tool for adhesive capsulitis⁽⁸⁾. The main characteristic feature seen in MR is the thickening of CHL, the thickening of the joint capsule in the rotator cuff interval, with obliteration of the sub-coracoid fat triangle⁽⁹⁾. Some studies have shown that the early feature of adhesive capsulitis is the thickening of the CHL and shortening with loss of its normal low signal intensity⁽²⁾. CHL is better to be visualized in oblique sagittal and coronal plane T1 and T2 fat sat sequences, seen as hypointense tight ligament extending from the coracoid process to the humeral head, and measure the maximum thickness through its course⁽¹⁰⁾.

AIM OF THE STUDY:

To study value of MRI for early diagnosis of adhesive capsulitis in diabetic patients through early recognition of increased thickness of Coraco-Humeral Ligament.

PATIENT AND METHODS:

This case-control analytic study was conducted in the Radiology Department of Al-Imamain Al-Kadhymian medical city/ Baghdad/ Iraq during the period between June 2021 to January 2022. Fifty-four adult participants were included in this study, 33 were females and 21 were males, their mean age 45.5 (age range 22-67 years),

divided into 2 groups (patient group and control group).

The patient group:

included 34 diabetic patients, with first complain of shoulder pain, stiffness \pm limitation in range of movement, for about 8 to 12 weeks in duration, never been examined or treated for this condition, the mean duration of diabetes was 5.9 years (range 2-11 year), most of them on oral hypoglycemic drug and some on insulin.

The Control group:

were 20 healthy subjects (9 female and 11 male), with a mean age of 43.0 \pm 11.4 year, selected from the radiology department that had MRI for other health problems, with no history of diabetes or other debilitating illness, after excluding any history of trauma or surgery to the shoulder.

Inclusion criteria:

diabetic patients with clinical suspicion of early adhesive capsulitis (first complain of shoulder pain \pm limitation in movement lasting for 8 to 12 weeks).

Exclusion criteria:

non-diabetic patients, diabetic patients with frozen shoulder or complained for more than 12 weeks, Rheumatoid arthritis, history of trauma or surgery, history of local injection of steroids, patient with general contraindications for MRI, patient in whom MRI was nonconclusive or inadequate and patients with advanced MRI findings of adhesive capsulitis (ligament fatty degeneration).

Ethical consideration:

the study was approved by the scientific committee of the Iraqi Board of diagnostic radiology. Oral informed consent was obtained from all patients included in the study.

MR protocol:

MRI imaging was performed using a 1.5T MR system (Achieva, Philips medical system, Netherland). The examination was done in the supine position. A phased-array surface coil was centered over the glenohumeral joint and strapped in place. The arm position was standardized, with the thumb pointing upward in a neutral position, the following imaging sequences were done: T1-weighted spin-echo images in the sagittal oblique plane, parallel to the glenohumeral joint from the humeral head to the scapula (TR/TE 550/15, section thickness 3mm, intersection gap 0.3mm, field of view 180 \times 180mm, matrix size 512 \times 512), Fat-suppressed proton-density weighted spin-echo images in the coronal oblique plane, paralleling

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the long axis of the supraspinatus tendon (TR/TE 3000/34, section thickness 3mm, intersection gap 0.3mm, field of view 180×180mm, and matrix size 512×512), Additional sequences including proton density (TR/TE 3000/30, section thickness 3mm, intersection gap 0.3mm, field of view 180×180mm, and matrix size 256×256) and T2 weighted spin-echo images (TR/TE 3500/60, section thickness 3mm, 0.3mm intersection gap, field of view 180×180mm, and matrix size 256×256) in axial and coronal section for the whole shoulder compartments to assess any other pathology and associated changes in shoulder joint.

Imaging interpretation:

The coraco-humeral ligament seen in oblique sagittal and coronal view extending from the coracoid process to the humeral head identified with the help of the subcoracoid fat in the rotator interval. Most of the patients shows thickening of the CHL and loss of tightness, with an undulating and tortuous course. The CHL showed diffuse thickening and the measurement is taken at the thickest part, few cases show focal thickening suggesting an early course of the disease. Loss of the low signal intensity of the ligament is suggestive of the degenerative course of the illness. Associated decrease the rotator interval with a decrease in its fat content is a significant feature of the adhesive capsulitis, with joint effusion and rotator cuff muscle changes.

Statistical analysis:

Was carried out using SPSS 27 (Statistical Packages for Social Sciences- version 27). Data were presented in simple measures of frequency, percentage, mean, standard deviation, and range (minimum-maximum values). The significance of difference of different means (quantitative data) was tested using Students-t-test for difference between two independent means or ANOVA test for difference among more than two independent means.

Statistical significance was considered whenever the P value was less than 0.05. Receiver Operating Characteristic “ROC” curve technique was used in order to determine the use of any parameter as diagnostic or screening tool for disease and the ability to determine the “cut-off value” which of optimum sensitivity and specificity for diagnosing disease. The ROC area “Area Under the Curve “AUC” explanation as follows (0.9 “Perfect”, 0.8 “Good”, 0.7 “Fair”, 0.6 “Poor”, <0.6 “Failure”.

RESULTS:

The study included 34 diabetic patients and 20 healthy participants as control group. The mean age of the patients’ group was 51±9.0 years whereas the mean in the control group was 43±11.4 years, this age difference was statistically significant (p value 0.002). In the patients group female were more affected than males when compared to the control group but this difference was statically insignificant (p value 0.063).

MRI measurement of CHL Thickness:

Mean CHL thickness in diabetic patients is 2.80 ±0.71mm (range 1.18-4.20) in comparison with 1.78±0.29mm (range 1.20-2.20) in the control group. This difference was statically significant, (P value 0.0001).

Rotator Interval:

Significant difference in the rotator interval between the diabetic cases (mean 1.62±0.18cm) and the control (mean 1.90±0.26cm), (P 0.0001). There is significant correlation between the rotator interval and the CHL thickness, (P 0.045).

Cut off value:

According to the ROC analysis, the area under the curve is (0.923) which is within the high confidence interval, the best cut-off value of CHL thickness is (2.1500mm) with a sensitivity of 91.2% and specificity of 90.0%, as shown in Table (1) and figure (1)

Table 1: Sensitivity and specificity of different cut off value of CHL thickness.

Test Result Variables: CHL thickness (mm)				
Positive if Greater Than or Equal To;		Sensitivity%	Specificity%	
1.9500		91.2	70.0	
2.0500		91.2	80.0	
2.1500		91.2	90.0	
2.2050		88.2	100	
Test Result Variables: CHL thickness (mm)				
			95% Confidence Interval	
Area Under the Curve (AUC)	Std. Error	P value	Lower Bound	Upper Bound
0.923	0.043	0.0001*	0.839	1.000

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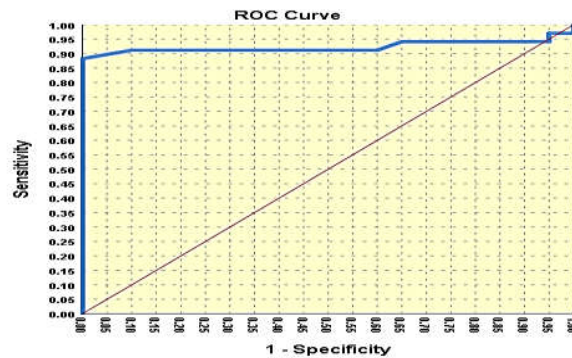


Figure 1: ROC curve.

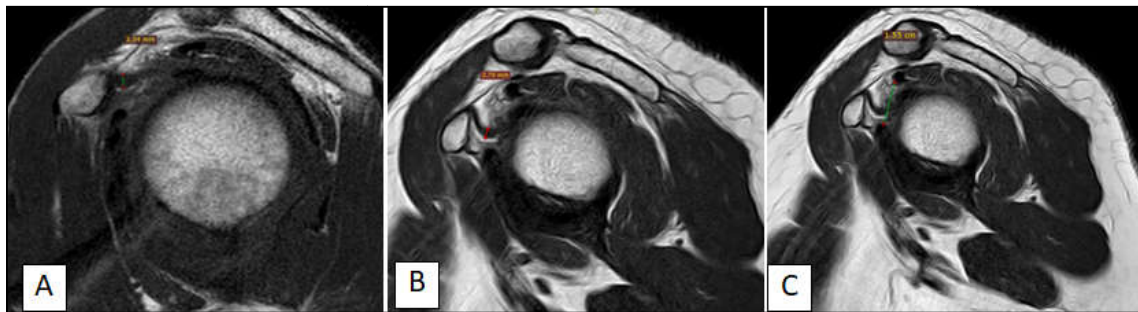


Figure 2: A: 65 years old male diabetic patient presented with 2 month history of Lt. shoulder pain and stiffness, coronal T1 WM-TSE show increased CHL thickness (3.34mm) and abnormal signal intensity with mild joint effusion. B and C: 60 years old female with history 7 years on OHA, present with limitation in shoulder movement and pain, oblique sagittal T1 WM-TSE show thickened CHL (2.79mm) as seen in image (B), and decrease rotator interval (1.55cm) as seen in image(C).

DISCUSSION:

Normally, The CHL appears as a linear homogenous low signal intensity band like, which arises from the coracoid process to the humeral head through the mid-portion of rotator cuff interval, surrounded by hyperintense fatty tissue in T1 weighted spin-echo images ⁽¹¹⁾. As the rotator interval shortens in the mediolateral and craniocaudal directions the relative gliding of the anterior margin of the supraspinatus tendon and the cranial margin of the subscapularis tendon is restricted and external rotation range is diminished ⁽¹²⁾.

It has been proposed that the CHL and rotator interval are of central importance in the course of adhesive capsulitis. In this study, there is a significant difference in CHL thickness of adhesive capsulitis in diabetic females (70.6%) compared to diabetic males (29.4%) and mean age in diabetic patients (51.0), these results were comparable to the results observed by Li et al ⁽²⁾ that show the incidence of the disease was (69.4%)

in female and (31.6%) in male, and mean age of (53.3).

This study showed that CHL was transformed into a tough contracted band in most of the cases with loss of normal homogeneous low signal intensity, and show an increase in thickness in diabetic patients with a mean of 2.80 ± 0.71 mm (range 1.18-4.20) in comparison with 1.78 ± 0.29 (range 1.20-2.20) in healthy controls subject, these results were in agreement with that reported by Homsy C. et al ⁽¹³⁾ study of CHL in adhesive capsulitis by ultrasound examination, where they noted that CHL is significantly greater in adhesive capsulitis with an average of (3mm) than asymptomatic shoulders (average 1.34mm), although MRI is more sensitive, the higher value of CHL thickness may be attributed to the fact that Ultrasound measures the ligament in different passive and active movements which may give a higher thickness to the ligament, while MRI done in a neutral position with a relaxed ligament.

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Another study done by Le et al⁽¹⁴⁾ mentioned that CHL is thickened in adhesive capsulitis (4.1mm vs 2.7mm) in comparison with the healthy patient, the higher value of CHL may be attributed to the difference in inclusion and exclusion criteria between the two studies as the current study include only diabetic patients and early stage of adhesive capsulitis. In this study, there was a significant difference between the rotator interval in diabetic patients (mean 1.62±0.18cm) and the control cases (mean 1.9±0.26cm), these results were in agreement with the results of Lee et al⁽¹²⁾ study which mention reduction in rotator interval in the early phase of adhesive capsulitis.

In this study the best cut off value of CHL thickness is (2.15mm) with a sensitivity and specificity of (91.2% and 90.0% respectively) and show the area under the curve is (0.923) which is within the 95% confidence interval. A study done by Yu et al⁽¹⁵⁾ give a cut-off value of 3.30mm with sensitivity and specificity of (71.2% and 70.6% respectively) and area under curve (0.81), this difference may be attributed to the difference in inclusion and exclusion criteria between the two studies as the current study include only diabetic patients and early stage of adhesive capsulitis.

CONCLUSION:

A significantly positive correlation was found between CHL thickness, rotator interval, and adhesive capsulitis. Thus, MRI study for CHL thickness in early stages of adhesive capsulitis in diabetic patients can be sensitive and specific and the best cut-off value of CHL thickness is (2.15mm) with a sensitivity of 91.2% and specificity of 90.0%.

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