



# Ultrasonographic Evaluation of Shoulder in Patients with Diabetes Mellitus

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## ABSTRACT

**Objective:** Shoulder degeneration and rotator cuff tears increase with age and become a frequent cause of shoulder pain. Diabetes mellitus (DM) is the most common endocrine disorder causing pathologies in the musculoskeletal system. In our study, we aimed to evaluate shoulder morphology in diabetic and control groups.

**Methods:** Fifty two diabetic patients (62.4±9.6 years) and 46 non-diabetic patients (66.2±7.8 years) with no shoulder pain were included in the study. Ultrasonographic evaluation was performed on right shoulder using the standard protocol. The examination was performed multiplanar with a linear probe (5-13 MHz).

**Results:** Calcific tendinitis was detected in 8 of diabetic patients (17.4%) and in 7 of control patients (13.5%). Partial tear was detected in supraspinatus tendon in 4 of diabetic patients (8.7%) and in 1 of control patients (1.9%). Full-thickness tears were found in supraspinatus tendon in 8 of diabetic patients (17.4%) and in 2 patients (3.8%). Biceps tendinitis was detected in 10 of diabetic patients (19.0%) and in 6 of control patients (13.0%). There was a significant difference between groups in terms of frequency of calcific tendinitis, presence of supraspinatus tendon tear, and frequency of biceps tendinitis ( $p<0.05$ ).

**Conclusion:** According to the results of our study, DM accelerates shoulder degeneration. Ultrasonography is an inexpensive and reliable imaging method that allows evaluation of shoulder problems.

**Keywords:** Ultrasound, shoulder, diabetes mellitus

## Introduction

Diabetes mellitus (DM) is an endocrine disorder characterized by hyperglycemia due to impaired insulin secretion and/or activity. It is the most common endocrine pathology that causes skeletal system complications and diabetic patients with late diagnosis and who receive medical treatment late can easily be affected by complications such as neuropathy, nephropathy and retinopathy (1,2). In 2004, the American National Health Survey showed that 58% of diabetic patients had functional losses (3). Increased protein glycosylation due to DM in soft tissues and periarticular structures, deterioration of microvascular structure and impaired

collagen accumulation are the causes of changes in muscle skeletal system (4).

Musculoskeletal system complications of DM are not only in joints. DM also causes functional loss by the involvement of bones and soft tissues. Ultrasound studies show that findings such as rotator cuff rupture and degeneration in the shoulder increase with age. This rate ranges between 1-15% in patients aged 60 years and ranges between 30-50% in patients aged 80 years (5,6). Studies with magnetic resonance imaging (MRI), which provides the opportunity to evaluate the pathologies of the shoulder, show that shoulder pathologies increase with age as studies with

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ultrasonography show, but high cost of MRI prevents the use of it as a screening test (7,8).

In this study, we aimed to compare the supraspinatus and biceps tendons (BT) in patients with DM which is the most common endocrine pathology that causes skeletal system complications, with non-diabetic patients in the same age group and to investigate the effect of DM on these muscles.

### Methods

The study was approved by İstanbul Bakırköy Dr. Sadi Konuk Training and Research Hospital Ethics Committee (number: 2018-113). All patients were informed about the study and informed consent was taken from all patients.

Right shoulder joints of 52 diabetic patients and 46 controls were evaluated between January 2016 and May 2016 in İstanbul Bakırköy Dr. Sadi Konuk Training and Research Hospital. Right hand was dominant in all diabetic patients and controls.

### Study Group

Fifty two (20 males, 32 females) asymptomatic patients with DM type 2 with mean age 62.4±9.6 years were evaluated. Mean time of DM diagnosis and follow up duration was 10.3±7.5 years.

The duration of DM in patients and for how many years the patients received treatment were learned. Hemoglobin (Hb) A1c level and body mass index (BMI) were measured in all patients.

### Control Group

Forty six patients (20 males, 26 females) with mean age of 66.2±7.8 years who were admitted to our hospital for other examinations, who did not have DM and who did not have a complaint about shoulder were evaluated. HbA1c level and BMI were measured in all patients.

BMI, comorbid diseases and medications of all participants in both groups were asked and recorded.

### Ultrasonographic Evaluation

Right shoulders of all patients were evaluated with ultrasound in the neutral position while sitting. In ultrasonographic examination, 5-13 MHz linear prob (Esaote MyLab 5; Genova, Italy) was used. The evaluation was carried out by a specialist experienced in musculoskeletal system ultrasonography. The standard protocol developed by Papatheodorou et al. (9) was used in evaluation.

Supraspinatus tendon (SST) was measured near the lateral head of the humerus in the longitudinal axle, while BT head was measured in the bisipital groove. Subacromial and subdeltoid bursitis were evaluated. Hypo-hyperechoic appearance in tendon, deterioration of fibrillar structure, dishomogeneous fibrillar structures were evaluated in favor of degeneration. While evaluating the tears of SST: 1) partial tears are seen as irregular bordered hypoechoic fields in intratendinous, bursal or articular side and bursal side tears flatten the bursal side and cause a decrease in the superior convexity of the tendon. Tears near the articular side are seen hypo-hyperechoic mix on the articular surface next to the joint cartilage, 2) full thickness tears contain the damaged areas that extend from the bursal surface to the articular surface intratendinously and may be filled with synovial fluid and cause loss in the upper convexity of tendon. Also, when pressed with transducer, it is seen that the deltoid muscle is in contact with the humerus head.

### Statistical Analysis

Statistical analysis was performed with SPSS (SPSS Inc., Chicago, IL) package program version 16. Statistical significance level was accepted as p<0.05. Data were expressed as mean ± standard deviation. Age, BMI and HbA1c level were evaluated in the study and control groups. Demographic data were evaluated. Search for calcific tendinitis, tear in SST and biceps tendinitis were made. Percentages of the distribution of data in the groups were given. Supraspinatus and BT thickness were evaluated by ultrasound. Independent sample t-test was used to determine the difference between groups.

### Results

The BMI was 29.6±4.2 kg/m<sup>2</sup> in the DM group and 33.6±4.6 kg/m<sup>2</sup> in the control group. HbA1c was 8.0%±1.7 in the DM group and 5.7%±0.2 in the control group (Table 1).

There was no difference between groups in terms of age, gender and BMI (p>0.05), whereas there was significant difference between groups in terms of HbA1c (p<0.05) (Table 1).

Calcific tendinitis was detected in 8 (17.4%) diabetic patients and 7 (13.5%) control patients. Partial tear in SST was detected in 4 (8.7%) diabetic patients and 1 (1.9%) control patients. Full thickness tear in SST was detected in 8 (17.4%) diabetic patients and 2 (3.8%) control patients. Biceps tendinitis was detected in 10 (19.0%) diabetic patients and in 6 (13.0%) control patients.

**Table 1.** Demographic features of the patients

|                                      | Diabetic patients | Control patients | Statistical analysis* |
|--------------------------------------|-------------------|------------------|-----------------------|
| Gender (female/male)                 | 32/20             | 26/20            | p>0.05                |
| Body mass index (kg/m <sup>2</sup> ) | 29.6±4.2          | 33.6±4.6         | p>0.05                |
| HbA1c (%)                            | 8.0±1.7           | 5.7±0.2          | p<0.05                |
| Age (years)                          | 62.4±9.6          | 66.2±7.8         | p>0.05                |

Hb: hemoglobin  
\*t-test

**Table 2.** Ultrasonographic evaluation of calcific tendinitis, tear in supraspinatus tendon and biceps tendinitis

|   | Diabetic patients | Control patients | Statistical analysis* |
|---|-------------------|------------------|-----------------------|
| Calcific tendinitis                         | 8 (17.4%)         | 7 (13.5%)        | p<0.05                |
| Partial tear in supraspinatus tendon        | 4 (8.7%)          | 1 (1.9%)         | p<0.05                |
| Full thickness tear in supraspinatus tendon | 8 (17.4%)         | 2 (3.8%)         | p<0.05                |
| Biceps tendinitis                           | 10 (19.0%)        | 6 (13.0%)        | p>0.05                |

Frequency (percentage in the group); \*t-test

**Table 3.** Ultrasonographic evaluation of thickness of supraspinatus and biceps tendon

|  | Diabetic patients   | Control patients    | Statistical analysis* |
|--|---------------------|---------------------|-----------------------|
| Thickness of supraspinatus tendon at glenoid level (mm)              | 7.9±1.4 (4.1-10.2)  | 6.6±0.5 (5.2-7.3)   | p<0.05                |
| Thickness of supraspinatus tendon at the median level of tendon (mm) | 6.4±1.3 (3.0-9.3)   | 5.4±0.8 (3.8-6.6)   | p<0.05                |
| Thickness of biceps tendon (mm)                                      | 12.6±4.4 (5.5-22.0) | 12.4±2.4 (8.0-18.0) | p>0.05                |

Mean ± standard deviation (minimum-maximum values); \*t-test

There was 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 (Table 2).

The thickness of SST was 7.9±1.4 mm at glenoid level in diabetic patients and 6.6±0.5 mm in control patients. SST thickness was 6.4±1.3 mm at the median level of tendon in diabetic patients and 5.4±0.8 in control patients. BT thickness was 12.6±4.4 mm in diabetic patients and 12.4±2.4 mm in control patients. Thickness of SST was increased both at glenoid and at the median level of 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) (Table 3).

## Discussion

Many studies show that degenerative changes in the shoulder increase with age (9-11). Aging increases degenerative changes in shoulder with or without pain and/or limitation of motion as well as in whole body (6,7).

In addition to degenerative pathologies that are increasing with aging, patients with DM are reported to have more frequent pathologies in the shoulder joint such as frozen shoulder and rotator cuff tear, and the risk of rupture in patients undergoing surgical repair is known to increase (12).

Yamaguchi et al. (13) reported that the pain and limitation of joint motion might occur on the basis of asymptomatic tearing, which could be the result of the degenerative process increasing with age.

As a result of minor or unaware trauma, tendinopathies can be observed in patients with DM due to reactive inflammation following trauma, as well as effusion can be observed in bursas and peritendinous structures, and can show itself with increased tendon thickness (14-18). We found increased SST thickness, more calcific tendinitis and tears in SST in diabetic patients than in control patients which may be explained by the common mechanisms that biochemical age-related degeneration and

diabetic degeneration have and by more collagen degeneration in diabetic patients.

The effect of DM on degeneration is thought to be due to the degenerative effect of advanced glycation end products (AGEs) on collagen which develops as a result of non-enzymatic glycosylation of collagen. AGEs are produced by the spontaneous condensation of glucose and the formation of metabolic intermediate products and covalent bonding between free amino acids; arginine, lysine, and hydroxylysine (19-21). AGEs causes changes in the properties of proteins, physically and chemically, hardening of the bonds between collagen, stiffness and ultimately weakening, and tearing of collagen structure (20).

In addition to increasing AGEs with aging, microvascular diseases cause tissue hypoxia, resulting in free oxygen radicals formation and excessive growth factor and cytokine production, which cause increase in tendon thickness and decrease in tissue flexibility, and increase predisposition to damage (22).

## Study Limitations

Studies with high number of patients with evaluation of more joints will provide more informative findings about the early pathologies of DM.

## Conclusion

Our study showed that DM could increase asymptomatic degeneration in supraspinatus and biceps muscles of the shoulder. Ultrasonography is an important and cheap diagnostic tool that assists in diagnosis of pathologies and degeneration during asymptomatic period, does not have radioactive content and makes it possible to assess the patient at the bedside. Ultrasonography in asymptomatic period may give information about possible tendon and muscle pathologies to be encountered.

## Ethics

**Ethics Committee Approval:** The study was approved by İstanbul Bakırköy Dr. Sadi Konuk Training and Research Hospital Ethics Committee (number: 2018-113).

**Informed Consent:** All patients were informed about the study and informed consent was taken from all patients.

**Peer-review:** Externally peer-reviewed.

### Authorship Contributions

Surgical and Medical Practices: S.Ç.O., E.Ç., Concept: S.Ç.O., E.Ç., Design: E.Ç., Data Collection or Processing: S.Ç.O., E.Ç., Analysis or Interpretation: S.Ç.O., E.Ç., Literature Search: E.Ç., Writing: S.Ç.O.

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### References

- American Diabetes Association. Diagnosis and classification of diabetes mellitus. *Diabetes Care* Jan 2008;31:55-60.
- Ardic F, Soyupek F, Kahraman Y, Yorgancioglu R. The musculoskeletal complications seen in type II diabetics: predominance of hand involvement. *Clin Rheumatol* 2003;22:229-33.
- Egede LE. Diabetes, major depression, and functional disability among U.S. adults. *Diabetes Care* 2004;27:421-8.
- Birch HL. Tendon matrix composition and turnover in relation to functional requirements. *Int J Exp Pathol* 2007;88:241-8.
- Itoi E, Minagawa H, Yamamoto N, Seki N, Abe H. Are pain location and physical examinations useful in locating a tear site of the rotator cuff? *Am J Sports Med* 2006;34:256-64.
- Milgrom C, Schaffler M, Gilbert S, van Holsbeeck M. Rotator-cuff changes in asymptomatic adults. The effect of age, hand dominance and gender. *J Bone Joint Surg Br* 1995;77:296-8.
- Moosmayer S, Smith HJ, Tariq R, Larmo A. Prevalence and characteristics of asymptomatic tears of the rotator cuff: an ultrasonographic and clinical study. *J Bone Joint Surg Br* 2009;91:196-200.
- Needell SD, Zlatkin MB, Sher JS, Murphy BJ, Uribe JW. MR imaging of the rotator cuff: peritendinous and bone abnormalities in an asymptomatic population. *AJR Am J Roentgenol* 1996;166:863-7.
- Papatheodorou A, Ellinas P, Takis F, Tsanis A, Maris I, Batakis N. US of the shoulder: rotator cuff and non-rotator cuff disorders. *Radiographics* 2006;26:e23.
- Reilly P, Macleod I, Macfarlane R, Windley J, Emery RJ. Dead men and radiologists don't lie: a review of cadaveric and radiological studies of rotator cuff tear prevalence. *Ann R Coll Surg Engl* 2006;88:116-21.
- Abate M, Schiavone C, Salini V. Sonographic evaluation of the shoulder in asymptomatic elderly subjects with diabetes. *BMC Musculoskelet Disord* 2010;11:278.
- Namdari S, Baldwin K, Glaser D, Green A. Does obesity affect early outcome of rotator cuff repair? *J Shoulder Elbow Surg* 2010;19:1250-5.
- Yamaguchi K, Ditsios K, Middleton WD, Hildebolt CF, Galatz LM, Teefey SA. The demographic and morphological features of rotator cuff disease. A comparison of asymptomatic and symptomatic shoulders. *J Bone Joint Surg Am* 2006;88:1699-704.
- Fukuda H, Hamada K, Yamanaka K. Pathology and pathogenesis of bursal side rotator cuff tears viewed from en bloc histologic sections. *Clin Orthop Relat Res* 1990;254:75-80.
- Goodmurphy CW, Osborn J, Akesson EJ, Johnson S, Stanescu V, Regan WD. An immunocytochemical analysis of torn rotator cuff tendon taken at the time of repair. *J Shoulder Elbow Surg* 2003;12:368-74.
- Hegedus EJ, Cook C, Fiander C, Wright A. Measures of arch height and their relationship to pain and dysfunction in people with lower limb impairments. *Physiother Res Int* 2010;15:160-6.
- Ishii H, Brunet JA, Welsh RP, Uthoff HK. "Bursal reactions" in rotator cuff tearing, the impingement syndrome, and calcifying tendinitis. *J Shoulder Elbow Surg* 1997;6:131-6.
- Rudzki JR, Adler RS, Warren RF, Kadrmas WR, Verma N, Pearle AD, Lyman S, Fealy S. Contrast-enhanced ultrasound characterization of the vascularity of the rotator cuff tendon: age- and activity-related changes in the intact asymptomatic rotator cuff. *J Shoulder Elbow Surg* 2008;17(Suppl 1):96S-100S.
- De Groot J. The AGE of the matrix: chemistry, consequence and cure. *Curr Opin Pharmacol* 2004;4:301-5.
- Dutta U, Cohenford MA, Guha M, Dain JA. Non-enzymatic interactions of glyoxylate with lysine, arginine, and glucosamine: a study of advanced non-enzymatic glycation like compounds. *Bioorg Chem* 2007;35:11-24.
- Reiser KM. Nonenzymatic glycation of collagen in aging and diabetes. *Proc Soc Exp Biol Med* 1998;218:23-37.
- Ippolito E, Natali PG, Postacchini F, Accinni L, De Martino C. Morphological, immunochemical, and biochemical study of rabbit achilles tendon at various ages. *J Bone Joint Surg Am* 1980;62:583-98.