

# Sonographic Findings of Shoulders in Parkinson's Disease

## Parkinson Hastalığında Omuzlarda Ultrasonografik Bulgular

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**Objectives:** The aim of this study was to draw attention to the lesions of the shoulders in Parkinson's disease (PD) and to evaluate the difference between the patients with mild and severe PD.

**Patients and Methods:** Sixty-seven shoulders of 35 patients (14 females, 53 males; mean age, 66.4±9.5 years; range 40 to 85 years) with PD were included in the study. Patients were divided into two groups according to the Hoehn & Yahr (H&Y) clinical stage: in the first group 30 shoulders of patients with mild PD (H&Y stage I-II), and in the second group 37 shoulders of patients with severe PD (H&Y stage III-IV) have been evaluated. All of the patients underwent shoulder sonography. Thicknesses of the rotator cuff tendons and the acromiohumeral distances were measured and abnormal findings have been recorded. Data were statistically analyzed by the t-test and chi-square tests.

**Results:** There was no significant difference in any of the parameters between the patients with mild and severe PD ( $p>0.05$ ). Effusion in the subacromial-subdeltoid bursa was detected in severe patients (29.7%) more often than mild ones (16.7%). Full-thickness tears were seen in the supraspinatus tendon of three severe patients (8.1%) and in the infraspinatus tendon of one patient (2.7%).

**Conclusion:** Advanced shoulder pathologies are more frequently seen in severe patients with PD than the mild ones. Sonography can be the first-line imaging modality in the PD patients who cannot undergo magnetic resonance imaging because of rest tremor.

*Key Words:* Musculoskeletal diseases; Parkinson disease; shoulder; ultrasonography.

**Amaç:** Bu çalışma Parkinson hastalığındaki (PH) omuz deformitelerine dikkat çekmek, erken ve ileri evre Parkinson hastalarında fark olup olmadığının belirlenmesi amacıyla planlandı.

**Hastalar ve Yöntemler:** Çalışmaya 35 Parkinson hastasının (14 kadın, 53 erkek; ort. yaş, 66.4±9.5 yıl; dağılım 40-85 yıl) 67 omzu dahil edildi. Hastalar Hoehn & Yahr (H&Y) ölçeğine göre iki gruba ayrıldı: Birinci grupta erken evre Parkinson hastalarının (H&Y evre I-II) 30 omzu, ikinci grupta ileri evre (H&Y evre III-IV) Parkinson hastalarının 37 omzu değerlendirildi. Tüm hastalara omuz ultrasonografisi uygulandı. Rotator kılıf tendon kalınlığı ve akromi-yohumeral mesafeler ölçülerek anormal bulgular kaydedildi. Verilerin analizi için t-testi ve ki-kare testi kullanıldı.

**Bulgular:** Erken evre ve ileri evre hastalarda parametrelerin hiçbirinde istatistik olarak anlamlı sonuç elde edilmedi ( $p>0.05$ ). Subakromial-subdeltoid bursada efüzyon, ileri evre hastalarda (%29.7) erken evre hastalara göre (%16.7) daha yüksekti. Tam kalınlıkta yırtılma, ileri dönem hastalardan üçünün supraspinatus tendonunda (%8.1), birinin ise infraspinatus tendonunda (%2.7) gözlemlendi.

**Sonuç:** İleri evredeki hastalarda omuz patolojileri erken evrede olanlara göre daha sık gözlenmektedir. Ultrasonografi istirahat tremoru nedeniyle manyetik rezonans çekilemeyen hastalarda ilk seçenek görüntüleme yöntemi olabilir.

*Anahtar Sözcükler:* Kas-iskelet sistemi hastalıkları; Parkinson hastalığı; omuz; ultrasonografi.

Parkinson's disease (PD) is a common movement disorder, and the diagnosis of PD is based on the presence of the core features of slowness and paucity of movements (bradykinesia and akinesia) and tremor. The classic tremor of PD is a rest tremor in a limb, most commonly a hand, that disappears with voluntary movement.<sup>[1]</sup>

Joint and skeletal deformities are common and frequently under-recognized features of PD that often cause marked functional disability independent of other motor symptoms.<sup>[2]</sup>

Although magnetic resonance imaging (MRI) is the best imaging tool for the diagnosis of musculoskeletal system pathologies, it is very sensitive to motion, which causes artefacts. Ultrasound (US) imaging is widely used for the evaluation of the pathologic conditions of the rotator cuff and it has specific advantages over the MRI.<sup>[3,4]</sup>

The aim of this study is to draw attention to the lesions of the shoulders in PD using sonography and answer the question whether there is any difference between the patients with mild and severe PD.

## PATIENTS AND METHODS

### Patient population

Sixty-seven shoulders of 35 patients with PD (14 females, 53 males; mean age  $66.4 \pm 9.5$  years; range 40 to 85 years) were included into the study according to Hoehn & Yahr (H&Y) clinical staging. The patients with PD were divided into two groups according to the H&Y staging scale. The H&Y staging scale summarized in Tablo 1 describes five stages of PD beginning with unilateral disease and progressing through end-stage disease.<sup>[5]</sup> Patients in stage V were excluded from the study.

The first group consisted of 30 shoulders of mild patients (H&Y stage I-II) with an age range

of 51-83 years (mean age:  $64.3 \pm 8.8$  years). The second group consisted of 37 shoulders of severe patients (H&Y stage III-IV) with an age range of 40-85 years (mean age:  $68.1 \pm 9.9$  years). As previous studies have shown that substantial rotator cuff pathology may be detected in asymptomatic older patients,<sup>[6-8]</sup> an age-matched control group was not established.

A small questionnaire was applied for the evaluation of the following information: age, gender, general medical history, shoulder and other musculoskeletal symptoms and injuries, existence of akinesia and tremor. Patients who had myocardial infarction, stroke, chronic lung disease, diabetes mellitus, rheumatoid arthritis, frozen shoulder and shoulder pain, history of shoulder pathologies, i.e. trauma, dislocation, fracture or surgery and cervical spine disease history were also excluded from the study.

Written informed consent was obtained from each patient. All of the patients with PD underwent shoulder sonography.

### Sonographic technique

All sonography examinations were performed with a real-time equipment (Toshiba Nemio 20 System, Toshiba, Japan) and an 11-MHz linear high-resolution probe by the same radiologist. The sonographic examinations were made with patients seated on a revolving stool. Standardized protocol for the US evaluation of the rotator cuff was employed. The long head of the biceps and the supraspinatus, infraspinatus and subscapularis tendons are evaluated in both transverse and longitudinal planes in proper position. The thicknesses of the each tendon, cross-sectional area of the long head of the biceps tendon and the acromiohumeral distance were measured. The long head of the biceps was examined with

**Table 1.** Description of patients with Parkinson's disease according to Hoehn & Yahr staging scale

H&Y staging scale	Descriptions
Stage I	Only unilateral involvement, usually with minimal or no functional impairment
Stage II	Bilateral or midline involvement without impairment of balance
Stage III	Physically capable of leading independent lives, mild to moderate disability
Stage IV	Fully developed Parkinson's disease, still able to walk and stand unassisted but markedly incapacitated
Stage V	Confinement to bed or wheelchair unless aided

**Table 2.** Measurements of each parameter of the patients with mild and severe Parkinson's disease

Parameters	Mild (n=30) Mean±SD	Severe (n=37) Mean±SD	<i>p</i> *
Supraspinatus†	6.83±1.5	6.47±1.1	0.239
Infraspinatus†	4.48±1.1	4.1±0.47	0.065
Subscapularis†	4.51±0.49	4.69±0.93	0.340
Biceps‡	10.22±3.44	8.97±3.15	0.123
AHD	9.60±1.6	10.0±1.5	0.268

\*: Compared by using the t-test; †: Tendon thickness: mm; ‡: Cross-sectional area of long head of biceps: mm<sup>2</sup>; AHD: Acromiohumeral distance: mm.

the elbow flexed 90° and hand supinated and resting on the thigh. The measurement of the cross-sectional area of the tendon was obtained at the level of the most proximal part of the bicipital groove. The supraspinatus tendon was examined with the patient's arm flexed at the elbow and directed posteriorly, and with the palm of the hand placed over the posterior iliac crest. The measurement point of this tendon was the end of the fibrocartilaginous insertion on the medial side. The subscapularis tendon was examined in orthogonal planes with the patient's arm in passive external rotation. In the infraspinatus tendon examination, the patient's bent arm was next placed in front of his or her chest, and the tendon was visualized from a posterior approach. The subscapularis and infraspinatus tendon thicknesses were measured at the point of the thickest level.

Increasing tendon thickness and/or diffuse heterogeneous hypoechogenicity were accepted as tendinosis.<sup>[3,9]</sup> Full-thickness rotator cuff tear diagnosis included nonvisualization or absence of rotator cuff tissue and a full thickness hypoechoic defect.<sup>[10]</sup>

Fluid inside the subacromial-subdeltoid bursa, glenohumeral joint and other abnormal findings were also recorded.

### Statistical analysis

Statistical analysis was done using a SPSS version 13.0 (SPSS Inc., Chicago, Illinois, USA) statistical program. Data were analyzed statistically by the t-test and chi-square test. All parametric results were expressed as mean ± standard deviation for each group. Local statistical significance was assumed as  $p < 0.05$  for all parameters.

### RESULTS

There was no significant difference for any parameters, except for one, between the patients with mild and severe PD ( $p > 0.05$ ). The measurements of each parameter were summarized in Table 2. There was a significantly higher frequency of tremor ( $p = 0.011$ ) in the mild PD group than the severe ones. Although it was not statistically significant, the thicknesses of the supraspinatus and infraspinatus tendons were lower in severe patients than the mild ones (mild vs. severe: 6.83±1.5 mm vs. 6.47±1.1 mm and 4.48±1.1 mm vs. 4.1±0.47 mm, respectively).

The most frequent sonographic finding was tendinosis, especially in the supraspinatus tendon. Interestingly, mild patients had more abnormalities in the biceps tendon than the severe ones. Again, although it was not statistically significant, the biceps tendon cross sectional area in mild patients (10.22±3.44 mm<sup>2</sup>) was greater than the severe ones (8.97±3.15 mm<sup>2</sup>). While abnormal effusion of the biceps tendon sheath was seen in 26.7% of mild patients and tendinosis was observed in 6.7% of them; in severe patients, these ratios were 24.3% and 5.4%, respectively. Surprisingly, one mild patient had a partial tear of the long head of the biceps tendon (3.3%).

Effusion in the subacromial-subdeltoid bursa was detected in severe patients (29.7%) more often than the mild ones (16.7%).

While no tears were detected in mild patients, a full-thickness tear in the supraspinatus tendon was seen in three shoulders (8.1%) and in the infraspinatus tendon of one shoulder (2.7%) belonging to severe patients. Magnetic resonance imaging was applied for the verification of the tears.

**Table 3.** The frequencies of all parameters of the patients with mild and severe Parkinson's disease

Parameters	Mild		Severe	
	n	%	n	%
Supraspinatus				
Tendinosis	15	50	10	27
Full-thickness tear	–	–	3	8.1
Calcification	5	16.7	4	10.8
Infraspinatus				
Tendinosis	1	3.3	3	8.1
Full-thickness tear	–	–	1	2.7
Subscapularis				
Tendinosis	–	–	3	8.1
Biceps				
Tendinosis	2	6.7	2	5.4
Partial tear	1	3.3	–	–
Fluid in tendon sheath	8	26.7	9	24.3
Effusion in subacromial-subdeltoid bursa	5	16.7	11	29.7

The frequencies of all parameters of the patients are shown in Table 3.

### DISCUSSION

To the best of our knowledge, musculoskeletal pathologies of PD have not been studied in the radiology literature.

Ultrasound has been shown to be an effective imaging modality in the evaluation of the rotator cuff, usually serving in a complementary role to MRI of the shoulder.<sup>[3]</sup> However, while the MRI is cost-intensive and time-consuming, the US is more available, faster, and has a higher resolution and dynamic capabilities.<sup>[3,4]</sup> Additionally, in the study, the US was the more suitable modality for the patients with tremor than an MRI, because movement appearing especially at rest causes artefacts in the MRI.

Tremor is one of the cardinal signs of PD most often observed when the body part is rest. It is classically a 4-6 Hz rest tremor and most often occurs in the hands.<sup>[11]</sup> As an extrinsic mechanism in rotator cuff tear, repetitive microtrauma is considered by many investigators to be a more relevant factor than acute trauma.<sup>[10]</sup>

The interesting finding was that the mild patients had more abnormalities in the biceps tendon than the severe ones, like effusion of the biceps tendon sheath, tendinosis and partial tear. Tears of the long head of the biceps tendon result

mainly as a complication of a supraspinatus injury.<sup>[12]</sup> Differentiation between tendinosis and a partial tear is not feasible on the US findings alone and requires correlation with the clinical data. In partial tears, the tendon appears swollen and hypoechoic, particularly at the level of the cranial biceps sulcus.<sup>[12]</sup> In the mild PD case, this appearance was evaluated as partial tear.

In mild patients, the cross sectional area of the long head of the biceps tendon was greater than the severe ones, although this was not statistically significant. Increasing cross sectional area of the biceps tendon supports the diagnosis of tendinosis. Another interesting finding was that the frequency of tremor was significantly higher in the mild PD group than the severe ones. As a repetitive microtrauma, tremor could predispose tendinosis of the long head of the biceps tendon in mild patients.

The supraspinatus tendon is most commonly involved in the anterosuperior impingement of the shoulder. Because of the anatomic location and reduced vascular supply of its lateral portion, the so-called "critical area", it is prone to degeneration and tears.<sup>[12]</sup> As expected, the main pathologies were focused on the supraspinatus tendon in the study. Tendinosis was the most frequent sonographic finding detected especially in the supraspinatus tendon. The ratio of the tendinosis and thicknesses of the supraspinatus and infraspinatus tendons were greater in mild

patients, unlike the severe patients in whom this was the case only in the supraspinatus tendon.

These results could be explained by the developing rotator cuff tear process: at the beginning, the tendinosis with a thickening of the tendon is seen in mild patients, and later, a thinning of the tendon with microtears and atrophy develops in severe patients.<sup>[10]</sup>

There were several limitations of this study: Firstly, the mean age of the patient population was  $66.4 \pm 9.5$  years and it was difficult to form an age-matched control group consisting of a geriatric population without shoulder disturbances.<sup>[6-8]</sup> Secondly, there were the sonographic techniques: the main disadvantage of the US is its operator-dependence, related mainly to the slow learning curve.<sup>[12]</sup> Anisotropy is a common cause of false positive diagnoses of rotator cuff tears and it is especially important to differentiate between tendinosis and partial thickness tears.<sup>[9,10]</sup>

In conclusion, advanced shoulder pathologies, like effusions in the subacromial-subdeltoid bursa and tears in the rotator cuff tendons were more frequently observed in severe patients with PD than the milder ones. Although sonography is not an ideal method of diagnosis for shoulder pathologies, it may be the first-line imaging modality in the patients with PD who cannot undergo an MRI examination because of rest tremor. Further studies with a wider patient population are needed to evaluate the shoulder and other musculoskeletal diseases of PD patients.

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