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ORIGINAL ARTICLE

The clinical, functional, and radiological features of hand osteoarthritis: TLAR-osteoarthritis multi-center cohort study

Mehmet Tuncay Duruöz[1], Didem Erdem Gürsoy[2], Tiraje Tuncer[3], Lale Altan[4], Figen Ayhan[5], Ajda Bal[6], Meral Bilgilisoy[7], Lale Cerrahoğlu[8], Erhan Çapkın[9], Hasan Fatih Çay[7], Remzi Çevik[10], Berrin Durmaz[11], Deniz Dülgeroğlu[6], Gülcan Gürer[12], Savaş Gürsoy[13], Simin Hepgüler[11], Sami Hizmetli[14], Cahit Kaçar[15], Ece Kaptanoğlu[16], Taciser Kaya[17], Hilal Ecesoy[18], Meltem Alkan Melikoğlu[19], Kemal Nas[20], Hakan Nur[3], Şüheda Özçakır[4], Merih Sarıdoğan[21], Selda Sarıkaya[22], İlhan Sezer[15], Dilşad Sindel[23], Nilay Şahin[24], Özlem Şahin[25], Ömer Faruk Şendur[26], Gülnur Taşçı Bozbaş[27], Canan Tıkız[8], Hatice Uğurlu[27]

[1]Department of Physical Medicine and Rehabilitation, Division of Rheumatology, Marmara University School of Medicine, Istanbul, Turkey
[2]Department of Physical Medicine and Rehabilitation, Rheumatology Clinic, Prof. Dr. Cemil Taşcıoğlu City Hospital, Istanbul, Turkey
[3]Department of Physical Medicine and Rehabilitation, Akdeniz University School of Medicine, Antalya, Turkey
[4]Department of Physical Medicine and Rehabilitation, Uludağ University School of Medicine, Bursa, Turkey
[5]Department of Physical Medicine and Rehabilitation, Atılım University School of Medicine, Ankara, Turkey
[6]Department of Physical Medicine and Rehabilitation, University of Health Sciences, Dışkapı Yıldırım Beyazıt Training and Research Hospital, Ankara, Turkey
[7]Department of Physical Medicine and Rehabilitation, Antalya Training and Research Hospital, Antalya, Turkey
[8]Department of Physical Medicine and Rehabilitation, Celal Bayar University School of Medicine, Manisa, Turkey
[9]Department of Physical Medicine and Rehabilitation, Karadeniz Technical University School of Medicine, Trabzon, Turkey
[10]Department of Physical Medicine and Rehabilitation, Dicle University School of Medicine, Diyarbakır, Turkey
[11]Department of Physical Medicine and Rehabilitation, Ege University School of Medicine, Izmir, Turkey
12Department of Physical Medicine and Rehabilitation, Division of Rheumatology, Adnan Menderes University School of Medicine, Aydın, Turkey
[13]Department of Physical Medicine and Rehabilitation, Gaziantep University School of Medicine, Gaziantep, Turkey
[14]Department of Physical Medicine and Rehabilitation, Division of Rheumatology, Cumhuriyet University School of Medicine, Sivas, Turkey
[15]Department of Physical Medicine and Rehabilitation, Division of Rheumatology, Akdeniz University School of Medicine, Antalya, Turkey
[16]Department of Physical Medicine and Rehabilitation, Division of Rheumatology, Başkent University Zübeyde Hanım Application and Research Center, Izmir, Turkey
[17]Department of Physical Medicine and Rehabilitation, University of Health Sciences, Izmir Faculty of Medicine, Izmir, Turkey
[18]Department of Physical Medicine and Rehabilitation, Division of Rheumatology, Karamanoğlu Mehmetbey University School of Medicine, Karaman, Turkey
[19]Department of Physical Medicine and Rehabilitation, Division of Rheumatology, Atatürk University School of Medicine, Erzurum, Turkey
[20]Department of Physical Medicine and Rehabilitation, Sakarya University School of Medicine, Sakarya, Turkey
[21]Department of Physical Medicine and Rehabilitation, Istanbul University Cerrahpaşa School of Medicine, Istanbul, Turkey
[22]Department of Physical Medicine and Rehabilitation, Bülent Ecevit University School of Medicine, Zonguldak, Turkey
[23]Department of Physical Medicine and Rehabilitation, Istanbul University Istanbul School of Medicine, Istanbul, Turkey
[24]Department of Physical Medicine and Rehabilitation, Balıkesir University, Balıkesir, Turkey
[25]Department of Physical Medicine and Rehabilitation, Cumhuriyet University School of Medicine, Sivas, Turkey
[26]Department of Physical Medicine and Rehabilitation, Adnan Menderes University School of Medicine, Aydın, Turkey
[27]Department of Physical Medicine and Rehabilitation, Necmettin Erbakan University School of Medicine, Konya, Turkey

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Correspondence: Didem Erdem Gürsoy, MD. Prof. Dr. Cemil Taşcıoğlu Şehir Hastanesi, Romatoloji Kliniği, 34384 Şişli, İstanbul,, Türkiye.
Tel: +90 544 - 594 00 23 e-mail: didem_blue86@hotmail.com

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ABSTRACT

Objectives: This study aims to evaluate the clinical, functional, and radiological features of hand osteoarthritis (OA) and to examine their relationships in different geographic samples of the Turkish population.

Patients and methods: Between April 2017 and January 2019, a total of 520 patients (49 males, 471 females; mean age: 63.6±9.8 years) with hand OA were included in the study from 26 centers across Turkey by the Turkish League Against Rheumatism (TLAR). The demographic characteristics, grip strengths with Jamar dynamometer, duration of hand pain (month), the severity of hand pain (Visual Analog Scale [VAS]), and morning stiffness were evaluated. The functional disability was evaluated with Duruöz Hand Index (DHI). The Kellgren-Lawrence (KL) OA scoring system was used to assess the radiological stage of hand OA.

Results: The DHI had significant correlations with VAS-pain (r=0.367, p<0.001), duration of pain (r=0.143, p=0.001) and bilateral handgrip strengths (r=-0.228, p=0.001; r=-0.303, p<0.001). Although DHI scores were similar between the groups in terms of the presence of hand deformity (p=0.125) or Heberden's nodes (p=0.640), the mean DHI scores were significantly higher in patients with Bouchard's nodes (p=0.015). The total number of nodes had no significant correlations with the VAS-pain and DHI score (p>0.05). The differences between the groups of radiological hand OA grades in terms of age (p=0.007), VAS-pain (p<0.001), duration of pain (p<0.001), and DHI (p<0.001) were significant. There were no significant differences between radiological hand OA grades according to the duration of the stiffness, grip strength, and BMI (p>0.05 for all).

Conclusion: In our population, the patients with hand OA had pain, functional disability, and weak grip strength. The functional impairment was significantly correlated with the severity of the pain, and the functional status was worse in high radiological hand OA grades.

Keywords: Function, grip strength, hand osteoarthritis, pain.

Hand osteoarthritis (OA) is a heterogeneous disease with varying symptoms that involve different joints.[1] Its prevalence varies depending on the definition. The most commonly used definitions are radiographic OA and symptomatic OA. While the radiographic definition includes only radiographic joint signs, the symptomatic definition includes both radiographic findings and joint symptoms.[2]

According to the Framingham study, the prevalence of symptomatic hand OA was 15.9% and 8.2% in women and men, respectively.[1] In the Rotterdam study, 67% of the women and 54.8% of the men aged over 55 years had radiographic OA.[3] The prevalence of symptomatic hand OA in patients aged over 70 years was higher in women (26.2%) than in men (13.4%).[4]

Symptomatic hand OA frequently affects multiple joints and occurs in a symmetrical pattern.[5] Typical symptoms are pain and mild morning or inactivity stiffness. The symptoms are often intermittent and affect target joints (distal and proximal interphalangeal joints, index and middle metacarpophalangeal joints, and thumb base), and the Heberden's nodes, Bouchard's nodes and bony enlargement are the clinical hallmarks of hand OA.[6]

Radiographic evaluation is widely used to evaluate the structural damage of hand OA. There are various methods to assess the radiographic findings of hand OA,[7] but the most frequently used method is the Kellgren-Lawrence (KL) scoring system.[8] The associations between radiographic hand OA and hand pain and function are controversial. There is evidence that radiographic hand OA is associated with pain. On the other hand, the evidence for the relationship between radiographic hand OA and hand function ranges from none to moderate.[9]

Symptomatic hand OA is associated with weak grip strength and impaired hand function, and it seems to be mediated by pain.[4,10,11] Furthermore, Heberden's and Bouchard's nodes can affect hand function and lead to poor cosmesis.[10,12]

In the present study, we aimed to determine the clinical, functional, and radiological features of hand OA and to evaluate their relationships in different geographic samples of the Turkish population.

PATIENTS AND METHODS

This national multi-center, cross-sectional study was conducted by the Turkish League Against Rheumatism (TLAR) between April 2017 and January 2019. A total of 520 patients (49 males, 471 females; mean age: 63.63±9.75 years) with hand OA were included in the study from 26 centers across Turkey. All patients were diagnosed with hand OA according to the American College of Rheumatology (ACR) diagnostic criteria.[13] Patients with a history of amputation, inflammatory arthritis, hand trauma, psychiatric diseases, and severe

neurological disease that can affect hand function were excluded from the study.

The demographic and clinical characteristics of the patients, body mass index (BMI), and dominant hand finger ratio (second to fourth finger length) were evaluated. Grip strengths (kg) of both hands were assessed in a standard procedure with a Jamar dynamometer.[14] The deformities of the hand (squaring of first carpometacarpal [CMC] joint, proximal and distal interphalangeal [DIP] joint deformities), Heberden's nodes, and Bouchard's nodes were evaluated during physical examination. Deformities were defined as subluxation and adduction of the thumb base and lateral deviation of DIP joints.

Hand joint symptoms

Pain duration (month), pain severity (Visual Analog Scale [VAS]), and duration of stiffness (min) were evaluated.

Functional disability assessment

The hand functional disability was assessed with Duruöz Hand Index (DHI). It is a self-report functional disability scale containing 18 items on daily living activities. Each question is scoring from 0 to 5. The total score ranges from 0 to 90.[15] A higher score indicates a greater level of limitations. Although it was originally developed as a practical functional disability scale for rheumatoid hands, the reliability and validity of the DHI in OA were conducted.[16] The DHI is used to evaluate functional disability in different hand arthropathies, such as the diabetic hand.[17]

Radiographic assessment

Anteroposterior radiographs of both hands were evaluated using standard techniques for each patient. Radiographic damages in both hands were scored according to the modified KL scale.[8] According to the KL, Grade 0: no OA; Grade 1: minimal OA; Grade 2: mild OA; Grade 3: moderate OA; Grade 4: severe OA.[1]

Bilateral thumb interphalangeal (IP) joint, and the thumb base joints (CMC/scaphotrapezial joint), second to fifth DIP joints, second to fifth proximal interphalangeal (PIP) joints, and first to fifth metacarpophalangeal (MCP) joints were assessed. The highest grade was noted as the OA stage of the right and left hand.

Statistical analysis

Statistical analysis was performed using the IBM SPSS for Windows version 25.0 software (IBM Corp., Armonk, NY, USA). Descriptive data were expressed in mean ± standard deviation (SD), median (min-max) or number and frequency, where applicable. The chi-square test was used to analyze relationships between categorical variables. The Mann-Whitney-U test was used to compare two sample means. The correlations between quantitative variables were evaluated with the Spearman correlation coefficient. The Kruskal-Wallis test and post-hoc test were used to examine age, pain severity, duration of pain, function, grip strength according to radiological hand OA stages. A p value of <0.05 was considered statistically significant.

Table 1. Sociodemographic characteristics of the patients

	n	%
Sex		
Female	471	90.6
Male	49	9.4
Educational status		
Primary school	227	44.0
High school	76	14.7
University	45	8.7
Not literate	107	20.7
Literate	61	11.8
Marital status		
Married	384	74.6
Single	12	2.3
Divorced/Widow	119	23.1
Working status		
Housewife	236	48.9
Retired	117	24.2
Active employee (office)	11	2.3
Active employee (physical)	36	7.4
Unemployed	83	17.2
Place of residence		
Rural	427	82.8
Urban	89	17.2
Smoking status		
Current smoker	30	5.9
Ex-smoker	66	13.1
Non-smoker	427	81.0
Family history of osteoarthritis		
Yes	288	56.7
No	220	43.3
Family history of Heberden's nodes		
Yes	194	38.4
No	311	61.6

RESULTS

There was no significant difference between women and men in terms of age (p=0.767). Demographic features of the participants are shown in Table 1.

The mean BMI was 29.47±4.52 kg/m^2 and the rate of obesity (BMI ≥30 kg/m^2) was 42.5%. The rate of right hand dominance was 85.2%. Hand deformity (squaring and DIP joint deformity) was found in 53.4% of the patients. There were Heberden's nodes and the Bouchard's nodes in 86.3% and 36.5% of the patients, respectively. For the right and left hand, Heberden's nodes were most frequently detected in the third finger (62.3% and 58.8%), and Bouchard's nodes were similarly detected most frequently in the third finger (21.5% and 18.1%). The mean number of Heberden's nodes was 4.24±2.65. The median number of Bouchard's nodes was two (range, 0 to 8). The mean second finger-to-fourth finger ratio was 0.96±0.057. The mean grip strengths of the right and left hands were 20.91±11.96 kg and 18.84±10.74 kg, respectively.

Table 2. The clinical and disease characteristics of the patients

	%	Mean±SD	Median	Min-Max
Body mass index (kg/m^2)		29.47±4.52		
Obesity	42.5			
Right-hand dominance	85.2			
Hand deformity (squaring and DIP joint deformity)	53.4			
Heberden's nodes (%) and involvement pattern	86.3			
Right 2nd finger	53.3			
Right 3rd finger	62.3			
Right 4th finger	45.8			
Right 5th finger	42.3			
Left 2nd finger	49.4			
Left 3rd finger	58.8			
Left 4th finger	37.5			
Left 5th finger	41.0			
Bouchard's nodes (%) and involvement pattern	36.5			
Right 2nd finger	15.2			
Right 3rd finger	21.5			
Right 4th finger	14.4			
Right 5th finger	14.0			
Left 2nd finger	14.0			
Left 3rd finger	18.1			
Left 4th finger	12.7			
Left 5th finger	12.5			
Total number of Heberden's nodes per hand		4.24±2.65		
Total number of Bouchard's nodes per hand			2	0-8
First CMC joint pain	46.5			
Right hand	42.1			
Left hand	40.4			
DIP joint pain				
Right hand	40.4			
Left hand	41.9			
Grip strength (kg)				
Right hand		20.91±11.96		
Left hand		18.84±10.74		
Pain duration (month)			24	1-480
VAS-pain		4.97±2.37		
Morning stiffness	47.4			
Duration of morning stiffness (min)			10	0-90
DHI score		16.42±14.80		

DIP: Distal interphalangeal; CMC: Carpometacarpal; VAS: Visual analog scale; DHI: Duruöz Hand Index.

Table 3. The correlation test results for Duruöz Hand Index scores

	r	p
Pain severity (VAS)	0.367	<0.001
Duration of pain (month)	0.143	0.001
Duration of joint stiffness (min)	0.246	<0.001
Grip strength (kg, right hand)	-0.228	0.001
Grip strength (kg, left hand)	-0.303	<0.001

VAS: Visual analog scale.

Table 4. The radiographic hand osteoarthritis grades according to the Kellgren-Lawrence scale

	Right hand X-ray		Left hand X-ray	
	n	%	n	%
Grade 0	17	3.6	19	4.0
Grade 1	80	16.9	99	21.1
Grade 2	171	36.1	165	35.1
Grade 3	128	27.0	117	24.9
Grade 4	78	16.4	70	14.9

The median duration of pain was 24 (range, 1 to 480) months. The mean pain VAS score was 4.97±2.37. The morning stiffness was found in 47.4% of the patients, and the median duration of morning stiffness was 10 (range, 0 to 90) min. The rate of patients with morning stiffness longer than 30 min was 3.1%. The mean DHI score was 16.42±14.80. Clinical and disease characteristics of the patients are given in Table 2.

The correlations of DHI with clinical parameters are given in Table 3. The DHI score had significant correlations with VAS-pain (r=0.367, p<0.001). Although DHI scores were similar between the groups in terms of the presence of hand deformity (p=0.125) or Heberden's nodes (p=0.640), the mean DHI scores were significantly higher in patients with Bouchard's nodes compared to patients who had no Bouchard's nodes (p=0.015). Moreover, DHI scores were found to be significantly higher in patients with Bouchard nodes in the fourth finger of the right hand (p=0.016) and the third (p=0.033) and fourth fingers (p=0.024) of the left hand. In addition, DHI scores were found to be higher in patients with the first CMC joint pain (p<0.001).

Although the total number of Heberden's nodes had no significant correlations with the duration of the stiffness, grip strength, VAS-pain, and DHI score (p>0.05), the total number of Bouchard's nodes had low correlations with the grip strength of right hand (r=0.243, p=0.009) and duration of the stiffness (r=0.230, p=0.001). No significant correlations between the number of Bouchard's nodes and VAS-pain (p=0.085) and DHI scores (p=0.130) were detected.

The radiological grades of the right-hand and left-hand OA according to the KL scoring are given in Table 4. The significant differences between the groups of radiological hand OA grades in terms of age (p=0.007), VAS-pain (p<0.001), duration of pain (p<0.001), and DHI (p<0.001) were found. While the DHI scores were higher in KL Grade 4 hand OA groups in both hands, the VAS-pain was significantly lower in KL Grade 0 hand OA groups. There were no significant differences between radiological hand OA grades according to the duration of the stiffness, grip strength, and BMI (p>0.05).

DISCUSSION

This national, multi-center OA study is the first community-based study in Turkey on clinical, radiological, and functional features of hand OA supported by the TLAR. The TLAR also published expert recommendations on managing of hand OA.[18]

Although the prevalence of hand OA increases with age, it is higher in women than in men.[1] In our study, 90.6% of the patients were women, and the mean age was 63.63±9.75 years and was similar between women and men. In addition, although conflicting results have been reported in the data regarding the impact of BMI on hand OA,[19-21] the mean BMI was high in our study population and 42% of patients had obesity.

Furthermore, the mean second-to-fourth finger ratio was 0.96±0.057 in the present study. Kalichman et al.[22] suggested that the finger ratio was associated with hand OA parameters. According to this study, females with a low finger ratio showed higher hand OA values. The mean finger ratio was also low in our study.

In the current study, we determined deformity (squaring and DIP joint deformity) in 53.4% of the patients, Heberden's nodes in 86.5%, and the Bouchard's nodes in 36.5% of the patients. In another study, among United States adults above 60 years old, 58% had Heberden's nodes, 29.9% had Bouchard's nodes, and 18.2% had first CMC deformities.[23] The authors reported that first carpometacarpal deformities were significantly more common in women than in men, but they excluded the DIP joint deformities. In our study, the majority of patients were females, and the percentage of deformities (thumb and DIP joint) was higher. Another study from Turkey among postmenopausal women with hand OA demonstrated that 85% of the patients had Heberden's nodes, and 36% had Bouchard's nodes, similar to our results.[12] Rees et al.[24] suggested that the nodes were more common in the dominant hand and affected most frequently the DIP joints of the index finger. In a recent study, Heberden nodes were observed more frequently on the dominant hand.[25] In our study, nodes were more common in the right-hand DIP joints of the third finger.

In the present study, the grip strengths of the patients were lower than the healthy population,[26] and patients had a different degree of functional impairment. Previous studies have reported that there are associations between symptomatic hand OA and grip strength and hand disability.[4] In a study, hand OA was shown to affect hand function, grip strength, and pain, and the associations with hand function and grip strength seemed to be mediated by pain.[10] Barthel et al.[11] also suggested that pain in hand OA could limit physical function, and any intervention to relieve the pain may improve the hand function. Similarly, we found that functional hand disability determined by DHI had a significant correlation with the severity of pain and pain duration. It also seems to be associated with the duration of morning stiffness.

Although DHI scores were not different between the groups in terms of the presence of hand deformity or Heberden's nodes, the mean DHI scores were higher in patients with Bouchard's nodes in our study. Moreover, DHI scores were higher in patients with Bouchard nodes in the fourth finger of the right hand and the third and fourth fingers of the left hand. Jones et al.[10] suggested that Heberden's nodes affected hand function. Bagis et al.[12] suggested that Heberden's and Bouchard's nodes negatively affect grip strength and function. However, according to our results, Heberden nodes and deformities seem to be not associated with hand function. On the other hand, Bouchard's nodes seem to affect hand function negatively. Furthermore, the total number of Heberden's nodes and Bouchard's nodes were not correlated with hand function and pain. As a result, hand function was associated with the presence and localization of Bouchard nodes, but not with the total number of nodes.

In addition, DHI scores were higher in patients with the first CMC joint pain. The presence of thumb base OA in non-erosive hand OA is an important factor for hand pain and disability.[27] The relationship between hand pain and functional disability has been demonstrated in these patients.[28]

Although most patients in our study had right-hand dominance, there were low correlations between DHI and handgrip strengths of both hands. While DHI assesses hand functional disability in daily living activities, grip strength reflects overall hand impairment. While grip strength is one of the most important functional abilities of the hand, it is associated with many factors such as age, sex, anthropometric measurements (height, BMI, hand size), hand dominance, occupations, and socioeconomic variables.[29,30] In other words, several factors other than joint-related factors seem to affect handgrip strength. Moreover, grip strength impairment may not affect all the daily functions. That may be the reason why we detected a low correlation between DHI and handgrip strength.

Furthermore, the mean grip strengths were not different between radiological hand OA groups. While the mean DHI scores were higher in KL Grade 4 hand OA groups in both hands, the VAS-pain and pain duration were significantly lower in KL Grade 0 hand OA groups. Although an association between radiographic hand OA and severity of pain was reported in a review, the association with hand function ranged from none to moderate.[9] Schaefer et al.[31] reported that patients who had KL Grade 3-4 hand OA were more likely to have pain. Kodama et al.[32] suggested that severe hand OA defined as KL Grade ≥3 was associated

with pain and grip strength. Ceceli et al.[33] found that radiological severity was correlated with age, hand function, and grip strength. Perrotta et al.[34] reported significant correlations between radiological severity of erosive hand OA and duration of symptoms and function. The results of another study showed a correlation between disease severity and grip strength.[35] According to a recent study, the severity of radiographic hand OA, and pain were associated with grip strength. Furthermore, sex, socioeconomic factors, and comorbidities also affect grip strength. In other words, in addition to hand OA, the general health of individuals can also affect grip strength.[36] Similar to our results, another study reported associations between the stage of radiographic hand OA and function, and pain.[37] Associations between the KL sum scores, and grip strength were also reported; however, we did not find weaker grip strength in higher radiographic hand OA stages. Although there were conflicting results in the literature, in our study, we found relationships between radiological hand OA and pain, and hand function impairment.

In conclusion, in our study population, including different geographic samples of Turkey, the patients diagnosed with hand OA had significant pain, hand disability, and weak grip strength. The functional impairment was significantly associated with weak grip strength and more severe and chronic pain, and the functional status was worse in patients with high radiographic grades.

Ethics Committee Approval: The study protocol was approved by the Akdeniz University, Faculty of Medicine Ethics Committee (No: 56, Date: 20.01.2016). . The study was conducted in accordance with the principles of the Declaration of Helsinki.

Patient Consent for Publication: A written informed consent was obtained from each patient.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

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