# Research Paper: The Correlation of Supra Patella Effusion With Pain and Disability in Patients With Knee Osteoarthritis

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## ABSTRACT

**Objectives:** The present research aimed to evaluate the relationship of supra patella effusion with pain and disability in patients with knee osteoarthritis by Ultrasonography (US).

**Methods:** In a cross-sectional study, 60 patients with knee OA (Mean±SD score of body mass index: 29.81±5.64 kg/m$^2$ and age: 50.48±7.57 years) were selected by nonprobability sampling method. Supra patella effusion was evaluated using an US. All study subjects completed the Visual Analogue Scale (VAS) and Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) for pain and disability outcomes, respectively. To evaluate the relationship between effusion, disability, and pain, the Pearson's correlation coefficient was employed.

**Results:** There was a poor but significant relationship between the area of effusion (r=0.27, P=0.03), the thickness of effusion (r=0.32, P=0.01), with pain. No correlation was found between the trace of effusion (r=-0.08, P=0.5) and pain. The area of effusion (r=0.1, P=0.17), the thickness of effusion (r=0.08, P=0.51), and the trace of effusion (r=0.0, P=0.9) were not correlated with disability.

**Discussion:** The effusion of supra patella was slightly correlated with pain. In contrast, the effusion of supra patella demonstrated no correlation with disability.

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## Highlights

- Supra patella effusion is correlated with pain.
- No association was found between disability and supra patella effusion.

## Plain Language Summary

Knee Osteoarthritis (OA) is the most common form of arthritis. In patients with knee OA, edema around the joint causes knee pain and disability. To determine the edema, many researchers have used Ultrasonography (US). This study evaluated the relationship between supra patellar edema, pain, and disability in patients with knee OA by US. Our findings demonstrated that joint edema revealed a poor and significant correlation with pain, but it was not correlated with disability.

## 1. Introduction

Osteoarthritis (OA) is a progressive degenerative disease of the joints caused by changes in the physiology, biomechanics, and biochemistry of the articular cartilage [1]. The prevalence of OA is high; 60% of men and 70% of women aged 70 to 80 years suffer from OA [2]. The occurrence of OA in each joint presents signs and symptoms [1]. The joint stiffness, crepitus, effusion, and pain cause a disturbance in daily living activities and reduce the quality of life in patients with knee OA [1, 3].

Alternations in the material composition of the cartilage and the inflammation of the synovial membrane trigger destructive changes in the cartilage; ultimately, it causes bone deformation and osteophyte [4]. The inflammatory nature of OA affects the functions of the sensory receptors. It also increases the frequency of the firing of groups III and IV mechanoreceptors to the central nervous system [5-7]. These events inhibit quadriceps muscle activity and may contribute to the atrophy of this muscle [8, 9]. The inhibition of the quadriceps muscle produces joint laxity, joint degeneration, and pain [10].

Effusion and synovitis findings are similar in Magnetic Resonance Imaging (MRI). Thus, these are introduced as effusion-synovitis [11, 12]. A study assessed the regional effusion-synovitis of the suprapatellar pouch. The relevant results revealed that the area of effusion-synovitis was highly correlated with knee OA [13]. In addition, controlling effusion may decrease the progression of knee OA in the early stages [14].

Ultrasonography (US) and MRI are used to measure and document joint inflammation and effusion [15]. MRI was used for measuring effusion in almost all studies [15-17]. The obtained data were controversial and only some studies suggested moderate correlations between pain, disability, and effusion [16-18]. Recently, US indicated high reliability and validity for measuring knee effusion [12, 18, 19]. Although US is employed to measure articular effusion in patients with OA, the relationship between articular effusion, disability, and pain is not determined in these patients. Therefore, the present study aimed to explore the relationship of effusion with pain, and functional disability in patients with knee OA.

## 2. Methods

Initially, 65 patients were recruited as the study participated. Then, 2 patients with a Body Mass Index (BMI) >40 kg/m$^2$, 1 patient with prostate cancer, and 2 patients aged >60 years were excluded from the research. Finally, a total of 60 males and females aged 40 to 60 years with knee OA of grades 1 and 2 (based on the Kellgren-Lawrence (K-L) criteria) were included in this study. Patients who referred to the healthcare centers affiliated to the Zahedan University of Medical Sciences in 2018 and 2019 included the study population. We implemented a simple nonprobability sampling approach for selecting the study subjects. This was an observational, cross-sectional, and analytical research project. The inclusion criteria were as follows: 1. the establishment of radiological findings of knee OA with grades 1 and 2 according to the K-L classification [20]; BMI ≤40 kg/m$^2$ [21, 22], and an age range of 40-60 years. Patients with rheumatoid arthritis, malignancy, local knee infection, knee surgery, fracture, complete meniscus, and cruciate ligaments rupture, neuropathic diseases, or the injection of hyaluronic acid or corticosteroid in the past 6 months, and history of physiotherapy in the last month were excluded from this research.

We used a form to record the explored patients' demographic information and effusion. The Visual Analogue Scale (VAS) [23] and the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) were applied for evaluating the intensity of pain, and functional disability, respectively [24]. Pain, stiffness, and physical function were assessed by the WOMAC. The WOMAC is a reliable and valid outcome measure for evaluating patients with hip and knee OA [25]. The scale includes 24 questions; 5 questions about pain, 2 about joint stiffness, and 17 about function. Each question is graded qualitatively, as follows: none, low, moderate, severe, and very severe; the relevant scores are 0, 1, 2, 3, and 4, respectively [25, 26]. The WOMAC was translated to Persian and indicated high validity and reliability for patients with knee OA [27, 28]. We used US device in the musculoskeletal model with the frequency of 1 to 5 Hz and linear probe to examine suprapatellar effusion. The device (Whison Med Ins) was manufactured in Japan and was calibrated every 6 months.

To measure joint effusion, the patient lay supine on the bed and the examiner put a towel under the knees to achieve a semi flexion position. Then, the ultrasound probe was longitudinally placed without pressure on the supra patella area near the upper pole of the patella. Synovial effusion was observed as hypoechoic space with an irregular environment. We recorded the trace and the area of the effusion and its thickness by US. For trace and area, the surrounding space of hypoechoic (all around the margin of supra patella effusion) and for thicknesses, the maximum depth (distance between the supra patella tendon on the sagittal plate & the cross with the quadriceps tendon) [9] were evaluated (Figure 1).

All data analyses were performed using SPSS. Shapiro-Wilk test was employed to evaluate the normal distribution of the data. Pearson's correlation coefficient was used to investigate the relationship between trace, area, and the thickness of effusion, and scale variables. Moreover, Spearman's correlation coefficient was performed for nominal variables. The level of statistical significance was set at $P<0.05$.

## 3. Results

Totally, 60 patients 12(20%) males & 48(80%) females) with knee OA (grade 1: 26(43.3%), grade 2: 34(56.7%) participated in the present study. Furthermore, 27(45%) and 33(55%) subjects presented bilateral and unilateral knee OA, respectively. In 52(86.7%) of the patients, the right leg was dominant. The demographic data of the study subjects are listed in Table 1.

Table 2 presents the correlation coefficients of the thickness, trace, area of effusion, pain, and disability. Significant and weak correlations were found between the area of effusion and pain (r=0.27. P=0.03), as well as the thickness of effusion and pain (r=0.32, P=0.01). No significant relationship was revealed between the area of effusion and disability (P=0.17), the thickness of effusion and disability (P=0.51); the trace of effusion and pain (P=0.50), as well as the trace of effusion and disability (P=0.90).

Supra patellar effusion suggested no significant correlation with sex, OA grade, bilateral or unilateral involvement, dominant leg, BMI, and age. The area of effusion indicated a reverse but not significant correlation with the dominant leg. The correlation between age and the thickness of effusion was reverse but not significant (Table 3).

**Table 1.** Demographic information of subjects with knee osteoarthritis

| Variables | Mean±SD |
|---|---|
| BMI (kg/m²) | 29.81±5.64 |
| Age (y) | 50.48±7.57 |
| The area of effusion | 0.95±0.68 |
| The thickness of effusion | 4.22±2.67 |
| The trace of effusion | 58.13±19.95 |
| VAS | 6.95±1.96 |

**Table 2.** The relationship between the thickness, trace, and area of effusion, pain, and disability

| Dependent Variables | Independent Variables | Pearson's Correlation Coefficient | P |
|---|---|---|---|
| The area of effusion | Pain | 0.27 | 0.03* |
| | Disability | 0.17 | 0.17 |
| The thickness of effusion | Pain | 0.32 | 0.01* |
| | Disability | 0.08 | 0.51 |
| The trace of effusion | Pain | -0.08 | 0.50 |
| | Disability | 0.01 | 0.90 |



* Significant

**Table 3.** The relationship between the area, thickness, trace of effusion and sex, OA grade, bilateral or unilateral involvement, dominant leg, BMI, and age

| Variables | Area of Effusion | | Thickness of Effusion | | Trace of Effusion | |
|---|---|---|---|---|---|---|
| | Spearman's Correlation Coefficient | P | Spearman's Correlation Coefficient | P | Spearman's Correlation Coefficient | P |
| Sex | 0.09 | 0.46 | 0.08 | 0.50 | 0.13 | 0.29 |
| OA grade | 0.19 | 0.13 | 0.11 | 0.36 | 0.08 | 0.51 |
| Bilateral or unilateral | 0.08 | 0.54 | 0.02 | 0.82 | 0.05 | 0.65 |
| Dominant leg | -0.01 | 0.94 | 0.11 | 0.39 | -0.16 | 0.20 |

| Variables | Area of Effusion | | Thickness of Effusion | | Trace of Effusion | |
|---|---|---|---|---|---|---|
| | Pearson | P | Pearson | P | Pearson | P |
| BMI (kg/m$^2$) | 0.07 | 0.59 | 0.07 | 0.55 | 0.06 | 0.62 |
| Age (y) | 0.02 | 0.85 | -0.16 | 0.20 | 0.15 | 0.23 |



## 4. Discussion

The present study results suggested that the relationship between the area and thickness of effusion with pain were direct and significant. However, there was no significant relationship between the area and thickness of effusion with functional disability. In addition, no significant relationship was observed between the area and thickness of effusion, with the variables, such as age, sex, BMI, OA grade, dominant leg, and the bilateral or unilateral involvement of the affected knee. The trace of effusion presented no significant relationship with pain, functional disability, and demographic variables. The thickness of the effusion was significantly associated with pain. However, the trace of effusion indicated a poor relationship with disability.

Previous studies reported that US is a useful device for detecting soft tissue damage in the initial stages [12, 29]. Besides, it provides more objective data about effusion [12, 18, 19, 30]. Some studies suggested that US could be used to predict OA, especially in low grades [30, 31]. OA increases intra-articular fluid that affects the patient's pain and function [32, 33]. Studies have revealed that suprapatellar effusion could exacerbate pain in patients [34, 35]. In addition to the patella's effusion, the effusion of meniscuses, ligaments, Baker cyst, and synovial damage were measured. Accordingly, the results signified that the effusion of soft tissue damage around the knee was associated with pain in these patients [12, 15-17, 30, 31, 34, 36]. In the lower grades of OA, the effusion of meniscuses, ligaments, and Baker cyst seem to be less. Thus, we only measured the supra patella effu-

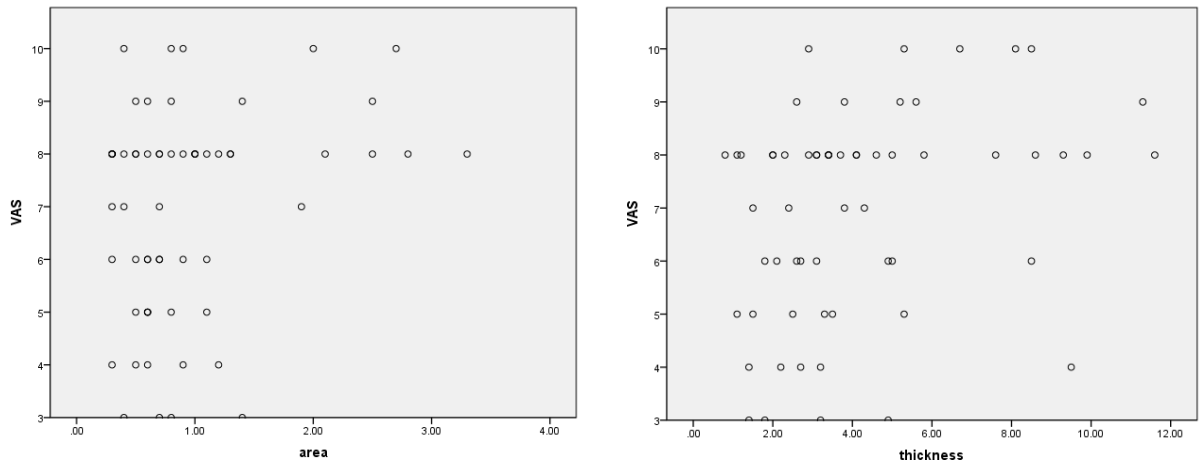


**Figure 1.** The scattergram of the area and thickness of suprapatellar effusion and pain



* The y-axis corresponds with pain, and the x-axis corresponds with the area ($cm^2$) and thickness (mm) of suprapatellar effusion evaluated by ultrasonography.

sion in patients with grades 1 and 2 OA. Previous studies documented contradictory data about the relationship between pain and effusion; some of which reported no relationship, and others referred to poor relationships in this regard [15, 30, 31, 36].

Other studies addressed the patient's position during the examination [15]. Bevers et al. stated that the contraction of the quadriceps muscle may influence the size of the suprapatellar effusion [31]. Loy et al. also argued that patients reported more pain in Weight-Bearing (WB) position, compared to the non-WB position. Besides, the pain was highly associated with effusion in WB; however, in our study, effusion was measured in the resting and non-WB positions [15]. D'Agostino et al. specified the time of measuring effusion as a key factor in reporting pain by patients. Due to more effusion, the patients complained of more pain and stiffness in the morning [31]. In our study, the time of measurement was disregarded. Bevers et al. mentioned MRI is more sensitive than US to observe the site of inflammation. In other words, US is an appropriate device for locating an effusion in the onset and prognosis of the disease [12, 30]; however, it probably fails to indicate the true volume of effusion in high grades of OA [31].

The present research detected no significant relationship between effusion and the disability of patients with OA. In 3 and 4 grades of knee OA, the extent of soft tissue destruction is more; thus, joint inflammation increased and affected the patients' function. In studies on the patients with a high grade of OA, the correlation between effusion and disability was significant [17, 36, 37]. Like our study, in previous studies, the WOMAC questionnaire was used to measure the disability degree in patients [25, 26]. In addition to supra patella effusion, the effusion due to the rupture of meniscus and ligaments, Baker cyst, osteophyte size, and the thickness of subchondral was measured by MRI [13, 16, 17, 37, 38]. Sowers et al. calculated the odds ratio for determining the correlation of the relevant variables. The reason for this strong relationship was the change in the direction of the patella, which could affect the patient's function [17]. However, in our study, only grades 1 and 2 of OA were evaluated. Moreover, other soft tissue damages in lower grades are usually less common; therefore, we only measured the supra patella effusion. Wallace et al. argued that the site of effusion plays a greater role in knee pain and the correlation between WOMAC pain and medial synovitis was strong and significant [37]. In contrast, we considered all subscales of WOMAC in the present study. Accordingly, it may be one reason for the lack of finding any correlation between the subscales of WOMAC and effusion. In a study, the WOMAC pain score was not significantly correlated with effusion [15, 35]. Some scholars suggested no correlation between synovitis and non-WB knee pain [36]. The non-WB scale of WOMAC is not appropriate for examining knee OA [15].

There were some limitations to the present study. Not separating grades 1 and 2 patients with knee OA, considering the overall scores of the WOMAC scale for disability, and the US examination of suprapatellar effusion only were the limitations of this study. A larger sample size, a wider age range, and recording the occupational status of the patients is recommended to be considered in future studies.

## 5. Conclusion

According to our findings, supra patella effusion was significantly related to pain. It seems that at the onset of the knee OA, increased supra patella effusion is associated with aggravated pain in these patients. Supra patella effusion seems not to be the main cause of disability in these patients.

## Ethical Considerations

### Compliance with ethical guidelines

Initially, the study subjects provided signed informed consent forms to participate in the study. The Ethics Committee of Zahedan University of Medical Sciences approved the current study (Code: IR.ZAUMS.REC.1398.140).

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The study was a part of the MSc. thesis of Anahita Hasan Nejad at the Zahedan University of Medical Sciences, Zahedan, Iran.

### Authors' contributions

Conceptualization: Kamran Ezzati, Hasan Namvar, Anahita Hasan Nejad; Methodology: Kamran Ezzati, Hasan Namvar; Investigation, writing original draft, data analysis: Kamran Ezzati, Anahita Hasan Nejad; Review & editing: Kamran Ezzati, Mohammad Hosseinifar, Fatemeh Ghiasi Asghar Akbari, Anahita Hasan Nejad; and Supervision: Hasan Namvar, Kamran Ezzati.

### Conflict of interest

The authors declared no conflicts of interest.

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**References:**

[1] Akbari M, Khajeh I. [Physical therapy in rheumatologic and dermatologic conditions (Persian)]. Tehran: Qalam-e Elm; 2013. http://opac.nlai.ir/opac-prod/bibliographic/3380493

[2] Al-Arfaj A, Al-Boukai AA. Prevalence of radiographic knee osteoarthritis in Saudi Arabia. Clinical Rheumatology. 2002; 21(2):142-5. [DOI:10.1007/s10067-002-8273-8] [PMID]

[3] Mathiessen A, Conaghan PG. Synovitis in osteoarthritis: Current understanding with therapeutic implications. Arthritis Research & Therapy. 2017; 19(1):18. [DOI:10.1186/s13075-017-1229-9] [PMID] [PMCID]

[4] Aceituno-Gómez J, Avendaño-Coy J, Gómez-Soriano J, García-Madero VM, Ávila-Martín G, Serrano-Muñoz D, et al. Efficacy of high-intensity laser therapy in subacromial impingement syndrome: A three-month follow-up controlled clinical trial. Clinical Rehabilitation. 2019; 33(5):894-903. [DOI:10.1177/0269215518824691] [PMID]

[5] Coggeshall RE, Hong KAP, Langford LA, Schaible HG, Schmidt RF. Discharge characteristics of fine medial articular afferents at rest and during passive movements of inflamed knee joints. Brain Research. 1983; 272(1):185-8. [DOI:10.1016/0006-8993(83)90379-7]

[6] Schaible HG, Schmidt RF. Time course of mechanosensitivity changes in articular afferents during a developing experimental arthritis. Journal of Neurophysiology. 1988; 60(6):2180-95. [DOI:10.1152/jn.1988.60.6.2180] [PMID]

[7] Schepelmann K, Meßlinger K, Schaible HG, Schmidt RF. Inflammatory mediators and nociception in the joint: Excitation and sensitization of slowly conducting afferent fibers of cat's knee by prostaglandin $I_2$. Neuroscience. 1992; 50(1):237-47. [DOI:10.1016/0306-4522(92)90395-I]

[8] Grigg P, Schaible HG, Schmidt RF. Mechanical sensitivity of group III and IV afferents from posterior articular nerve in normal and inflamed cat knee. Journal of Neurophysiology. 1986; 55(4):635-43. [DOI:10.1152/jn.1986.55.4.635] [PMID]

[9] He X, Proske U, Schaible HG, Schmidt RF. Acute inflammation of the knee joint in the cat alters responses of flexor motoneurons to leg movements. Journal of Neurophysiology. 1988; 59(2):326-40. [DOI:10.1152/jn.1988.59.2.326] [PMID]

[10] Shakespeare DT, Stokes M, Sherman KP, Young A. Reflex inhibition of the quadriceps after meniscectomy: Lack of association with pain. Clinical Physiology. 1985; 5(2):137-44. [DOI:10.1111/j.1475-097X.1985.tb00589.x] [PMID]

[11] Hunter DJ, Guermazi A, Lo GH, Grainger AJ, Conaghan PG, Boudreau RM, et al. Evolution of semi-quantitative whole joint assessment of knee OA: MOAKS (MRI Osteoarthritis Knee Score). Osteoarthritis and Cartilage. 2011; 19(8):990-1002. [DOI:10.1016/j.joca.2011.05.004] [PMID] [PMCID]

[12] Chiba D, Tsuda E, Maeda Sh, Sasaki E, Takahashi I, Nakaji Sh, 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 Research & Therapy. 2016; 18:181. [DOI:10.1186/s13075-016-1078-y] [PMID] [PMCID]

[13] Wang X, Blizzard L, Halliday A, Han W, Jin X, Cicuttini F, et al. Association between MRI-detected knee joint regional effusion-synovitis and structural changes in older adults: A cohort study. Annals of the Rheumatic Diseases. 2016; 75(3):519-25. [DOI:10.1136/annrheumdis-2014-206676] [PMID]

[14] Wang X, Blizzard L, Jin X, Chen Z, Zhu Z, Han W, et al. Quantitative assessment of knee effusion-synovitis in older adults: Association with knee structural abnormalities. Arthritis & Rheumatology. 2016; 68(4):837-44. [DOI:10.1002/art.39526] [PMID]

[15] Lo GH, McAlindon TE, Niu J, Zhang Y, Beals C, Dabrowski C, et al. Bone marrow lesions and joint effusion are strongly and independently associated with weight-bearing pain in knee osteoarthritis: Data from the osteoarthritis initiative. Osteoarthritis and Cartilage. 2009; 17(12):1562-9. [DOI:10.1016/j.joca.2009.06.006] [PMID] [PMCID]

[16] Zhang Y, Nevitt M, Niu J, Lewis C, Torner J, Guermazi A, et al. Fluctuation of knee pain and changes in bone marrow lesions, effusions, and synovitis on magnetic resonance imaging. Arthritis & Rheumatology. 2011; 63(3):691-9. [DOI:10.1002/art.30148] [PMID] [PMCID]

[17] Sowers MF, Karvonen-Gutierrez CA, Jacobson JA, Jiang Y, Yosef M. Associations of anatomical measures from MRI with radiographically defined knee osteoarthritis score, pain, and physical functioning. The Journal of Bone & Joint Surgery. 2011; 93(3):241-51. [DOI:10.2106/JBJS.I.00667] [PMID] [PMCID]

[18] Abraham AM, Goff I, Pearce MS, Francis RM, Birrell F. Reliability and validity of ultrasound imaging of features of knee osteoarthritis in the community. BMC Musculoskeletal Disorders. 2011; 12:70. [DOI:10.1186/1471-2474-12-70] [PMID] [PMCID]

[19] Conaghan P, D'Agostino MA, Ravaud P, Baron G, Le Bars M, Grassi W, et al. EULAR report on the use of ultrasonography in painful knee osteoarthritis. Part 2: Exploring decision rules for clinical utility. Annals of the Rheumatic Diseases. 2005; 64(12):1710-4. [DOI:10.1136/ard.2005.038026] [PMID] [PMCID]

[20] Croft P. The epidemiology of osteoarthritis: Manchester and beyond. Rheumatology. 2005; 44(Suppl 4):iv27-iv32. [DOI:10.1093/rheumatology/kei058] [PMID]

[21] Alghadir A, Omar MTA, Al-Askar AB, Al-Muteri NK. Effect of low-level laser therapy in patients with chronic knee osteoarthritis: A single-blinded randomized clinical study. Lasers in Medical Science. 2014; 29(2):749-55. [DOI:10.1007/s10103-013-1393-3] [PMID]

[22] Youssef EF, Muaidi QI, Shanb AA. Effect of laser therapy on chronic osteoarthritis of the knee in older subjects. Journal of Lasers in Medical Sciences. 2016; 7(2):112-9. [DOI:10.15171/jlms.2016.19] [PMID] [PMCID]

[23] Miller LE, Block JE. US-approved intra-articular hyaluronic acid injections are safe and effective in patients with knee osteoarthritis: Systematic review and meta-analysis of randomized, saline-controlled trials. Clinical Medicine Insights: Arthritis and Musculoskeletal Disorders. 2013; 6:57–63. [DOI:10.4137/CMAMD.S12743] [PMID] [PMCID]

[24] Kheshie AR, Alayat MSM, Ali MME. High-intensity versus low-level laser therapy in the treatment of patients with knee osteoarthritis: A randomized controlled trial. Lasers in Medical Science. 2014; 29(4):1371-6. [DOI:10.1007/s10103-014-1529-0] [PMID]

[25] Bellamy N, Buchanan WW, Goldsmith CH, Campbell J, Stitt LW. Validation study of WOMAC: A health status instrument for measuring clinically important patient relevant outcomes to antirheumatic drug therapy in patients with osteoarthritis of the hip or knee. The Journal of Rheumatology. 1988; 15(12):1833-40. [PMID]

[26] Fernandes MI. [Translation and validation of the WOMAC (Western Ontario McMaster Universities) specific quality of life questionnaire for osteoarthritis into Portuguese (Portuguese)] [MSc. thesis]. São Paulo: Federal University of São Paulo; 2003. http://repositorio.unifesp.br/handle/11600/19401

[27] Ebrahimzadeh MH, Makhmalbaf H, Birjandinejad A, Golhasani Keshtan F, Hoseini HA, Mazloumi SM. The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) in persian speaking patients with knee osteoarthritis. The Archives of Bone and Joint Surgery. 2014; 2(1):57-62. [PMID] [PMCID]

[28] Nadrian H, Moghimi N, Nadrian E, Moradzadeh R, Bahmanpour K, Iranpour A, et al. Validity and reliability of the Persian versions of WOMAC Osteoarthritis Index and Lequesne Algofunctional Index. Clinical Rheumatology. 2012; 31(7):1097-102. [DOI:10.1007/s10067-012-1983-7] [PMID]

[29] Kumm J, Tamm A, Lintrop M, Tamm A. Association between ultrasonographic findings and bone/cartilage biomarkers in patients with early-stage knee osteoarthritis. Calcified Tissue International. 2009; 85(6):514. [DOI:10.1007/s00223-009-9302-2] [PMID]

[30] 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. Annals of the Rheumatic Diseases. 2005; 64(12):1703-9. [DOI:10.1136/ard.2005.037994] [PMID] [PMCID]

[31] 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(9):1625-9. [DOI:10.1093/rheumatology/keu030] [PMID]

[32] Scanzello CR, Goldring SR. The role of synovitis in osteoarthritis pathogenesis. Bone. 2012; 51(2):249-57. [DOI:10.1016/j.bone.2012.02.012] [PMID] [PMCID]

[33] Goldenberg DL, Egan MS, Cohen AS. Inflammatory synovitis in degenerative joint disease. The Journal of Rheumatology. 1982; 9(2):204-9. [PMID]

[34] 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 and Cartilage. 2005; 13(7):568-74. [DOI:10.1016/j.joca.2005.02.008] [PMID]

[35] Wu PT, Shao CJ, Wu KC, Wu TT, Chern TC, Kuo LC, et al. Pain in patients with equal radiographic grades of osteoarthritis in both knees: The value of gray scale ultrasound. Osteoarthritis and Cartilage. 2012; 20(12):1507-13. [DOI:10.1016/j.joca.2012.08.021] [PMID]

[36] 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 and Cartilage. 2014; 22(10):1627-33. [DOI:10.1016/j.joca.2014.05.025] [PMID] [PMCID]

[37] Wallace G, Cro S, Doré C, King L, Kluzek S, Price A, et al. Associations between clinical evidence of inflammation and synovitis in symptomatic knee osteoarthritis: A cross-sectional substudy. Arthritis Care & Research. 2017; 69(9):1340-8. [DOI:10.1002/acr.23162] [PMID]

[38] Neogi T, Guermazi A, Roemer F, Nevitt MC, Scholz J, Arendt-Nielsen L, et al. Association of joint inflammation with pain sensitization in knee osteoarthritis: The multi-center osteoarthritis study. Arthritis & Rheumatology. 2016; 68(3):654-61. [DOI:10.1002/art.39488] [PMID] [PMCID]