EJR European Journal of Rheumatology

DOI: 10.5152/eurjrheum.2017.160097

Original Article

Correlations between ultrasonographic findings, clinical scores, and depression in patients with knee osteoarthritis

Samia M Abd EL Monaem, Nashwa Ismail Hashaad, Noha Hosni Ibrahim

Abstract

Objective: This study aimed to explore correlations between the presence of depression, clinical scores, and ultrasonographic (US) grading in osteoarthritis (OA) patients and to clarify if depressive symptoms might cause a discrepancy between US findings and clinical scores.

Material and Methods: Two hundred patients with primary knee OA and 100 healthy hospital volunteers of the same age and sex not complaining of knee troubles participated in this study. We evaluated depressive symptoms in all participants using the Beck Depression Inventory (BDI) scale. Thorough clinical examination was performed, including assessment using the Western Ontario and McMaster Universities Osteoarthritis index (WOMAC) for disability. All patients underwent US examination of their affected knees.

Results: Depression was detected in 60 patients with knee OA (30%) and in 5 controls (5%). The mean of BDI score was 12.8±12.2 in OA patients and 5.8±3.2 in controls, and this difference was statistically significant (p=0.03). Correlations of BDI with both body mass index (BMI) (p=0.04) and Numerical Rating Scale of Pain (NRSP) score (p=0.006) were significant, while correlations of BDI with both the ages of our patients (p=0.74) and their disease duration (p=0.88) were insignificant. There were statistically significant correlations between patients' disease duration and US measurements regarding osteophyte length, lateral femoral cartilage thickness, medial femoral cartilage thickness, and thickness of the quadriceps tendon despite of the presence of insignificant correlations between disease duration and both the effusion volume and volume of Baker's cysts. There were statistically significant correlations between patients' disease duration and US measurements except for effusion volume and volume of Baker's cysts. There were statistically significant correlations between the NRSP score in OA patients and BDI (p=0.006) and all US measurements apart from lateral femoral cartilage thickness, medial femoral cartilage thickness, and thickness of quadriceps tendon. There were statistically significant correlations between BDI in OA patients and the WOMAC (p=0.005), Kellgren-Lawrence (KL) grading (p=0.034), and US grading (p=0.041).

Conclusion: The presence of knee effusion, Baker's cysts, osteophytes, and high BMI have a great impact on the pain and disability associated with OA. Higher clinical scores, radiographic scores, and US scores correlate with the emergence of depression in OA patients.

Keywords: Ultrasonography, depression score, osteoarthritis

Cite this article as: El Monaem SM, Hashaad NI, Ibrahim NH. Correlations between ultrasonographic findings, clinical scores, and depression in patients with knee osteoarthritis. Eur J Rheumatol 2017; 4: XX-XX.

Department of Rheumatology, Rehabilitation & Physical Medicine, Benha University School of Medicine, Benha, Egypt

Address for Correspondence: Nashwa Ismail Hashaad, Department of Rheumatology, Rehabilitation & Physical Medicine, Benha University School of Medicine, Benha, Egypt

E-mail: zeinahashaad@yahoo.com

Submitted: 5 November 2016
Accepted: 29 April 2017
Available Online Date: 20.06.2017

©Copyright by 2017 Medical Research and Education Association - Available online at www.eurjrheumatol.org.

Introduction

Osteoarthritis (OA) is considered one of the most frequent reasons for pain and debility and leads to significant problems for the individual and for society. The occurrence of OA increases with age, so longer life expectancy will result in an increase in OA in the future (1).

The knee is among the most common joints affected by OA. It is a weight-bearing joint that is crucial for function and is commonly linked with many complaints in OA (2). Pain in OA impedes the patient's capability to participate in vocational and non-vocational activities of daily living and diminishes their quality of life (3). Despite of the negative impact of OA pain, its underlying causes are not clear (4). Pain in OA is multifaceted and is triggered by both peripheral and central agents (5). Although treatment for knee OA is typically directed to peripheral origins, there is growing evidence that central nervous system factors might have a major role in OA pain in many individuals (6). Many of these symptoms are associated with increased pain severity in OA. The outcomes of OA pain include non–region-specific symptoms such as fatigue, cognitive problems, mood fluctuations, and sleep difficulties (7).

Musculoskeletal ultrasound (MSUS) has emerged as an important imaging modality for the assessment of various joint pathologies because it allows for direct visualization of the hyaline articular cartilage, menis-

ci, synovial membrane, bursa, and bone cortex (8). Therefore, ultrasonography is a safe, non-invasive, and rapid imaging modality that is useful for early diagnosis and follow up of OA, especially in joints with a wide acoustic window such as the knee (9).

Materials and methods

Study approval

This study obtained approval by the Research Ethics Committee, Benha University School of Medicine, Egypt. The aim and methods of this study and each research question were explained to all participants, and informed written consent was obtained from all of them prior to participation in this study.

Subjects

Two hundred OA patients diagnosed according to the American College of Rheumatology (ACR) criteria for knee OA (10) and 100 apparently healthy volunteers of the same age and sex as our patients were enrolled in this study. All of the patients and controls were recruited from the inpatient and outpatient clinics of the Rheumatology, Rehabilitation and Physical Medicine department, Benha University Hospitals.

Exclusion criteria included previous knee trauma; metabolic, blood, or rheumatic diseases; genetic bone or joint diseases; taking non-steroidal anti-inflammatory drugs or painkillers during the previous 24 hours; and any other painful condition or thyroid dysfunction.

Methods

A complete history was taken from each patient, and general and locomotor system examinations were performed. The Numerical Rating Scale of Pain (NRSP) was used for pain evaluation (11), and the Western Ontario and McMaster Universities Osteoarthritis index (WOMAC) was used to evaluate disease-specific self-reported disability. This index consists of three sections. Pain was assessed using the pain section of the WOMAC (WOMAC A), and the total subscore for pain can range between 0 and 20. The stiffness subscale of the WOMAC (WOMAC B) includes two items and has a total subscore of 0–8. The disability and functional status and the physical function sections of the WOMAC (WOMAC C) evaluate 17 different activities. Subjects rated the degree of difficulty experienced in the preceding 48 hours for each of the 17 activities using a 5-level numeric verbal descriptor scale with a total subscore ranging from 0 to 68. (12). Depression was evaluated using the translated Arabic version of the Beck Depression Inventory (BDI). The BDI is a 21-item questionnaire rated on a 0–3 scale for a total score of 0–63. A score of 9 indicates a depressive mood, 10–18 indicates mild depression, 19–29 indicates moderate depression, and 30–63 indicates severe depression (13).

Conventional radiological assessment

X-ray weight-bearing antero-posterior and Schuss-tunnel views were obtained for both knees in each subject. An experienced observer blinded to the patients' details evaluated each radiograph according to the Kellgren–Lawrence Index (KL) (14).

US assessment

A commercially available Logiq E real-time scanner (General Electric Medical Systems, Milwaukee, Wisconsin, USA) was used for the US examination of both knees using a high-frequency (8–13 MHz) linear transducer according to EULAR guidelines (15). In each patient, the US grading scale for degenerative cartilage changes in knee OA was applied for the pretentious knee (16).

Statistical analyses

SPSS version 20 software was used for the analysis. Differences between frequencies (qualitative variables) and percentages in groups were compared with the chi-square test (X^2), and differences between means (quantitative variables) in two parametric groups were compared by Student's t-test. Non-parametric data were compared by Mann–Whitney U test. Pearson's correlation was used.

Results

This study included 200 knee OA patients (160 females and 40 males) diagnosed according to ACR criteria for OA and 100 sex and age-matched apparently healthy controls. The patients ranged in age between 40 and 66 years with a mean age of 51.9±7.82 years, and the disease duration ranged from 6 to 60 months with a mean of 20.2±16.70 months. The NRSP score ranged from 5 to 9 with a mean of 6.4±1.33, and the total WOMAC score ranged from 20 to 80 with a mean of 53.6±18.0. On clinical examination, 20 patients (10%) had mild knee effusion, 30 patients (15%) had moderate knee effusion, and 50 patients (25%) had Baker's cysts. The mean BMI was 22.27±1.16 kg/m^2 in knee OA patients, while it was 21.79±2.34 kg/m^2 in the controls. Regarding US findings of the examined knees, there was a suprapatellar effusion in 60 patients (30%) with a mean volume 6.4±3.9 mm^3. Baker's cysts were detected in 25 patients (12.5%) with a mean volume of 702±3.83 mm^3, and osteophytes were detected in 60 patients (30%) with a mean length of 3.2±1.69 mm. The lateral and medial femoral cartilage had a mean thickness of 2.0±0.3 mm and 1.9±.3 mm, respectively, and the mean thickness of the quadriceps tendon was 4.9±0.37 mm (Table 1).

Table 1. Clinical data and ultrasonographic findings in OA patients

Finding	Mean	±SD.
Age (years)	51.9	±7.82
Disease duration (months)	20.2	±16.7
NRSP	6.4	±1.33
WOMAC	53.6	±18
BMI (kg/mm^2)	22.27	±1.16
BDI	184.69	±38.59
Effusion size (mm^3)	6.41	±.3.9
Baker cyst longitudinal diameter (mm)	4.92	±1.39
Baker cyst transverse diameter (mm)	2.21	±0.83
Osteophyte length (mm)	3.21	±.1.69
LFC thickness (mm)	2	±0.3
MFC thickness (mm)	1.9	±0.3.
Thickness of quadriceps tendon (mm)	4.9	±.037

NRSP: Numerical Rating Scale of Pain; WOMAC: Western Ontario and McMaster Universities Osteoarthritis index; BMI: Body mass index; BDI: Beck Depression Inventory; LFC: lateral femoral cartilage; MFC: medial femoral cartilage

Table 2. Comparison between patients and controls regarding the prevalence of depression and BDI scores

	Patients (n=200)	Controls (n=100)	Chi-square test	
			X2	p
Depression	60 (30.0 %)	5 (5.0 %)	4.7	0.03*
			Student's t-test	
			T	p
BDI	148.69±38	5.8±3.2	3.0	0.005*

BDI: Beck Depression Inventory; p>0.05: insignificant; p<0.05*: significant

Table 3. Comparison between patients with depression and patients without depression regarding the radiological and ultrasonographic (US) findings

		Depression (+) n=60	Depression (–) n=140	Chi-square test	
				X^2	p
KL grading	Stage I	-	14 (10%)	8.7	0.034*
	Stage II	12 (2 0%)	93 (66.7 %)		
	Stage III	41 (68.33 %)	33 (23.8 %)		
	Stage IV	7 (11.66 %)	-		
US score	Stage I	-	12 (8.57%)	4.09	0.021*
	Stage II	14 (2 3.33%)	95 (67.86 %)		
	Stage III	33 (55 %)	33 (23.57%)		
	Stage IV	13 (16.6%)	-		

KL: Kellgren–Lawrence Index. p>0.05: insignificant, p<0.05*: significant

Table 4. Correlations of different clinical findings and clinical scores in OA patients with ultrasonographic (US) findings

US finding		Disease duration	BMI	NRSP	WOMAC score
Effusion size/mm	r	0.54	1.46	3.08	3.11
	p	0.59	0.15	0.004	0.0031
Baker's cyst size/mm	r	0.41	0.68	2.83	2.11
	p	0.68	0.58	0.007	0.006
Osteophyte length/mm	r	2.23	8.44	2.91	7.14
	p	0.03	0.001	0.006	0.81
LFC cartilage thickness/mm	r	1.23	4.281	0.453	0.099
	p	0.02	0.045	0.505	0.7550
MFC cartilage thickness/mm	r	2.150	4.281	0.857	0.014
	p	0.037	0.045	0.360	0.970
Thickness of quadriceps tendon/mm	r	0.205	2.890	0.141	2.530
	p	0.276	.005	0.710	0.004

BMI: Body Mass Index; NRSP: Numerical Rating Scale of Pain; WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index; LFC: lateral femoral cartilage; MFC: medial femoral cartilage p>0.05: insignificant, p<0.05*: significant

There were 60 OA patients (30%) diagnosed as having depression versus 5 controls (5%). The mean BDI score was 12.8±12.2 in knee OA patients, while it was 5.8±3.2 in the controls, and this difference was highly significant (p=0.005) (Table 2). Depression was observed in 12 of the patients (20 %) classified as stage II according to KL grading, in 41 (68.33%) of the patients classified as Stage III, and in 7 (11.77%) of the patients classified as Stage IV. Depression was observed in 14 (23.33%) of the patients classified as class II according to US grading, in 33 (55 %) of those classified as class III, and in 13 (21.77%) of those classified as class IV (Table 3). There were significant correlations between the disease duration in OA patients and US findings regarding osteophyte length (p=0.003), the lateral femoral cartilage (LFC) thickness (p=0.02), the medial femoral cartilage (MFC) thickness (p=0.037), and the quadriceps tendon thickness (p= 0.007), but there was no correlation with either effusion volume (p=0.59) or Baker's cyst volume (p=0.68). There were significant correlations between OA patients' BMI and LFC thickness (p=0.045), MFC thickness (p= 0.045), and quadriceps tendon thickness (p=0001). There were no significant correlations between OA patients' BMI and US findings regarding effusion volume (p=0.15) or the volume of Baker's cysts (p=0.58). The NRSP score correlated significantly with US-measured effusion volume (p=0.004), osteophyte length (p=0.003), and Baker's cysts volume (p=0.007), but no significant correlation with US-measured LFC thickness (p=0.5), MFC thickness (p=0.360), or quadriceps tendon thickness (p=0.71). There were significant correlations between WOMAC and US-measured effusion volumes (p=0.0031), Baker's cysts volumes (p=0.006), and quadriceps tendons thickness (p=0.004). There were no significant correlations between WOMAC and osteophyte length (p=0.81), LFC thickness (p=0.755), or MFC thickness (p=0.970) (Table 4). There were statistically significant correlations between BDI and BMI (p=0.04), NRSP (p=0.006), and WOMAC (p=0.005), but there were no correlations between BDI and the ages of OA patients (p=0.74) or their disease duration (p=0.88). There were significant correlations between BDI score and both US (p=0.041) and KL (p=0.034) gradings (Table 5).

Table 5. Correlations between BDI and different clinical findings, clinical scores, and ultrasonographic (US) findings in OA patients

Variable	BDI	
Age	r	0.14
	p	0.47
Disease duration	r	0.03
	p	0.88
BMI	r	2.2
	p	0.04
NRSP score	r	3.0
	p	0.006*
WOMAC	r	3.1
	p	0.005*
KL grading	t	8.8
	p	0.034*
US grading	t	2.1
	p	0.041*

BDI: Beck Depression Inventory; BMI: Body Mass Index; NRSP: Numerical Rating Scale of Pain; WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index; p>0.05: insignificant, p<0.05*: significant

Discussion

Disability among the elderly is often linked to the pain associated with OA (2), which is assumed to be caused by both peripheral and central factors. The escalating nature of knee OA can lead to psychosocial deterioration in addition to physical inability, which makes it difficult to interpret the source of the patients' complaints. It is becoming increasingly evident that structural changes alone do not account for all musculoskeletal pain (17). In this study, we found that the frequency of depression among OA patients was 30%, with a highly statistically significant difference regarding BDI score between OA patients and healthy controls (p=0.005). This is similar to that reported by Ozcakir et al. (18) who found that 27% of their patients had moderate to mild depression. This also agreed with Kim et al. (19) who reported that 26.9% of patients with symptomatic knee OA had depressive symptoms. However, our results were very different from those of Leite et al. (20) who reported depression in 61.3% of patients as evaluated by the Goldberg depression questionnaire. This discrepancy might be explained by different sample sizes, different patient characteristics, and different depression assessment scales. In our study, Baker's cysts were detected in 50 OA patients (25%) by US measurements, whereas osteophytes and joint effusion were detected in 60% of the patients, which is in agreement with Chiou et al. (21) who found that Baker's cysts were demonstrated by MSUS in 21.2% of their patients and effusions were detected in 59.8%. However, they reported that osteophytes were detected in 48.8% of their patients, and this dissimilarity compared to our resultswas due to differences in disease duration. Our results are also consistent with those of Gaafar et al. (22) and Bevers et al. (23).

This work showed statistically significant correlations between the disease duration in OA patients and osteophyte length (p=0.03), LFC thickness (p=0.02), and MFC thickness (p=0.037), but no significant correlations were found between disease duration and the volume of knee effusion (p=0.59), Baker's cyst volume (p=0.19), or thickness of the quadriceps tendon (p= 0.276**)**. This was the same as observed by Naredo et al. (24). We found a significant correlation between knee effusion volume and NPRS score (p=0.004), which is in agreement with Hall et.al. (25) who found that US-detected knee effusions were significantly associated with pain level.

In this work, the WOMAC score correlated significantly with knee effusion volume (p=0.003), which is in agreement with Serban et al. (26). We also found significant correlations between Baker's cyst size and WOMAC score (p=0.003), which is in accordance with the observation of Chiba et al. (27) who documented that painful flare-ups in knee OA frequently arise from Baker's cysts. Our study showed no correlation between osteophyte length and WOMAC score (p=0.83), which is in agreement with Creamer et al. (28) who found no correlations between osteophyte length and pain severity or functional status in OA patients. In addition, our results support Cubukcu et al. (29) who reported that WOMAC scores were not related to the KL grading scale. We observed statistically significant correlations between the WOMAC score and quadriceps tendon thickness (p=0.004), which is in agreement with the results of Koca et al. (30). However, they demonstrated a significant correlation between disease duration and quadriceps tendon thickness that was in contrast to our findings. Our results showed statistically significant correlations between BMI in knee OA patients and osteophyte length (p=0.006), LFC thickness (p=0.045), MFC thickness (p=0.045), and quadriceps tendon thickness (p=0.0001), but no significant correlations were observed between BMI, effusions volumes (p=0.15), or Baker's cyst volumes (p=0.46), and these results are in agreement with Holmberg et al. (31).

We have revealed a highly statistically significant correlation between patients' BMI and BDI score for depression (p=0.04), which is consistent with Leonore et al. (32) and might be explained by the well-known contribution of obesity to depression. It is noteworthy that we observed a highly statistically significant correlation between BDI score and NRSP (p=0.006), which is in accordance with Power et al. (33) who found that OA pain determined subsequent depressed mood through its effect on fatigue and disability. Furthermore, we found a highly statistically significant correlation between BDI score and WOMAC (p=0.005), which is in agreement with the findings of Possley et al. (34). A statistically significant correlation was found between BDI score and KL score in knee OA (p=0.034) and US score (p=0.041), which is similar to Ozcakir et al. (17) who found that radiological grading is an important indicator for pain, debility, depression, and social withdrawal. Furthermore, our results are in accordance with Pereira et al. (35).

The presence of knee effusion, Baker's cysts, osteophytes, and high BMI have a great impact on the pain and disability associated with OA. Higher clinical scores, radiographic scores, and US scores are correlated with the emergence of depressive symptoms. Depression might be the culprit behind the discrepancy between radiological or US findings and the patients' clinical score.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Benha University School of Medicine.

Informed Consent: Written informed consent was obtained from patients who participated in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept - S.M.A., N.I.H.; Design - S.M.A.; N.I.H., N.H.I.; Supervision - S.M.A.; Materials - N.I.H., N.H.I.; Data collection - N.I.H., N.H.I.; Analysis and Interpretetion - S.M.A., N.I.H., N.H.I., Literature Search - N.H.I., N.H.I.; Critical review - S.M.A.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study has received no financial support.

References

1. Felson DT. Developments in the clinical understanding of osteoarthritis. Arthritis Res Ther 2009; 11: 203-14. [CrossRef]
2. Attur M, Krasnokutsky-Samuels S, Samuels J, Abramson SB. Prognostic biomarkers in osteoarthritis. Curr Opin Rheumatol 2013; 1: 136-44. [CrossRef]
3. Filardo G, Kon E, Buda R, Timoncini A, Di Martino A, Cenacchi A, et al. Platelet-rich plasma intra-articular knee injections for the treatment of degenerative cartilage lesions and osteoarthritis. Knee Surg Sports Traumatol Arthrosc 2011; 19: 528-35. [CrossRef]
4. Chappell AS, Desaiah D, Liu-Seifert H, Zhang S, Skljarevski V, Belenkov Y, et.al. A double-blind, randomized, placebo-controlled study of the efficacy and safety of duloxetine for the treatment of chronic pain due to osteoarthritis of the knee. Pain Pract 2011; 11: 33-41. [CrossRef]
5. Fitzcharles MA, Lussier D, Shir Y. Management of chronic arthritis pain in the elderly. Drugs Aging 2010; 27: 471-90 . [CrossRef]
6. Goldring MB, Otero M. Inflammation in osteoarthritis. Curr Opin Rheumatol 2011; 23: 471-8. [CrossRef]
7. Wise BL, Niu J, Zhang Y, Wang N, Jordan JM, Choy E, et al. Psychological factors and their relation to osteoarthritis pain. Osteoarthritis Cartilage 2010; 18: 883-7. [CrossRef]
8. Möller, D. Bong, E. Naredo, E. Filippucci, I. Carrasco, C. Moragues, et al. Ultrasound in the study and monitoring of osteoarthritis. Osteoarthritis Cartilage 2008; 16(Suppl 3): S4-S7. [CrossRef]
9. Grassi W, Filippucci E, Farina A. Ultrasonography in osteoarthritis. Semin Arthritis Rheum 2005; 34: 19-23. [CrossRef]
10. Altman R, Asch E, Bloch D, Bole G, Borenstein D, Brandt K, et al. Development of criteria for the classification and reporting of osteoarthritis. Classification of osteoarthritis of the knee. Arthritis Rheum 1986; 29: 1039-49. [CrossRef]

11. Breivik, Bjornsson GA, Skovlund E. A comparison of pain rating scales by sampling from clinical trial data. Clin J Pain 2000; 16: 22-8. [CrossRef]
12. Bellamy N, Buchanan WW, Goldsmith CH, Campbell J, Stitt LW. Validation study of WOMAC: a health status instrument for measuring clinically important patient relevant EK outcomes to antirheumatic drug therapy in patients with osteoarthritis of the hip or knee. J Rheumatol 1988; 15: 1833-40.
13. Kapci EG, Uslu R, Turkcapar H, Karaoglan A. Beck Depression Inventory II: evaluation of the psychometric properties and cut-off points in a Turkish adult population. Depress Anxiety 2008; 25: E104-E110. [CrossRef]
14. Kellegren JH, Lawrence JS. Radiological assessment of osteoarthritis. Ann Rheum Dis 1957; 16: 494–501. [CrossRef]
15. D'Agostino MA, Conaghan P, Le Bars M, Baron G, Grassi W, Martin-Mola E, et al. EULAR report on the use of ultrasonography in painful knee osteoarthritis. Part 1: prevalence of inflammation in osteoarthritis. Ann Rheum Dis 2005; 64: 1703-9. [CrossRef]
16. Saarakkala S, Waris P, Waris V, Tarkiainen I, Karvanen E, Aarnio J, et al. Diagnostic performance of knee ultrasonography for detecting degenerative changes of articular cartilage. Osteoarthritis Cartilage 2012; 20: 376-81. [CrossRef]
17. Hawker GA, Gignac MA, Badley E, Davis AM, French MR, Li Y, et al. A longitudinal study to explain the pain-depression link in older adults with osteoarthritis. Arthritis Care Res 2011; 63: 1382-90. [CrossRef]
18. Ozcakir S, Raif SL, Sivrioglu K, Kucukcakir N. Relationship between radiological severity and clinical and psychological factors in knee osteoarthritis. Clin Rheumatol 2011; 30: 1521-6. [CrossRef]
19. Kim KW, Han JW, Cho HJ, Chang CB, Park JH, Lee JJ, et al. Association between comorbid depression and osteoarthritis symptom severity in patients with knee osteoarthritis. J Bone Joint Surg Am 2011; 93: 556-63. [CrossRef]
20. Leite AA, Costa AJ, Lima Bde A, Padilha AV, Albuquerque EC, Marques CD. Comorbidities in patients with osteoarthritis: frequency and impact on pain and physical function. Rev Bras Reumatol 2011; 51: 118-23. [CrossRef]
21. Chiou CS, Liao ST, Liu HY, Chang CC, Hou TY, Liu FC, et al. Prevalence of Baker's cysts in painful primary osteoarthritis of the knee: a musculoskeletal ultrasound study. Formosan Journal of Rheumatology 2008; 22: 43-9.
22. Gaafar R, El-Ghobary MA, El Gohary RM. The importance of using ultrasonography in knee osteoarthritis. Egypt J Intern Med 2012; 24: 93-6.
23. Bevers K, Bijlsma JW, Vriezekolk JE, van den Ende CH, den Broeder AA. Ultrasonographic features in symptomatic osteoarthritis of the knee and relation with pain. Rheumatology 2014; 53: 1625-9. [CrossRef]
24. Naredo E, Cabero F, Palop MJ, Collado P, Cruz A, Crespo M. Ultrasonographic findings in knee osteoarthritis: A comparative study with clinical and radiographic assessment Osteoarthritis Cartilage 2005; 13: 568-74. [CrossRef]
25. Hall M, Doherty S, Courtney P, Latief K, Zhang W, Doherty M. Synovial pathology detected on ultrasound correlates with the severity of radiographic knee osteoarthritis more than with symptoms. Osteoarthritis Cartilage 2014; 22: 1627-33. [CrossRef]
26. Serban O, Porojan M, Deac M, Cozma F, Solomon C, Lenghel M, et al. Pain in bilateral knee osteoarthritis - correlations between clinical examination, radiological, and ultrasonographical findings. Med Ultrason 2016; 18: 318-25. [CrossRef]
27. Chiba D, Tsuda E, Maeda S, Sasaki E, Takahashi I, Nakaji S, et al. Evaluation of a quantitative measurement of suprapatellar effusion by ultrasonography and its association with symptoms of radiographic knee osteoarthritis: a cross- sectional observational study. Arthritis Res Ther 2016; 18: 181. [CrossRef]
28. Creamer P, Lethbridge-Cejku M, Hochberg MC. Factors associated with functional impairment in symptomatic knee. Rheumatology (Oxford) 2000; 39: 490-6. [CrossRef]
29. Cubukcu D, Sarsan A, Alkan H. Relationships between pain, function and radiographic findings in osteoarthritis of the knee: a cross-sectional study. Arthritis 2012; 22: 1-5. [CrossRef]
30. Koca I, Boyaci A, Tutoglu A, Boyaci N, Ozkur A. The relationship between quadriceps thickness, radiological staging, and clinical parameters in knee osteoarthritis. J Phys Ther Sci 2014; 26: 931-6. [CrossRef]
31. Holmberg S, Thelin A, Thelin N. Knee osteoarthritis and body mass index: a population-based case-control study. Scand J Rheumatol 2005; 34: 59-64. [CrossRef]
32. de Wit LM, van Straten A, van Herten M, Penninx BW, Cuijpers P. Depression and body mass index, a u-shaped association. BMC Public Health 2009; 9: 14. [CrossRef]
33. Power J, Badley EM, Wheaton B, Hawker GA. Investigating the overlap of fatigue, pain and depression in an osteoarthritis population. Osteoarthritis Cartilage 2014; 22 (Suppl): S220-S221. [CrossRef]
34. Possley D, Budiman-Mak E, O'Connell S, Jelinek C, Collins EG. Relationship between depression and functional measures in overweight and obese persons with osteoarthritis of the knee. J Rehabil Res Dev 2009; 9: 1091-8. [CrossRef]
35. Pereira D, Severo M, Barros H, Branco J, Santos RA, Ramos E. The effect of depressive symptoms on the association between radiographic osteoarthritis and knee pain: a cross-sectional study. BMC Musculoskelet Disord 2013; 22: 214. [CrossRef]