The European Research Journal 2019;5(5):781-786 ORIGINAL ARTICLE

# Frequency of physical therapy in knee osteoarthritis: a randomized controlled trial

**Sadiye Murat[1], Yasemin Yumuşakhuylu[1], Zeliha Gençoğlu[1], Afitap İçağasıoğlu[1], Nur Kesiktaş[2], Turgay Altınbilek[3]**

[1]*Department of Physical Medicine and Rehabilitation, Istanbul Medeniyet University, Goztepe Training and Research Hospital, İstanbul, Turkey*
[2]*Department of Physical Medicine and Rehabilitation, Istanbul Physical Therapy and Rehabilitation Training and Research Hospital, İstanbul, Turkey*
[3]*Physical Medicine and Rehabilitation Specialist, Private Office, İstanbul, Turkey*

DOI: 10.18621/eurj.420854

## ABSTRACT

**Objectives:** This study is conducted to compare the three different frequency of the physical therapy application for knee osteoarthritis in female patients.

**Methods:** Consecutive 89 female patients with knee osteoarthritis were randomized into three groups of physical therapy as twice-daily, once-a-day and alternate day, by computerized random number generator. We used Visual Analog Scale (VAS); to determine pain level, Western Ontario McMaster Osteoarthritis Index (WOMAC); to determine osteoarthritis (OA) severity, 10-meter walking test (WD); to determine walking speed and Short Form (SF-36) questionnaire; to determine the quality of life. All groups received a total of 10 physical therapy sessions including hot pack, therapeutic ultrasound (US) and transcutaneous electrical nerve stimulation (TENS). We evaluated subjects at the beginning, at the end of treatment and at the third month control at post-treatment period.

**Results:** Improvement was observed in all groups after treatment ($p < 0.05$). While there was no significant difference in once-a-day treatment group at 3rd month control ($p > 0.05$), alternate day group showed a significant improvement ($p < 0.05$).

**Conclusions:** In the treatment of knee osteoarthritis, usually once-a-day physical therapy approach is preferred in daily practice. Alternatively twice a day or alternate day therapies can be applicable.

**Keywords:** Knee osteoarthritis, physical theraphy agents, frequency of treatment

***Received: May 4, 2018; Accepted: November 20, 2018; Published Online: March 14, 2019***

Osteoarthritis (OA) is a slowly progressive, non-inflammatory, chronic, degenerative arthropathy characterized with cartilage destruction, osteophyte formation and subchondral sclerosis especially in load bearing joints [1]. Knee OA is the joint disease with the highest incidence and the most important cause of pain and disability in middle-aged and elderly individuals [2, 3].

Aims of OA treatment are reducing pain, increasing physical function, preventing disability and increasing quality of life [4]. Clinical treatment guidelines suggest conservative treatment methods as first-line treatment in knee OA [5-8]. Even though there is no proven, effective treatment method that re-

***Address for correspondence:*** *Sadiye Murat, MD., Istanbul Medeniyet University, Göztepe Training and Research Hospital, Department of Physical Medicine and Rehabilitation, İstanbul, Turkey*
*E-mail: samurftr@gmail.com*

e-ISSN: 2149-3189

stores structural changes; there are evident-based and non-evident-based treatment guidelines derived from various studies [9]. Conservative treatment includes pain killers, anti- inflammatory drugs, weight loss, exercise and physical therapy [10]. In optimal OA treatment pharmacological therapy is combined with physical therapy [5-8].

Physical therapy agents, which are one of non-pharmacological treatment modalities, are important due to side effects of pharmacological and surgical treatments. In literature, different practices can be seen about number and duration of sessions in physical therapy [11]. In our country, generally 10-20 sessions are administered in total, combining deep tissue heating, superficial heat and analgesic current once a day. Considering the current literature regarding our topic, there is no standardization of number, duration and frequencies of sessions in physical therapy studies. In this study, we evaluated treatment effectiveness of modalities with different frequencies.

## METHODS

This study included 100 knee osteoarthritis patients who applied to Physical Therapy and Rehabilitation outpatient clinic and were diagnosed as knee osteoarthritis according to American College of Rheumatology (ACR) criteria. 11 patients lost follow-up and excluded from the study. Study was completed with 89 patients. The inclusion criteria were defined as mechanical knee pain lasting more than 6 months, stage I, II or III osteoarthritis radiography according to Kellgren-Lawrence Radiological Staging System, being able to walk 20 meters without help and age above 40 years. The exclusion criteria was setted as patients with >10° flexion contracture, >15° varus/valgus deformity, knee operation history, enlarged varicose veins or skin lesions in the knee, lower extremity neuropathy, inflammatory, infectious, endocrinological, tumoral or severe decompensated systemicdisease, received intraarticular treatment in the last 3 months and received physical therapy in the last 1 year. Patients were randomized into three groups by a computerized random number generator. All patients received 10 total physical therapy sessions including hot pack, ultrasound (US), transcutaneous electrical nerve stimulation (TENS). First group received the therapy twice a day, second group once a day, and third group alternate day. Physical therapy program was administered as 20 minutes of hot pack for superficial heating, 10 minutes of 1 MHz, 1.5 watt US for deep tissue heating, 20 minutes of 100 Hz, 50 mAmp TENS for analgesic current. Treatments were administered by the same physiotherapist. Patients were told to use paracetamol up to 3000 mg/day in case of pain and record the tablet consumed. Sociodemographic data of patients were recorded. Evaluations were done before treatment, end of treatment and three months after the cessation of treatment by a physiatrist who was blind to the treatment group. Visual Analog Scale (VAS) was used to determine pain level, Western Ontario McMaster Index (WOMAC) [12] was used to determine OA severity, 10-meter walking test (WD) [13] was used to determine walking speed and Short Form 36 questionnaire (SF-36) [14] was used to determine quality of life.

This study was approved by local ethical committee of our hospital. All patients were informed about the aim of the study and written consent was obtained.

### Statistical Analysis

Statistical analyses were performed with the SPSS software ver. 16.0 (SSPS, Chicago, IL, USA). The type of the distribution was evaluated using the Kolmogorov-Smirnov test. Comparisons of the treatment groups were assessed with the Student's t or Mann-Whitney U test for continuous variables which one is appropriate. and with chi-square test for categorical variables. Differences between pre- and after treatment values of groups were evaluated with paired t-test or Wilcoxon Signed Rank Test which one is appropriate. Results were considered statistically significant if the two tailed $p$ value was $< 0.05$.

## RESULTS

All 89 patients were female. The mean age was 56.6 ± 10.4 (40-77) years. Education level of 68.5% were below 5 years and 86.5% were unemployed. Patients were stratified into three groups for treatment as twice a day (n = 29), once a day (n = 30) and alternate day (n = 30) by random number generator.

**Table 1.** Demographic characteristics and clinical parameters

| Treatment Groups | Total (n = 89) | Group 1 (n = 29) | Group 2 (n = 30) | Group 3 (n = 30) | *p* value |
|---|---|---|---|---|---|
| **Age (years)** | 56.6 ± 10.5 | 54.9 ± 10.4 | 59.1 ± 10.8 | 55.7 ± 10.0 | 0.190 |
| **BMI (kg/m$^2$)** | 31.6 ± 5.2 | 32.0 ± 6.3 | 30.5 ± 4.7 | 32.3 ± 4.6 | 0.467 |
| **Pain duration (month)** | 41.4 ± 42.2 | 46.2 ± 46.0 | 38.5 ± 33.5 | 39.6 ± 47.1 | 0.769 |
| **VAS1** | 7.0 ± 2.0 | 7.0 ± 2.1 | 6.8 ± 2.0 | 7.2 ± 2.1 | 0.949 |
| **WOMAC1** | 37.9 ± 16.6 | 35.8 ± 14.6 | 35.6 ± 16.7 | 42.4 ± 17.9 | 1.000 |
| **WD1** | 14.0 ± 4.3 | 13.5 ± 3.9 | 13.1 ± 4.1 | 15.5 ± 4.6 | 0.898 |

BMI = Body mass index, VAS = Visual analog scale, WOMAC = Western Ontario and McMaster Universities Arthritis Index, WD = walking distance, 1 = Pre-treatment

The groups showed no differences by age, body mass index (BMI), education level, occupation, smoking, duration of disease, previous treatments, comorbidities and radiological stages ($p > 0.05$). Table 1 shows demographic characteristics and also initial VAS, WOMAC and WD values of patients.

There was a significant improvement in pre-treatment, post-treatment and control VAS scores ($p < 0.001$) and WOMAC total scores ($p = 0.001$) in twice-a-day treatment group, while there was a significant improvement in pre-treatment and post-treatment WD ($p = 0.002$) became insignificant at 3rd month control ($p = 0.050$). While there was an improvement in pre-treatment and post-treatment VAS scores ($p = 0.011$), and WOMAC total scores ($p = 0.008$) in once-a-day group, it became insignificant at the 3rd month control ($p = 0.765$, $p = 0.457$, respectively). Even though there was an improvement in pre-treatment, post-treatment and 3rd month control of WD in once-a-day group it was statistically insignificant ($p = 0.191$). In alternate day group, there was a significant improvement in pre-treatment, post-treatment and control VAS scores ($p < 0.001$). A significant improvement was found in pre-treatment, post-treatment and 3rd month control in both WOMAC total and WD scores (both $p < 0.001$).

There were no difference between pre-treatment and post-treatment VAS scores among groups ($p = 0.547$ and $p = 0.153$, respectively). But in the once-a-day and alternate day treatment groups there were significant differences in the pre-treatment and 3rd

**Table 2.** Changes in treatment parameters among groups

| | Treatment Groups | | | | *p value* | | |
|---|---|---|---|---|---|---|---|
| **Group** | **Total (n = 89)** | **Group 1 (n = 29)** | **Group 2 (n=30)** | **Group 3 (n = 30)** | **Group 1-2** | **Group 1-3** | **Group 2-3** |
| **VAS1** | 7.0 ± 2.0 | 7.0 ± 2.1 | 6.8 ± 2.0 | 7.2 ± 2.1 | 0.949 | 0.928 | 0.775 |
| **VAS2** | 5.3 ± 2.4 | 5.0 ± 2.2 | 5.7 ± 2.3 | 5.0 ± 2.6 | 0.488 | 0.998 | 0.521 |
| **VAS3** | 5.2 ± 3.0 | 4.7 ± 2.8 | 6.6 ± 2.5 | 4.5 ± 3.1 | **0.044** | 0.965 | **0.025** |
| **WOMAC1** | 37.9 ± 16.6 | 35.8 ± 14.6 | 35.6 ± 16.7 | 42.4 ± 17.9 | 1.000 | 0.271 | 0.252 |
| **WOMAC2** | 28.7 ± 15.6 | 27.6 ± 14.6 | 29.6 ± 16.7 | 28.9 ± 17.9 | 0.883 | 0.949 | 0.985 |
| **WOMAC3** | 27.9 ± 16.2 | 23.7 ± 13.4 | 32.2 ± 13.4 | 28.6 ± 18.9 | 0.150 | 0.490 | 0.72 |
| **WD1** | 14.0 ± 4.3 | 13.5 ± 3.9 | 13.1 ± 4.1 | 15.5 ± 4.6 | 0.898 | 0.184 | 0.071 |
| **WD2** | 12.9 ± 3.7 | 12.0 ± 2.7 | 12.1 ± 3.5 | 14.6 ± 4.4 | 0.994 | **0.024** | **0.030** |
| **WD3** | 12.7 ± 3.8 | 12.4 ± 3.1 | 12.0 ± 3.0 | 13.7 ± 4.9 | 0.929 | 0.452 | 0.285 |

VAS = Visual analog scale, WOMAC = Western Ontario and McMaster Universities Arthritis Index, WD = walkin distance, 1 = Pre-treatment, 2 = Post-treatment, 3 = 3rd month control

month VAS scores ($p$ = 0.036 and $p$ = 0.015, respectively). Pain reduction was found better in alternate treatment group. There was no statistically significant difference between WOMAC total subgrup scores ($p$ = 0.131, $p$ = 0.943 and p = 0.279). No statistically significant difference was observed for pre-treatment, post-treatment and 3rd month control results of 10-meter walking among 3 groups ($p$ = 0.063, p = 0.113 and $p$ = 0.730, respectively) (Table2). Paracetamol use was more often in once-a-day group ($p$ = 0.019).

When examining for SF-36 scores, there was no difference among groups. After analyzing intra-group pre-treatment, post-treatment and 3rd month scores there was a significant improvement only in SF-36 body pain and physical component scores of twice a day group ($p$ = 0.004 and $p$ = 0.012, respectively). Other parameters of SF-36 showed no significant difference.

## DISCUSSION

Pain is the most common and debilitating complaint in patients with OA. Aim of knee OA treatment is to reduce pain and eburnation of joint, preserve and improve joint mobility, minimize physical limitations, improve quality of life, prevent further joint destruction and inform about prognosis and results of the disease. Gastrointestinal and cardiac side effects of pharmacological agents used in the treatment are important subjects. Physical therapy agents should be administered to prevent these side effects of NSAIDs. Physiotherapy is a recommended non-pharmacological form of treatment in knee OA by European League Against Rheumatism (EULAR) and Osteoarthritis Research Society International (OARSI) [5, 7]. Most commonly used physical therapy agents are superficial heating (hot pack- infrared radiation), TENS and deep tissue heating (short wave diathermy, US) [11, 15, 16]. In our clinical practice, these agents are usually administered separately or in combination in one or 2 sessions per day. In literature 2 or 3 sessions per week are common. In this study, we evaluated the effectiveness of most common physical therapy agents such as TENS, hot pack and US combination treatments in different frequencies. We achieved our goal of pain reduction, improvement of functionality and quality of life in OA treatment among all 3 treatment groups.

In literature, especially therapeutic US and TENS studies are very common [17-21]. TENS is a cheap and non-invasive modality with extensive use in several kinds of pain. Previous studies showed that TENS increases pain threshold due to pressure and heat in healthy individuals [22-24] and also reduces pain due to mechanic causes and heat in animals [25]. In the systematic review of Osiri *et al*. [26], it was shown that TENS is effective in reducing pain of knee OA. Also in another meta-analysis [27], a substantial amount of pain reduction was shown with TENS in knee OA.

US is a deep tissue heating modality with analgesic and anti-spasmodic effects on muscles. It is a mechanical energy generated by high- frequency sound waves and can be applied as continue or pulse forms. While pulse US generates non-thermal effects, continue US generates thermal effects. Its analgesic effect originates from thermal and non-thermal effects [28]. Loyola-Sanchez *et al*. [29] made a meta-analysis about improvement of physical function and pain reduction in knee OA and showed that US reduced pain by %21 comparing to control group. Although it is commonly used in the treatment of knee OA, there is no consensus about dosage, frequency and duration of US treatment in the literature. In the study of Huang *et al*. [30], which compares intermittent US treatment with sham US in knee OA, 60 patients received 3 sessions per week for 4 weeks, 12 sessions in total. Tascioglu *et al*. [31] compared two different doses of US and sham US, 90 patients received 5 sessions per week for 2 weeks, 10 sessions in total. In the randomized study of Eyigor *et al*. [32], which analyzes efficacy of superficial hot, exercise treatment, TENS and US, 45 patients received 5 sessions per week for 3 weeks, 15 treatment session in total. Falconer *et al*. [33] searched the effect of US on knee OA and contracture, patients received 2-3 sessions/week for 4-6 weeks. As one can see, all these studies are conducted with different session numbers and frequencies. National studies [31, 32] used once a day approach as in second group in our study, while foreign studies [30, 33] used every other day approach as in third group in our study.

As seen in literature, there are studies with different treatment session numbers and frequencies.

The primary objective of our study was to observe if the success of physical therapy liable to the frequency of the treatment sessions, not the number of sessions; so all groups received 10 sessions of therapy. However, to our knowledge there is no study to research comparing different intervals of therapy to treatment success. In this study, we observed a significant improvement in 3rd month control results of both twice a day and alternate day treatment groups. Improvement of post-treatment parameters in once-a-day treatment group did not persist in 3rd month control. Improvement was observed in all groups in terms of walking speed, pain level, functionality and quality of life after treatment, but this improvement was not statistically important. We did not see this improvement at 3rd month control of once a day group. We can attribute the excess use of parasetamols in this group to this situation. Improvement in pain and functional status in twice a day group continued at 3rd month of therapy but there was no difference in walking speed. Improvement in all treatment parameters was seen in alternate day group, and the best improvements was seen in alternate day group. Physical therapy agents, especially heat and cold applications, creates stress on body and human organism activates an adaptation mechanism against this stress. These reactions against stress called 'general Adaptation Syndrome'. First response of body when it encounters stres called 'alarm period' and this period tooks 48 hours. For body adaptation to physical therapy agents and also for tissue repair this alarm period should be passed [34]. We can explain the effect of daily after treatment by this way.

### Limitations

Most important limitation of our study is the small number of subjects. A further study with larger case series and control group is required. Our patient cohort constituted only by consecutive female patients with bilateral knee OA. Even though this limitation prevented us to compare the gender difference, it increased the homogeneity of the cohort.

## CONCLUSION

Physical therapy is a cheap and reliable treatment method with proven-efficacy. In literature, there is no study to show at which frequencies physical therapy approaches are more effective. Our aim is not to question a method with proven-efficacy but to find out at which frequency treatment is more effective. To our knowledge, this is the first study in literature on this topic. In the treatment of knee osteoarthritis, mostly once-a-day physical therapy approach is administered in daily practice. As a result, even though larger studies with high number of patients are necessary, alternate day treatment provided an effective treatment modality with consuming less time and thus reduce cost and labor loss.

*Conflict of interest*

The authors disclosed no conflict of interest during the preparation or publication of this manuscript.

*Financing*

The authors disclosed that they did not receive any grant during conduction or writing of this study.

## REFERENCES

[1] Bennell KL, Hunter DJ, Hinman RS. Management of osteoarthritis of the knee. BMJ 2012;345:e4934.

[2] Cimmino MA, Sarzi-Puttini P, Scarpa R, Caporali R, Parazzini F, Zaninelli A, et al. Clinical presentation of osteoarthritis in general practice: determinants of pain in Italian patients in the AMICA study. Semin Arthritis Rheum 2005;35:17-23.

[3] Elders MJ. The increasing impact of arthritis on public health. J Rheumatic 2000;60:6-8.

[4] Fernandes L, Hagen KB, Bijlsma JW, Andreassen O, Christensen P, Conaghan PG, et al; European League Against Rheumatism (EULAR). EULAR recommendations for the non-pharmocolagical core management of hip and knee osteoarthristis. Ann Rheum Dis 2013;72:1125-35.

[5] Yildiz SK, Özkan FÜ, Aktaş I, Silte AD, Kaysin MY, Badur NB. The effectiveness of ultrasound treatment for the management of knee osteoarthritis: a randomized, placebo-controlled, double-blind study. Turk J Med Sci 2015;45:1187-91.

[6] McAlindon TE, Bannuru RR, Sullivan MC, Arden NK, Berenbaum F, Bierma-Zeinstra SM, et al. OARSI guidelines for the non-surgical management of knee osteoarthritis. Osteoarthritis Cartilage 2014;22:363-88.

[7] Jevsevar DS, Brown GA, Jones DL, Matzkin EG, Manner PA, Mooar P, et al; American Academy of Orthopaedic Surgeons. The American Academy of Orthopaedic Surgeons evidence-based guideline on: treatment of osteoarthritis of the knee, 2nd edition. J Bone Joint Surg Am 2013;95:1885-6.

[8] 9. National Institute for Health and Care Excellence. Osteoarthritis. GC177. NICE, 2014.

[9] Buttgereit F, Burmester GR, Bijlsma JW..Non-surgical management of knee osteoarthritis: where are we now and where do we need to go? RMD Open 2015;1:e000027.
[10] Cetin N, Aytar A, Atalay A, Akman MN. Comparing hot pack, short-wave diathermy, ultrasound, and TENS on isokinetic strength, pain, and functional status of women with osteoarthritic knees: a single-blind, randomized, controlled trial. Am J Phys Med Rehabil 2008;87:443-51.
[11] Sarıfakıoğlu B, Güzelant AY, Özduran E. [The comparision of the effectiveness of short wave diathermy and ultrasound in the treatment of gonarthrosis]. Türk Osteoporoz Dergisi 2014;20:16-20. [Article in Turkish]
[12] Tüzün EH, Eker L, Aytar A, Dağkapan A, Bayramoğlu M. Acceptability, reliability, validity and responsiveness of the Turkish version of WOMAC osteoarthritis index. Osteoarthritis Cartilage 2005;13:28-33.
[13] Shubert TE, Schrodt LA, Mercer VS, Busby-Whitehead J, Giuliani CA. Are scores on balance screening tests associated with mobility in older adults? J Geriatr Phys Ther 2006;29:35-9.
[14] Ware JE Jr, Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. Med Care 1992;30:473-83.
[15] Cheing GL, Hui-Chan CW. Would the addition of TENS to exercise training produce better physical performance outcomes in people with knee osteoarthritis than either intervention alone? Clin Rehabil 2004;18:487-97.
[16] Doi T, Akai M, Fujino K, Iwaya T, Kurosawa H, Hayashi K, et al. Effect of home exercise of quadriceps on knee osteoarthritis compared with nonsteroidal antiinflammatory drugs: a randomized controlled trial. Am J Phys Med Rehabil 2008;87:258-69.
[17] Huang MH, Lin YS, Lee CL, Yang RC. Use of ultrasound to increase effectiveness of isokinetic exercise for knee osteoarthritis. Arch Phys Med Rehabil 2005;86:1545-51.
[18] Law PP, Cheing GL. Optimal stimulation frequency of transcutaneous electrical nerve stimulation on people with knee osteoarthritis. J Rehabil Med 2004;36:220-5.
[19] Law PP, Cheing GL, Tsui AY. Does transcutaneous electrical nerve stimulation improve the physical performance of people with knee osteoarthritis? J Clin Rheumatol 2004;10:295-99.
[20] Brosseau L, Yonge KA, Robinson V, Marchand S, Judd M, Wells G, et al. Thermotherapy for treatment of osteoarthritis. Cochrane Database Syst Rev 2003;4:CD004522.
[21] Philadelphia Panel. Philadelphia Panel evidence-based clinical practice guidelines on slected rehabilitation interventions for knee pain. Phys Ther 2001;81:1675-700.
[22] Chesterton LS, Foster NE, Wright CC, Baxter GD, Barlas P. Effects of TENS frequency, intensity and stimulation site parameter manipulation on pressure pain thresholds in healthy human subjects. Pain. 2003;106:73-80.
[23] Tong KC, Lo SK, Cheing GL. Alternating frequencies of transcutaneous electric nerve stimulation: does it produce greater analgesic effects on mechanical and thermal pain thresholds? Arch Phys Med Rehabil 2007;88:1344-9.
[24] Chen CC, Johnson MI. An investigation into the hypoalgesic effects of high- and low-frequency transcutaneous electrical nerve stimulation (TENS) on experimentally-induced blunt pressure pain in healthy human participants. J Pain 2010;11:53-61.
[25] Hingne PM, Sluka KA. Differences in waveform characteristics have no effect on the anti-hyperalgesia produced by transcutaneous electrical nerve stimulation (TENS) in rats with joint inflammation. J Pain 2007;8:251-5.
[26] Osiri M, Welch V, Brosseau L, Shea B, McGowan JL, Tugwell P, et al. Transcutaneous electrical nerve stimulation for knee osteoarthritis. Cochrane Database Syst Rev 2000;4:CD002823.
[27] Bjordal JM, Johnson MI, Lopes-Martins RA, Bogen B, Chow R, Ljunggren AE. Short-term efficacy of physical interventions in osteoarthritic knee pain: a systematic review and meta-analysis of randomised placebo-controlled trials. BMC Musculoskelet Disord 2007;8:51.
[28] Loyola-Sánchez A, Richardson J, MacIntyre NJ. Efficacy of ultrasound therapy for the management of knee osteoarthritis: a systematic review with meta-analysis. Osteoarthritis Cartilage 2010;18:1117-26.
[29] Rutjes AW, Nüesch E, Sterchi R, Jüni P. Therapeutic ultrasound for osteoarthritis of the knee or hip. Cochrane Database Syst Rev 2010;1:CD003132.
[30] Huang MH, Lin YS, Lee CL, Yang RC. Use of ultrasound to increase effectiveness of isokinetic exercise for knee osteoarthritis. Arch Phys Med Rehabil 2005;86:1545-51.
[31] Tascioglu F, Kuzgun S, Armagan O, Ogutler G. Short-term effectiveness of ultrasound therapy in knee osteoarthritis. J Int Med Res 2010;38:1233-42.
[32] Eyigor S, Karapolat H, Ibisoglu U, Durmaz B. [Does transcutaneous electrical nerve stimulation or therapeutic ultrasound increase the effectiveness of exercise for knee osteoarthritis: a randomized controlled study] Ağrı 2008;20:32-40. [Article in Turkish]
[33] Falconer J, Hayes KW, Chang RW. Effect of ultrasound on mobility in osteoarthritis of the knee. A randomized clinical trial. Arthritis Care Res 1992;5:29-35.
[34] Hatungil R. [The role of the hypothalamic-pituitary-adrenal axis on stress and demantia]. Mersin Üniv Sağlık Bilim Derg 2008;1:1-7. [Article in Turkish].