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A Case Control Study of Ultrasound Evaluation of shoulder Joint among Diabetic and Non-Diabetic Patients

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Abstract

Background: Musculoskeletal disorders are one of the most common complications in diabetic patients. The most common complaints are shoulder pain and limitation of movement.

Aim of Study: The aim of this study is to evaluate the diagnostic performance of high-resolution ultrasound in the diagnosis of shoulder joint pain in diabetic patients.

Material and Methods: This study was performed on 48 adult type 2 diabetic patients who were complaining of shoulder pain and/or limitation of shoulder movement. Greyscale sonography was done, comparing the results with fifty control subjects.

Results: Supraspinatus tendon thickness (SST) was significantly greater in diabetics than in controls (p<0.001). There was no significant correlation between shoulder pain, clinical limitation of movement of the shoulder joint, and ultrasound findings in the diabetic group (p-value >0.05). However, there were significant SST tears, subacromial bursitis, and limitation of movement of SST ultrasound findings in older diabetic patients than in younger ones with a p-value (<0.05). In the diabetic patients, ultrasound revealed a sensitivity of 82.6% in detecting the underlying cause of shoulder pain. Also, it showed a 67.4% sensitivity and 50% specificity in the detection of the underlying cause of shoulder limitation of movement.

Conclusion: Ultrasound may be a high-quality diagnostic tool for diabetes individuals with shoulder joint disorders.

Key Words: *High – Resolution ultrasonography – Shoulder pain – Diabetic patient.*

Introduction

DIABETES mellitus (DM) is the most common endocrine disease caused by impaired insulin secretion, resulting in musculoskeletal system hazards. Musculoskeletal affection is due to protein glycosylation in periarticular structures and deterioration of collagen accumulation **[1]**.

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Musculoskeletal complications in diabetic patients involvetendinitis, adhesive capsulitis (frozen shoulder), and peri-arthritis. Frozen shoulder and rotator cuff disorders are the most commonly seen **[2,3]**.

Applications for Musculoskeletal ultrasound (MSK US) have increased nowadays. Especially in the detection of shoulder pain causes and rotator cuff disorders. Thus increasing the diagnostic assessment of undiagnosed type 2 DM **[4]**.

Ultrasound (US) and magnetic resonance imaging (MRI) are the most commonly used tools in diagnosing the severity of rotator cuff disorders [5]. Since, ultrasound scan is used to produce real-time images, MSK US can be used to provide dynamic tools for examinations in different planes [6].

Adhesive capsulitis (AC) can be clinically diagnosed, but other causes of shoulder pain in diabetics should be excluded in order to detect the possible treatment **[6,7]**. Being invasive, arthroscopy is not used nowadays as the gold standard in diagnosing frozen shoulders. Therefore, other imaging modalities like ultrasound and MRI should be used to confirm the diagnosis of AC **[8]**.

Tendon pathologies can be easily detected by both (US) and (MRI) **[9]**. However, greyscale ultrasonographyis the first-line tool to detect tendon pathology because of itsbenefits of being real-time access and its ability to detect vascularitywithout contrast injection and to evaluate the elasticity of the tendons **[10,11]**.

It is necessary to detect the underlying disorder in diabetic patients to avoid the development of chronic shoulder pain, which helps in ensuring optimal treatment outcomes. Because shoulder pain can interfere with physical exercise, which is a key component of diabetes management, as a result, ineffective shoulder pain treatment may have a negative impact on diabetes management, creating a vicious cycle. More knowledge of which specific types of shoulder pathology are frequent in T2DM patients is essential to prevent the development of persistent shoulder discomfort in these patients [12].

The purpose of this study is to evaluate the role of high-resolution ultrasonography in diagnosing shoulder joint changes in diabetic patients in comparison with the control group, to find out the value added by dynamic ultrasonography to the static examination of such cases, and to define the dimensions of the supraspinatus and long head biceps tendons in a healthy population and compare them with the diabetic patients, thus optimizing the suitable treatment.

Material and Methods

This prospective study was performed between March 2021 and January 2022 atthe Radiology Department of our University and approved by our Research and Ethical Committee.

Study group:

This study was conducted on forty-eightadult type 2 diabetic patients who were complaining of shoulder pain and/or limitation of shoulder movement. They were referred to the radiology department for assessment of the shoulder joint. It included both males and females (31 females and 17 males) whose age was above 16 years. Meantime of DM diagnosis and follow-up duration was 7.3 ± SD 4.4 years. The duration of DM received treatment was learned. Hemoglobin (Hb) A1C level and body mass index (BMI) were also attached. According to the laterality of the shoulder impairment, twenty patients out of 48 had bilateral shoulder affection. As a result, 68 shoulders were examined (40 left and 28 right-sided), considering bilateral shoulder affection as one case in our analysis.

The exclusion criteria for the patient group were those with any history of shoulder injury or previous shoulder interventions.

Each patient was subjected to an analysis of the complaint; pain onset (sudden or gradual), neck pain involvement, and limitation of movement. Relevant past medical and surgical history, revision of previous imaging studies (if available) were evaluated. After ultrasonographic assessment, the following clinical evaluation was done to confirm our diagnosis, considering the clinical assessment our gold standard. Muscle wasting and scapular winging were observed. Active and passive abduction and passive external rotation were carried out to assess the pain and range of motion. Additionally, the Hawkins-Kennedy test and the Neer impingement test were carried out.

Control group:

Fifty control subjects with unilateral shoulder examination aged above 16 years (16 males and 34 females) were evaluated. They were admitted to our hospital for other examinations, and did not have DM orany complaints about their shoulders. Those with no significant medical conditions and with no history of previous surgical intervention were selected. Informed consent was obtained from all participating patientsin the control group before any study-related procedures.

Ultrasonographic evaluation:

Greyscale sonography was done using the Toshiba Apilo 500 with a high-frequency linear probe at 7-11 MHz frequency. Static and dynamic techniques were applied. Typically, the patient is seated on a backless chair. The evaluation was carried out bytwo consultants with more than 10 yearsof experience in musculoskeletal system ultrasonography who were blinded to the clinical results.

Initially, B-mode ultrasound was done for the shoulder joint to examine the related tendons. Power or color Doppler was applied to evaluate tissue hyperemia and thus evaluate the presence of inflammatory changes.

The main targets of our greyscale ultrasound were to identify the tendon of interest, to obtain an image of the tendon in two planes (short axis and long axis), to eliminate artefacts by directing the ultrasound beam perpendicular to the tendon, and to reach a diagnosis.

Scanning protocol:

1- *Long head of biceps tendon (BT)-short and long-axis:*

The patient was asked to sit with his hand resting on his thigh and the elbow flexed to 90°. While scanning the short axis; the transducer was placed in the axial plane at the bicipital groove (the anterior aspect of the shoulder). For scanning the long axis, the transducer was rotated 90°. The probe was then moved in a craniocaudal direction to demonstrate the tendon length down to its myotendinous junction. The maximum thickness was measured in the transverse view at the highest point of the groove.

2- Supraspinatus-long and short-axis and rotator interval:

Patients were asked to put the palm of their hand on the back pocket, to allow abduction and internal rotation of the shoulder. The short-axis view of the tendon was obtained by placing the probe anteriorly in the transverse plane. The probe was then moved over the supraspinatus tendon in a medial and lateral direction to ensure complete tendon assessment from the myotendinous junction proximally to the tendon insertion into the greater tuberosity. For the long axis of the tendon, the probe was turned 90 degrees. The maximum mediolateral diameter of the supraspinatus footprint at its insertion was measured in the coronal view. Its maximum thickness was made at the medial edge and at the midpoint of the footprint on the coronal view, it was done at a fixed point 15mm posterior to the biceps tendon on the sagittal view.

3- Presence of sub-acromial and subdeltoidbursitis (SASD) were evaluatedby the presence of increased fluid in the bursa and/or thickening of the wall of the bursa.

4- Coracohumeral ligament (CHL):

The scanned shoulder was in a neutral position and the forearm was extended. The scanning was performed in an axial oblique plane, by positioning the transducer longitudinally on the lateral border of the coracoid process. Its thickness was measured in an externally rotated arm.

5- Dynamic parameter for the evaluation of the limited SST movement:

For the assessment of the supraspinatus tendon during the abduction, the transducer was placed in the oblique coronal plane with its medial margin at the anterolateral edge of the acromion. The shoulder was abducted anterolaterally with the thumb down. Limitation of continuous smooth sliding movement of supraspinatus underneath the acromion and/or buckling of soft tissues lateral to the acromion edge during the lateral elevation of the arm was considered indicative of restricted abduction.

6- Assessment of rotator cuff interval echotexture and its boundaries integrity:

Was done by modified Crass position, where the patient's ipsilateral hand is placed on the closest hip or buttock region.

Data collection and sonographic interpretation:

The tendinous thickness measurements of both supraspinatus and long head of biceps were taken by reference to bony landmarks and were compared in both control and diabetic patients' groups. Correlation of the thickness measurements was done with the age and gender in both groups.

A Comparison of US shoulder joint interpretation findings in both groups was done.

A hypoechoic or anechoic defect in the tendon that takes the entire thickness from the bursal to the articular surface was identified as a full-thickness rotator cuff tear. Measurement of the defect length and width was done by both LS and TS scans. Apartial thickness tear was diagnosed as a focal hypoechoic or anechoic area involving one surface of the tendon but not extending across the entire thickness of the tendon.

Tendinopathy was diagnosed as increased thickness and/or hypo-hyperechoic signal in the tendon. Inchronic tendinosis, calcium may be deposited in the rotator cuff tendons and/or the subacromialsub-deltoid (SASD) bursa.

Acromioclavicular osteoarthritis (AC OA) changes were evaluated by joint widening or narrowing, margin irregularity, capsular hypertrophy, and synovitis.

Biceps tenosynovitis was diagnosed asperitendinous fluid accumulation with internal echoes within the fluid with areas of increased vascularity by Doppler flow.

Increased rotator interval soft tissue echotexture with increased Doppler flow, CHL contraction, and thickening of the joint capsule enhanced adhesive capsulitis diagnosis.

Statistical analysis and sample size calculation:

The sample size was calculated using the sample size equation for sensitivity and specificity detection Buderer N M **[13]**, using the following parameters: Expected sensitivity 89%, specificity 82%, disease prevalence 20%, precision ± 20%, confidence interval 95% and level of significance 0.05, the sample size was estimated to be study group N=48 and control group N=50.

Statistical analysis was conducted using the statistical package for the Social Sciences (SPSS) version 28 (IBM Corp., Armonk, NY, USA). Data were presented using mean and standard deviation for quantitative variables and frequencies (number of cases) and relative frequencies (percentages) for categorical variables. Comparisons between groups were done using an unpaired *t*-test and Mann Whitney U test in the duration of diabetes. For comparing categorical data, Chi-square (χ^2)

and McNamara tests were performed. The exact test was used instead when the expected frequency is less than 5. The logistic regression model was conducted to assess the risk factors for developing shoulder pain and limitation of movement. Correlations between quantitative variables were done using the Pearson correlation coefficient. *p*-value >0.05 was considered non-significant, *p*-value <0.05 was considered significant and *p*-value <0.01 was considered highly significant.

Results

A total of 48 study group diabetic patients [31 (64.6%) females and 17 (35.4%) males] and 50 control group volunteers [34 (68.08%) females and 16 (32%) males] were included in our analysis. The age range of the patients was from 39 to 62 years (mean age 52.65 5.9 SD), and from 36 to 66 years (mean age 50.42 7.6 SD) in the diabetic and control groups, respectively.

According to age, diabetic patients with SST tears were significantly older than others who had an intact SST, with a *p*-value of 0.026. Subacromial bursitis and dynamic US SST limitation were more frequently reported in older patients with *p*-values of 0.003 and 0.007, respectively, in the diabetic group (Table 1).

Also, we found a non-significant positive correlation between age and SST thickness in both groups. A significant positive correlation was displayed between BT, CHL thickness, and age in diabetic patients with a *p*-value <0.05.

The CHL thickness showed a significant positive correlation with age, *p*-value <0.05 in the control group. A non-significant positive correlation was found between US AC osteoarthritis findings and age in both groups.

There was no significant gender difference in clinical symptoms of all included diabetic patients, as well as no significant correlation between AC OA, subacromial bursitis, SST dynamic ultrasound movement limitation, thickened CHL findings, and sex in the diabetic group with *p*-values >0.05 as described in (Table 2). On the other hand, there was a significant gender discrepancy in SST tendinopathy in both groups as it was mostly detected in females (Table 3).

The complete tear of SST was significantly higher in female diabetic patients. SST thickness measurements showed significant gender discrepancy at its insertion and at the medial edge with *p*-value <0.05 in both groups as detailed in (Table 4). Biceps tendon tenosynovitis was detected significantly in the female diabetic patient (Fig. 1).

Clinically, 83.3% were presented with shoulder pain, while 66.7% had limitationsin shoulder movement. All the included diabetic patients had a mean duration since diagnosis of 7.3 ± SD 4.4 years.

Ultrasound assessment of shoulder joint pain and limitation of movement causes in both groups was described in detail in (Table 5). There was a statistically significant difference between both groups in terms of the presence of AC osteoarthritis, SST tendinopathy, and SST complete tear (*p*<0.05), whereas there was no statistically significant difference in terms of the other findings.

Table (1): Correlation between age and ultrasound findings in diabetic group.

	Age		*p*-value
	Mean	Standard Deviation	
Pain:			
No	44.4	7.8	0.057
Yes	49.1	6.0	
Limitation of movement:			
No	47.4	4.8	0.44
Yes	48.8	7.2	
Acromioclavicular OA:			
No	46.0	6.1	0.07
Yes	49.5	6.4	
SST tendinopathy:			
No	48.7	8.1	0.79
Yes	48.1	5.1	
SST tear:			
No	47.1	5.6	0.026
Yes	51.7	7.5	
BT Tenosynovitis:			
No	48.0	6.5	0.50
Yes	49.7	6.3	
Subacromial bursitis:			
No	47.4	6.1	0.007
Yes	54.8	5.4	
Limitation of movement of SST:			
No	46.6	6.2	0.003
Yes	52.5	5.2	
Thickened CHL:			
No	48.1	6.3	0.50
Yes	50.0	8.0	
Increased rotator interval soft tissue:			
No	47.8	6.1	0.10
Yes	52.8	8.2	

Table (2): Correlation between ultrasound findings and sex.

	Sex				p-value
	Male		Female		
	N	%	N	%	
Pain:					
No	3	17.6	5	16.1	0.89
Yes	14	82.4	26	83.9	
Limitation of movement:					
No	6	35.3	10	32.3	0.83
Yes	11	64.7	21	67.7	
Acromioclavicular OA:					
No	7	41.2	9	29.0	0.39
Yes	10	58.8	22	71.0	
Subacromial bursitis:					
No	15	88.2	27	87.1	0.90
Yes	2	11.8	4	12.9	
Limitation of movement of SST:					
No	13	76.5	21	67.7	0.52
Yes	4	23.5	10	32.3	
Thickened CHL:					
No	16	94.1	26	83.9	0.30
Yes	1	5.9	5	16.1	
Increased rotator interval soft tissue:					
No	16	94.1	27	87.1	0.44
Yes	1	5.9	4	12.9	

Table (3): Correlation between SST tendinopathy and sex in both groups.

Diabetic group	Sex				p-value
	Male		Female		
	Count	%	Count	%	
SST tendinopathy:					
Positive	0	0.0	28	90.3	<0.001
Negative	17	100.0	3	9.7	
Negative	17	100.0	25	80.6	
Control group					
SST tendinopathy:					
Positive	0	0.0	11	32.4	0.010
Negative	16	100.0	23	67.6	
Negative	16	100.0	30	88.2	

Table (4): Correlation between SST thickness and sex in both groups.

Diabetic group	Sex				p-value
	Male		Female		
	Mean	Standard deviation	Mean	Standard deviation	
- SST thickness at insertion (mm)	5.45	0.53	8.40	1.61	<0.001
- SST thickness at medial edge (mm)	5.80	0.56	9.33	1.55	<0.001
Control group:					
- SST thickness at insertion (mm)	4.04	1.22	5.54	2.27	0.004
- SST thickness at medial edge (mm)	4.43	1.24	5.95	2.31	0.004

Table (5): The frequency and percentage of the cause of shoulder pain and limitation of movement by ultrasound.

	Count	%	Count	%	p-value
AC Osteoarthritis:					
Positive	32	66.7	11	22.0	<0.001
Negative	16	33.3	39	78.0	
SST tendinopathy:					
Positive	28	58.3	11	22.0	<0.001
Negative	20	41.7	39	78.0	
SST complete tear:					
Positive	7	14.6	0	0.0	0.005
Negative	41	85.4	50	100.0	
SST partial tear:					
Positive	6	12.5	4	8.0	0.520
Negative	42	87.5	46	92.0	
Biceps tenosynovitis:					
Positive	8	16.7	3	6.0	0.094
Negative	40	83.3	47	94.0	
Subacromial bursitis:					
Positive	6	12.5	4	8.0	0.520
Negative	42	87.5	46	92.0	
Thickened CHL:					
Positive	6	12.5	2	4.0	0.155
Negative	42	87.5	48	96.0	
Increased rotator interval soft tissue:					
Positive	5	10.4	0	0.0	–
Negative	43	89.6	0	0.0	
Calcific tendinitis:					
Positive	7	14.6	2	4.0	0.088
Negative	41	85.4	48	96.0	

There was no significant correlation between shoulder pain, clinical limitation of the affected shoulder movement, and ultrasound findings in the diabetic group, with all *p*-values >0.05 as shown in Tables (6,7).

The duration of diabetes didn't differ significantly among diabetic patients who had positive ultrasound findings as well as positive clinical features with *p*-values >0.05.

Ultrasound revealed a sensitivity of 82.6% and 67.4% sensitivity in detecting the underlying cause of shoulder pain and clinical shoulder limitation of movement, respectively, with 50% specificity.

Also, the dynamic ultrasound limitation of movement of SST was significantly different from the clinical limitation of movement with a sensitivity of 85.7%, a specificity of 41.2%, and a *p*-value of 0.000, (Fig. 2).

Table (6): Correlation between shoulder pain and ultrasound findings in diabetic group.

	Shoulder pain				*p*-value
	No		Yes		
	N	%	N	%	
Acromioclavicular OA:					
No	3	37.5	13	32.5	0.78
Yes	5	62.5	27	67.5	
SST tendinopathy:					
No	5	62.5	15	37.5	0.19
Yes	3	37.5	25	62.5	
SST tear:					
No	6	75.0	29	72.5	0.88
Yes	2	25.0	11	27.5	
BT Tenosynovitis:					
No	5	62.5	35	87.5	0.08
Yes	3	37.5	5	12.5	
Sub-acromial bursitis:					
No	7	87.5	35	87.5	1.0
Yes	1	12.5	5	12.5	
Limitation of movement of SST:					
No	6	75.0	28	70.0	0.77
Yes	2	25.0	12	30.0	
Thickened CHL:					
No	8	100.0	34	85.0	0.24
Yes	0	0.0	6	15.0	
Increased rotator interval soft tissue:					
No	7	87.5	36	90.0	0.83
Yes	1	12.5	4	10.0	

Table (7): Correlation between clinical limitation of shoulder movement and ultrasound findings in diabetic group.

	Limitation of movement				*p*-value
	No		Yes		
	N	%	N	%	
Acromioclavicular OA:					
No	5	31.3	11	34.4	0.82
Yes	11	68.8	21	65.6	
SST tendinopathy:					
No	6	37.5	14	43.8	0.67
Yes	10	62.5	18	56.3	
SST tear:					
No	13	81.3	22	68.8	0.35
Yes	3	18.8	10	31.3	
BT Tenosynovitis:					
No	13	81.3	27	84.4	0.78
Yes	3	18.8	5	15.6	
Sub-acromial bursitis:					
No	14	87.5	28	87.5	1.0
Yes	2	12.5	4	12.5	
Limitation of movement of SST:					
No	14	87.5	20	62.5	0.07
Yes	2	12.5	12	37.5	
Thickened CHL:					
No	13	81.3	29	90.6	0.35
Yes	3	18.8	3	9.4	
Increased rotator interval soft tissue:					
No	15	93.8	28	87.5	0.50
Yes	1	6.3	4	12.5	

The mean thickness of SST was 7.35±1.95mm at the glenoid level in diabetic patients and 5.06± 2.11mm in control patients. SST thickness mean was 8.08±2.13mm at the median level of the tendon in diabetic patients and 5.47±2.14mm in control patients. The mean biceps tendon thickness was 3.81±1.19mm in diabetic patients and 3.43±0.74mm in control patients. Themean thickness of CHL was 0.55±0.34mm in diabetic patients and 0.47± 0.29mm in the control group, (Fig. 3). The thickness of SST increased at both glenoid and at the median level of the tendon in diabetic patients than in controlpatients ($p<0.05$) (Fig. 2). There was no difference between groups in terms of BT and CHL thickness (Table 8).

Subacromial bursitis and increased rotator interval soft tissue were significantly detected as combined findings incoherent with SST tear, either partial or complete, in the diabetic group (Table 9).

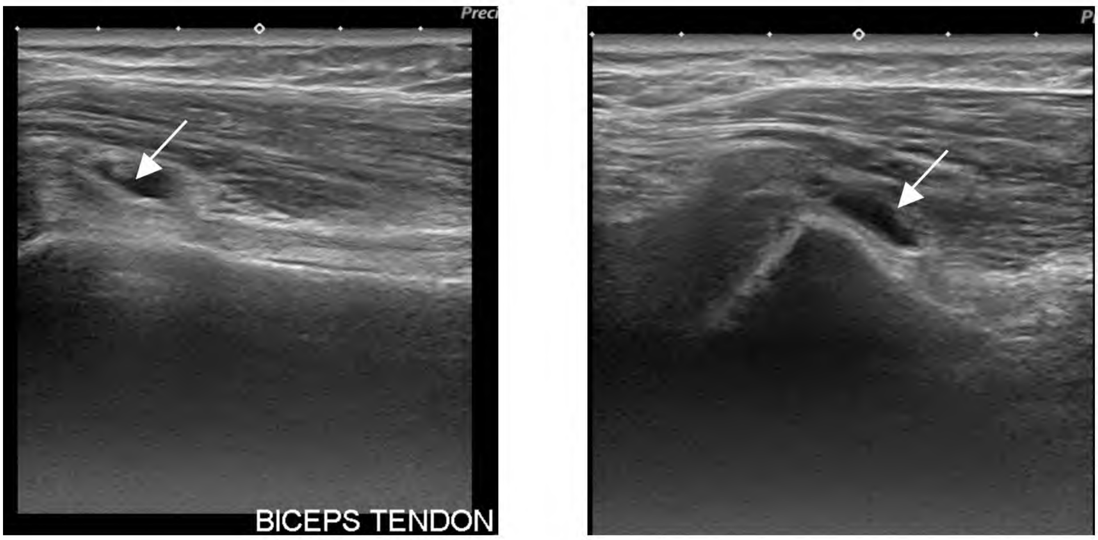
Table (8): Comparison of the SST thickness, Biceps thickness and CHL between both groups.

	Diabetic group				Control group				*p*-value
	Mean	SD	Minimum	Maximum	Mean	SD	Minimum	Maximum	
Age	52.65	5.93	39.00	62.00	50.42	7.63	36.00	66.00	0.111
SST thickness at insertion (mm)	7.35	1.95	4.40	10.50	5.06	2.11	2.50	9.90	<0.001
SST thickness at medial edge (mm)	8.08	2.13	4.70	10.70	5.47	2.14	2.80	10.30	<0.001
Biceps thickness (mm)	3.81	1.19	2.40	7.40	3.43	0.74	2.20	6.00	0.063
CHL (mm)	0.55	0.34	0.22	2.00	0.47	0.29	0.20	2.00	0.198

Table (9): Combined findings in diabetic patients.

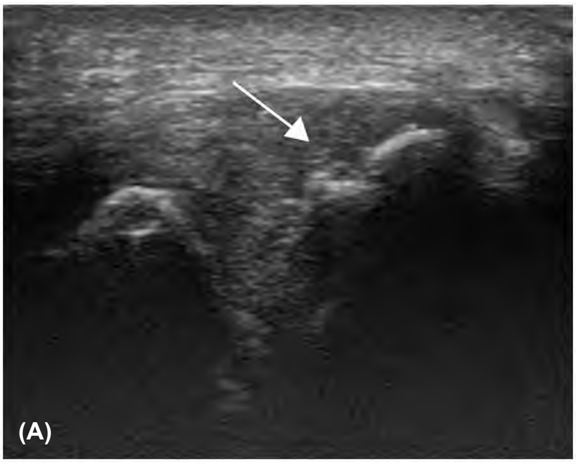
Diabetic group	SST complete tear				*p*-value
	Positive		Negative		
	Count	%	Count	%	
Increased rotator interval soft tissue:					
Positive	5	71.4	0	0.0	<0.001
Negative	2	28.6	41	100.0	
Subacromial bursitis:					
Positive	6	85.7	0	0.0	<0.001
Negative	1	14.3	41	100.0	

Diabetic group	SST partial tear				*p*-value
	Positive		Negative		
	Count	%	Count	%	
Increased rotator interval soft tissue:					
Positive	5	83.3	0	0.0	<0.001
Negative	1	16.7	42	100.0	
Subacromial bursitis:					
Positive	6	100.0	0	0.0	<0.001
Negative	0	0.0	42	100.0	



(A) (B)

Fig. (1): 40 year old female patient diabetic 3 years ago complaining of left shoulder pain and limitation of movement for 1 years. (A) Hypoechoic fluid is seen along the tendon sheath of long head of biceps. (B) Hypoechoic fluid is seen within the subacromial/subdeltoid bursa. Diagnosis wasbicipital tendon tenosynovitis with subacromial/subdeltoid bursitis.



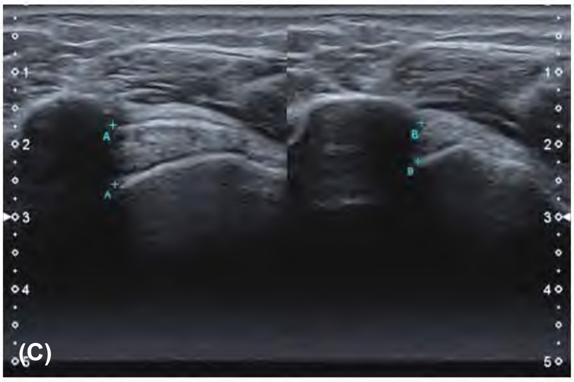


Fig. (2): 60 year old female patient diabetic for 15 years presented with severe right shoulder pain since two years ago with severe limitation of movement of her shoulder. Static US images shows (A) Acromio-clavicular osteoarthritis. (B) Swollen supraspinatus tendon measuring 7.5 mm at glenoid and 7.5mm at medial edge with ill-defined hypoechogenicity yet with preserved fiber continuity. (C) Dynamic examination: Showed marked narrowing of the subacromial tunnel with limited movement on raising arm up (measuring 0.57cm on raising arm up after 0.37cm). Diagnosis was acromio-clavicular osteoarthritis with secondary impingement syndrome and supraspinatus tendinopathy.

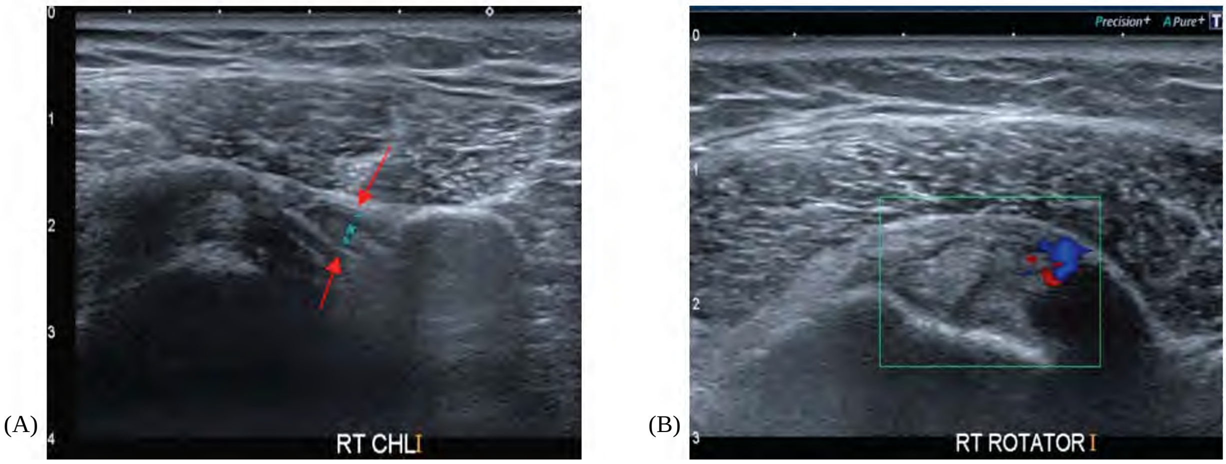


Fig. (3): 49 years old female patient diabetic 7 years ago complaining of right shoulder pain and difficulty of its movement. Static US image showed (A) Thickened CHL measuring 1.4mm. (B) Rotator cuff interval soft tissue thickening with prominent vascularity. The diagnosis was adhesive capsulitis.

Discussion

Currently, DM affects 240 million people worldwide, and this number is projected to increase to 380 million by 2025. Alarmingly, 80% will affect low and middle-income countries **[14]**.

Many studies show that degenerative changes in MSK joints increase with age. Aging increases degenerative changes with or without pain and/or limitation of motion of the affected joint. In addition to the degenerative changes, DM has a dramatic effect on overall MSK system disorders, but its exact etiology is still uncertain **[1]**.

A total of 48 diabetic patients were included in our final analysis, with a mean age of 52.65 5.9 SD years old. Of the included patients, 35.4% were males, and 64.6% were females. Our findings were consistent with a recent meta-analysis conducted on diabetic patients who were assessed by ultrasound for shoulder joint pain and revealed a mean age of 56.1 years, with a large portion of shoulder pathologies occurring in females [15].

Diabetic patients with SST tears were significantly older than others who had an intact SST, with a *p*-value of 0.026.Subacromial bursitis and dynamic US SST limitation were more frequently reported in older patients with *p*-values of 0.007 and 0.003, respectively. Yamaguchi et al., [16] concluded that older diabetic patients are more prone to SST tears, and we agree with Abate et al., [17] who discovered that older diabetic patients have a higher risk of SST limitation of movement as well as shoulder bursitis, which can reach 50%.

A non-significant positive correlation between age and SST thickness in both groups and a significant positive correlation displayed between BT thickness and age in diabetic patients with *p*-value <0.05 were detected in our study. This was consistent with Uchendu E et al., [18] that showed there was a positive correlation between SST thicknesses with increasing subjects' age in diabetics.

The sonographic features of tendon degeneration elicited in men were generally different from women in terms of SST tendinopathy as it was mostly detected in females in both study groups. On the other hand, Uchendu E et al., [18] showed that there was no significant gender difference in tendinous degenerative changes among groups.

The duration of diabetes didn't differ significantly among patients who had positive ultrasound findings as well as positive clinical features with *p*-values >0.05. These findings disagreed with Kidwai et al., [19], who reported that shoulder joint abnormalities were directly correlated to the duration of diabetes with a *p*-value of 0.001.

We also were not matched with a study performed by Uchendu E et al., [18] that stated that subjects with more than ten years' duration of diabetes had significantly higher SST thickness and a higher prevalence of effusion compared to those who had the disease for less than ten years.

In our study, 83.3% were presented with shoulder pain, while 66.7% had limitations in shoulder movement. These findings were in line with Kidwai et al., [19] population-based study that showed that the most frequent musculoskeletal abnormality among diabetic patients was shoulder joint adhesive capsulitis. On the other hand, aprospective study done by Makepeace et al., [20] confirmed that the hand was the most commonly affectedjoint in diabetic patients, they were mainly affected by joint stiffness and limitation of movement.

When comparing both diabetic and control groups' ultrasound findings, we concluded that there was a statistically significant difference between both groups in terms of the presence of AC osteoarthritis, SST tendinopathy, and SST complete tear ($p<0.05$), whereas there was no statistically significant difference in terms of the other findings. These were almost incoherent with a study by Sibel Ç and EsraÇ. [1] conducted among diabetic and non-diabetic groups and showed that there was a statistically significant difference between groups in terms of the presence of calcific tendinitis and tear in SST ($p<0.05$), whereas there was no difference in terms of BT.

The thickness of SST was increased at both the glenoid and at the median level of the tendon in diabetic patients than in control patients ($p<0.05$). There was no difference between groups in terms of BT thickness ($p>0.05$). These results were agreed with Sibel Ç and Esra Ç [1] who stated the same findings.

The SST thickness measurements showed significant gender discrepancies at its insertion and at the medial edge, with *p*-value <0.05 in both groups. This was also mentioned in a study by Shanmugam et al., [21] who stated that there was a significant difference between men and women for the dominant and non-dominant sides in healthy individuals.

In our study, CHL thickness showed a significant positive correlation with age *p*-value in both groups with *p*-value <0.05. Also, it was found to be non-significantly thicker in the diabetic group as compared to the control group. This was in line with Tandon et al., [6] but the CHL thickness comparison between groups was significant.

Tandon et al., [6] stated that the rotator cuff interval was known to be important in the motion of the glenohumeral joint and it has been implicated in the pathogenesis of adhesive capsulitis in recent studies. The presence of increased soft tissue in the rotator interval with increased vascularity associated with thickening and contraction of CHL combined with restricted shoulder abduction was found to enhance the sensitivity and specificity parameters for early diagnosis of adhesive capsulitis. These were observed in our study as a combined factor in the diabetic group in comparison with the control group.

Our results agreed with Abdelzaher et al., **[22]** who conducted a cross-sectional study to detect underlying shoulder joint pathologies. Ultrasound showed a sensitivity of 96.6% and specificity of 93.3% in detecting SST tendinopathy and a sensitivity of 87.5% and specificity of 97.6% in detecting subacromial-subdeltoid bursitis. As well, sensitivity was 85.7% and specificity was 95.7% for detecting acromioclavicular osteoarthritis.

The results of Aminzadeh et al., **[23]** also agreed with ours. The highest sensitivity of ultrasound was observed in the detection of full-thickness tears (93.7%) and rotator cuff tendinopathy (90%). The specificity for detection of full-thickness rotator cuff tears was almost 100% and for partial-thickness rotator cuff tears, 96.7%.

In our dynamic ultrasound, we found the limitation of movement of SST was significantly different from the clinical limitation of movement with a sensitivity of 85.7%, specificity of 41.2%, and *p*-value of 0.0001. The significance of this finding is the early diagnosis of symptomatic shoulder rotator cuff lesions and early management of such cases to avoid their hazardous progression.

The limitations of this study included a small sample size, reducing the generalizability of the findings. We didn't assess the correlation between glycemic control and shoulder joint pathologies, which could be a risk factor for severity or types of shoulder joint abnormalities, as well as we didn't assess the range of motion in degrees, which could be a reference range of motion for future studies.

Conclusion:

There is an increase in the range of asymptomatic shoulder pathologies in diabetics that is aggravated by aging. Real-time ultrasound with its high sensitivity andspecificity provides a well-tolerated, non-invasive, convenient, and cost-effective method of evaluating these shoulder lesions and their early diagnosis. It can also be used as a follow-up tool after therapy.

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دراسة حالة مراقبة لتقييم الموجات فوق الصوتية لمفصل الكتف بين مرضى السكرى وغير المصابين بالسكرى

الاضطرابات العضلية الهيكلية هى واحدة من أكثر المضاعفات شيوعاً لدى مرضى السكرى. ألام الكتف والحد من الحركة هى الشكاوى الأكثر شيوعاً.

الهدف من هذه الدراسة هو تقييم الأداء التشخيصى للموجات فوق الصوتية عالية الدقة فى تشخيص ألام مفصل الكتف لدى مرضى السكرى.

أجريت هذه الدراسة على ٤٨ من النوع الثانى لمرضى السكرى الذين يشكون من ألام الكتف و/أو الحد من حركة الكتف. تم إجراء التصوير بالموجات فوق الصوتية ذات التدرج الرمادى، ومقارنة النتائج مع خمسين حالة سليمة.

كان سمُك وتر عضلة الكتف (SST) أكبر بكثير فى مرضى السكرى منه فى الضوابط. لم تكن هناك علاقة كبيرة بين ألام الكتف، والحد السريرى لحركة مفصل الكتف، ونتائج الموجات فوق الصوتية فى مجموعة مرضى السكرى.

ومع ذلك، كانت هناك تمزقات كبيرة، والتهاب كيسى تحت الأكرومى، والحد من حركة نتائج الموجات فوق الصوتية فى مرضى السكرى الأكبر سناً مقارنة بالمرضى الأصغر سناً، كشفت الموجات فوق الصوتية عن حساسية بنسبة ٨٢.٦٪ فى الكشف عن السبب الكامن وراء ألام الكتف. كما أظهرت حساسية بنسبة ٦٧.٤٪ وخصوصية بنسبة ٥٠٪ فى الكشف عن السبب الكامن وراء تقييد حركة الكتف.