



# Is There an Effective way to Prescribe a Home-Based Exercise Program in Patients With Knee Osteoarthritis? A Randomized Controlled Study

## Diz Osteoartriti Olan Hastalarda Ev Egzersiz Programı Önermenin Etkili Bir Yolu Var mıdır? Randomize Kontrollü Bir Çalışma

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### Summary

**Objective:** The aim of this study was to evaluate an effective way in prescribing exercise program in patients with knee osteoarthritis (OA).

**Materials and Methods:** Sixty patients were included in the study. Group 1 received exercise program with both visual demonstration and written information materials. In addition, they have learned exercises under the supervision of a physiotherapist at the physiotherapy unit. Group 2 has got written materials describing exercises and they learned exercises under the supervision of a physiotherapist. Group 3 received only written materials about exercise program. Pain severity was assessed using a visual analogue scale (VAS) and the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). Functional ability was evaluated with WOMAC functional score and WOMAC total score as well as 100-meter walk test, time required to ascend and descend, and chair rises. All assessments were performed before the treatment and one month and three months after the treatment.

**Results:** At the end of three months of follow-up, there were statistically significant improvements in VAS, WOMAC scores, 100-meter walking test, time to ascend and descend stairs and sit-to-stand chair rises in both group 1 and 2 ( $p<0.05$ ). In group 3, statistically significant improvements were detected in all parameters except for pain severity ( $p<0.05$ ). After one month of follow-up, there were statistically significant differences between the groups in all parameters except for WOMAC pain scores ( $p<0.05$ ), however, after three months of follow-up, statistically significant differences were observed in all parameters between the groups ( $p<0.05$ ).

**Conclusion:** Our results showed that an effective way for prescribing an exercise program seems to be giving both visual demonstration and written materials together. Besides, accompanying training lectures were found to be increasing the effectiveness of therapy in patients with OA. *Turk J Phys Med Rehab 2013;59:1-6.*

**Key Words:** Knee, osteoarthritis, exercise, education, pain

### Özet

**Amaç:** Bu çalışmanın amacı diz osteoartriti (OA) olan hastalarda egzersiz programı önermede etkili yolu değerlendirmektir.

**Gereç ve Yöntem:** Altmış hasta çalışmaya dahil edildi. Grup 1 hem görsel sunum, hem de yazılı bilgi materyali ile egzersiz programı aldı. Ek olarak fizyoterapi biriminde fizyoterapist gözetiminde egzersizleri öğrendiler. Grup 2 egzersizleri içeren yazılı materyal aldı ve fizyoterapist gözetiminde egzersizleri öğrendiler. Grup 3 egzersiz programı ile ilgili sadece yazılı materyal aldı. Ağrı şiddeti vizüel ağrı skalası (VAS) ve Western Ontario McMaster Üniversiteler Osteoartrit İndeksi (WOMAC) ağrı skalası ile değerlendirildi. Fonksiyonel kapasite WOMAC fonksiyonel skoru ve WOMAC total skoru ile değerlendirildi. Ayrıca 100 metre yürüme testi, merdiven inip-çıkma süresi ve bir sandalyeye oturup kalkma süresi ile kaydedildi. Tüm değerlendirmeler tedavi öncesi, tedaviden 1 ve 3 aylık takip sonrasında yapıldı.

**Bulgular:** Üç aylık takip sonunda VAS, WOMAC skorları, 100 metre yürüme testi, merdiven inip-çıkma süresi ve sandalyeye oturup kalkma süresinde hem Grup 1 hem de Grup 2'de istatistiksel olarak anlamlı iyileşme vardı ( $p<0,05$ ). Grup 3'te ağrı şiddeti dışında tüm parametrelerde istatistiksel olarak anlamlı düzelme saptandı ( $p<0,05$ ). Tedavi sonrası 1. ayda gruplar arasında WOMAC ağrı skoru hariç diğer değerlendirme parametrelerinde anlamlı farklılık varken 3. ay takip sonunda tüm parametrelerde gruplar arasında istatistiksel olarak anlamlı farklılıklar gözlemlendi ( $p<0,05$ ).

**Sonuç:** Bulgularımız egzersiz programı önerirken etkili yolun hem görsel sunum hem de yazılı materyalin birlikte verilmesi olduğunu göstermektedir. Eğitim sunumunun eşlik etmesinin OA'lı hastalarda tedavi etkinliğini arttırdığı saptanmıştır. *Türk Fiz Tıp Rehab Derg 2012;59:1-6.*

**Anahtar Kelimeler:** Diz, osteoartrit, egzersiz, eğitim, ağrı

## Introduction

Osteoarthritis (OA) is the most common joint disorder and is an important cause of morbidity in elderly people (1). OA is mostly seen in the knee joint, and causes significant functional limitations (2). Difficulties in daily living activities including walking, ascending and descending stairs, and sitting in or standing up out of chairs cause serious disability (3).

The goals of the treatment are to reduce pain, to maintain joint range of motion (ROM) and muscle strength, to prevent joint deformities, and to increase quality of life. Combinations of pharmacological and non-pharmacological methods are mostly preferred (4,5). Non-pharmacological treatment modalities recommended by the Osteoarthritis Research Society International (OARSI) emphasize patient education programs, strategies for coping with disease, weight loss, and exercise programs in the treatment of knee OA (6).

Patient education programs have been very popular in recent years. These programs include a short information about the etiology and pathogenesis of OA, risk factors and protection from them, factors increasing or decreasing complaints of the patients and non-pharmacological strategies for pain management (7,8). Various studies indicate that patients' participation has positive effects in preventing future complications and improving the quality of life when given in the early stages (8-11).

As the quadriceps are the primary stabilizer of the knee joint, the weakness of this muscle group is an important cause of disability in patients with knee OA. Therefore, programs involving ROM, stretching, isometric, isotonic and isokinetic strengthening exercises targeting knee region muscles are commonly used in the treatment (8,12-14). Exercise programs recommended for the patients are either given in the form of illustrated brochures, or these exercises are practically shown under the supervision of a physiotherapist. Besides, combinations of these are also applied (8,14-16). Although most of the studies show the beneficial effects of home-based exercise programs, there is no control system whether the patients apply the program in the right way or not.

The hypothesis of this study is to try to find out the effective way of prescribing home-based exercise program (illustrated brochures or practice under the supervision of a physiotherapist, or a combination of both) and to investigate if adding a specific training program to the home-based exercises improves pain and functional capacity in patients with knee OA.

## Materials and Methods

Sixty patients (47 women, 13 men) diagnosed with bilateral knee OA were included in the study. The diagnosis of OA was based on the American College of Rheumatology (ACR) criteria (17). The mean age of the patients was 59.91 years (42-86 years). Patients having knee effusion, previous knee arthroplasty, severe cardiovascular diseases, neurologic diseases, intraarticular corticosteroid or hyaluronic acid injections and physical treatment program during the last six months, trauma history and pregnancy were excluded. After physical examination, full blood count, erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), and biochemical markers were evaluated. All

patients underwent weight-bearing anteroposterior and lateral radiography of the knee. These were evaluated according to the Kellgren-Lawrence scale and the patients having Grade 2 and 3 OA were included in the study (18).

### Study Design

This study was a prospective, randomized-controlled trial. Before treatment, all participants were informed of the study and signed a written informed consent form. The study was approved by the Ufuk University Human Research Ethics Committee.

### Randomization

The patients were randomly assigned into three groups. Randomization was allocated by numbered envelopes method.

Group 1 received home-based exercise program. Exercise program included ROM, isometric, isotonic quadriceps exercises.

Isometric quadriceps exercise: The patients were requested to contract the quadriceps muscles for 10 seconds by pushing against the roll of towel with knees extended and ankles dorsiflexed when sitting on a flat floor, then relax for 5 seconds. The exercises were applied for 15 repetitions.

Straight leg raise exercise: The patients were requested to lift the foot slowly 10 cm off the surface, hold for 5 seconds and then lower slowly with knee extended and ankle dorsiflexed when lying supine on a flat surface. The exercises were applied for 15 repetitions.

Isotonic quadriceps exercise: The patients were requested to extend the leg slowly, hold for 10 seconds and then lower slowly with knee bent about 90° when sitting on a chair. These exercises were applied with weight as well. They started with 0.5 kg then increased to a maximum of 5 kg. The exercises were applied for 15 repetitions.

This program was given with both visual demonstration and by written information materials. Besides, they have learned exercises under the supervision of a physiotherapist. In addition, this group has received a one-hour lecture about knee OA, basic knee joint anatomy, and the pathogenesis of OA and predisposing factors which lead knee OA. Risk factors (weight gain, occupational repetitive trauma, etc.) and the ways to avoid them (losing weight, trauma and overuse prevention, modification in activities of daily living, etc.) were the other main topics. Finally, the treatment methods (e.g. hot-cold applications) which were easily applied at home were taught. The lectures were given by a physician in a classroom for one hour.

Group 2 received the exercise program by written material, and was applied once under the supervision of a physiotherapist to assure the exercises were done in a right way.

Group 3 received only written materials about the program.

Exercises were recommended to be performed once a day with 15 repetitions for 3 months.

The patients were not allowed taking analgesic or nonsteroidal anti-inflammatory drugs (NSAID) during the follow-up period.

### Clinical Outcomes

The patients were evaluated by means of pain and functional capacity. Functional capacity was assessed by 100-meter walking test, time to ascend and descend stairs (12 stairs), sit-to-stand chair rises and the Western Ontario McMaster

University Osteoarthritis (WOMAC) functional and global index (19-21). The assessment parameters were measured by the same author before and one and three months after the therapy program.

Pain: Pain was evaluated by using visual analog scale (VAS, 0-10 cm; 0=no pain, 10=severe pain) and the Western Ontario McMaster Osteoarthritis Index (WOMAC, 0-4 Likert scale) (20,22).

#### Functional Capacity

100-meter walking test: The patients were asked to walk a distance of 100 meters. The times taken to complete the three repetitions were calculated using a stopwatch and the mean value was accepted (19).

Stair ascend and descend time: The patients were asked to ascend and descend twelve steps at the therapy unit. The mean time of three repetitions was calculated (19,21).

Time of sitting-standing up an armchair: The patients were asked to sit and immediately rise from a chair. Time to sitting and standing up was recorded and the mean of three repetitions was used for subsequent analysis (19,21).

#### Western Ontario McMaster University Osteoarthritis

(WOMAC): The functional capacities of patients were assessed by the WOMAC functional capacity and WOMAC global index which had the reliability and validity of the Turkish version. The Likert scale version of the index was used. The functional capacity index included 17 questions and the scores ranged between 0 and 68 (0=no disability, 68=severe disability). Global index included three categories: pain (5 questions), stiffness (2 questions), and functional capacity (17 questions). The possible scores ranged between 0 and 96 (22).

#### Statistical Analysis

The results of statistical analysis were expressed as mean±SD (standard deviations). All data for normality was tested by using the Kolmogorov-Smirnov test. All assessment parameters showed normal distribution except stair ascend and descend time. The Friedman test was used to calculate the differences between the pre- and post-treatment values. To compare the differences between the groups, one-way analysis of variance (ANOVA) test or the Kruskal-Wallis test was used. A value of less than 0.05 was considered statistically significant. All analyses were performed using the SPSS 16.0 for Windows.

## Results

All patients completed the study. There were no statistically significant differences in age, gender, disease duration, education and radiographic grades between the groups (Table 1). Most of the patients had Grade 3 OA based on radiological findings. No statistically significant baseline differences were observed for pain and functional capacity between the groups.

The results of full blood count, ESR, CRP and biochemical markers were within normal ranges for all groups.

#### Pain

After 1 month of the therapy VAS was found to be statistically significantly decreased in group 1 and 2 ( $p=0.000$ ,  $p=0.020$ ). In addition, there was a statistically significant improvement in WOMAC pain scores in group 1 and 2 ( $p=0.000$ ). However, no significant change was observed in pain severity in group 3 ( $p=0.593$ ). The improvements in VAS and WOMAC pain scores in both group 1 and 2 continued during 3-month follow-up ( $p<0.05$ ). Nevertheless, WOMAC pain scores worsened in group 3 at the end of the third month ( $p=0.000$ ) (Table 2).

There were statistically significant differences in VAS scores ( $p=0.001$ ) at the first month of the therapy, but no significant differences were detected in WOMAC pain scores ( $p=0.930$ ) between the groups. After a three month period, significant differences were observed in VAS and WOMAC pain scores between the groups ( $p=0.001$ ) (Table 2).

#### Functional Capacity

There were statistically significant improvement in 100-meter walking test in all groups after the first and third months of the therapy ( $p<0.05$ ). Stair ascend and descend time was found to be decreased in group 1 and 2 after 1 and 3 months of the therapy ( $p<0.05$ ). In group 3, this improvement was observed only after 3 months of the therapy. After the therapy, no significant changes were observed in sit-to-stand rises in group 1, 2 and 3. However, three-month follow-up results showed an improvement in all groups (Table 3).

There were statistically significant differences in 100-meter walking test, stair ascend/descend test, and sitting-standing up test between the three groups at baseline and at the third month of the therapy ( $p<0.05$ ) (Table 3).

There were statistically significant improvement in WOMAC functional and WOMAC total scores in all groups after the first and the third months of the therapy ( $p<0.001$ ) (Table 4).

One month after therapy and during the follow-up period, significant differences were observed in WOMAC functional and WOMAC total scores between the groups ( $p<0.05$ ) (Table 4).

## Discussion

After oral medications, exercise programs are the second most common treatment prescribed for the treatment of knee OA (23). Although there are studies comparing the performance of home-based exercise programs with those performed under the supervision of a physiotherapist, or together with a group, the most effective method of teaching exercising in long term is not clear (13,14,24-26). The results of the studies investigating the effectiveness of adding training programs to home exercise programs for knee OA patients are controversial (13,14,27,28). In the literature, we could not find any study comparing the effectiveness of home-based

**Table 1. Demographic and clinical features of the patients.**

	Group 1	Group 2	Group 3
Age (years)	59.35±11.71	61.50±11.05	58.90±8.39
Gender (Female/Male)	17/3	15/5	15/5
Disease duration (month)	29.15±32.42	22.20±31.48	28.65±40.98
Education (n)			
Primary school	6	7	7
Secondary school	7	5	6
High school	2	5	3
University	5	4	3
Kellgren- Lawrence			
Grade 2	9	7	4
Grade 3	11	13	16

exercise programs (given in brochures with printed illustrations or supervision by a physiotherapist) and those combined with patient training programs on knee OA. In this study, we aimed to find out the best way of teaching the home exercise programs for OA patients and if adding training program will provide an additional benefit to knee OA treatment. With this purpose, an easy-to-understand training program specific for knee OA patients was developed with a plain language. A home exercise program including ROM exercises and isometric-isotonic quadriceps exercises was prepared. These exercise programs were shown by photographs and explained by a physiotherapist, or else were delivered in a visual brochure.

Education programs in the previous studies were general individual or group-based programs developed for various chronic diseases. Later, disease-specific education programs were developed due to the lack of effectiveness (9). Mazzuca et al. (29) compared the disease-specific self care education and a general training on arthritis in patients with knee OA. They found that a significant improvement in pain and disability was achieved with self care education program. In a study by Coleman et al. (8), a training program including pain management strategies, exercise advice, joint protection, treatment, balance, and falls prevention was given to patients with knee OA both under the supervision of a physiotherapist and a written material for 6 sessions once a week. Improvements in pain, functional capacity and quality of life parameters were observed after 12 weeks of the therapy. This was a long-term follow-up study, however, having no control group and having an irregular exercise program which patients could freely choose the type and level of exercise were the limitations of the study. In our study, we prepared a disease-specific training program and developed a standard exercise program. Similar to the studies with disease-specific training programs, in our study, decreases in pain levels and increases in functional capacities were observed. Tsauo et al. (26) compared the effectiveness of self exercise, team-exercise and lecture-only programs in patients with neck and shoulder pain, and observed that team-

exercise group responded most favorably and the group that lecture program was given had the least response to treatment. In another study (16), physiotherapist-prescribed exercise and advice combination in sub-acute lower back pain was found to be more effective in reducing pain and disability as compared to physiotherapist-prescribed exercise-only or advice-only groups. A comparison of home-based and class-based exercise programs (21) showed that class-based programs which were given by a physiotherapist additional to a written material were more effective in pain relief and improvement in functional capacity in patients with knee OA. In our study, we observed an improvement in functional capacity in all groups at the end of 1<sup>st</sup> and 3<sup>rd</sup> months. However, no reduction in pain was seen; even an increase in pain severity was observed at the end of 3<sup>rd</sup> month in patients with the home exercise program given by visual brochures. This was probably due to not paying attention to brochures as a treatment method and overlooking the importance of the exercise program. Additionally, the exercises might be applied in a wrong manner because of the difficulties in understanding the written education materials. The major factor was the low-level socio-cultural characteristics and educational level of the patients. The exercises given under the supervision of a physiotherapist together with brochures were more effective compared to those given with written education materials alone. As they had the opportunity to ask about the exercises directly to a physiotherapist and even if they forgot about them when practicing at home, the brochures with the photos helped them to remember. When we have investigated the functional capacity test results, we observed no significant improvement in the sit-to-stand test 1 month after the therapy. However, in the three-month follow-up, an improvement was seen in all groups. To sit and rise from a chair is a complex activity that requires more muscle strength. The effects of exercise occur in a long period of time. This may be the reason for the lack of improvement in the sit-to-stand test in all groups.

Studies investigating the effectiveness of exercise and

**Table 2. The results of VAS and WOMAC pain scores of the patients.**

VAS1	Group 1 (mean±SD3)	Group 2 (mean±SD)	Group 3 (mean±SD)	p value
Baseline	6.52±1.92	5.97± 2.26	6.87±2.08	
Posttreatment 1 <sup>st</sup> month	4.55±1.37	5.70±1.85	6.82±2.00	0.001**
P	0.000**	0.020*	0.593	
Posttreatment 3 <sup>rd</sup> month	2.75±1.08	5.00±1.91	6.92±1.92	≤0.001***
P	0.000**	0.000**	0.683	
WOMAC pain <sup>2</sup>				
Baseline	6.95±3.23	11.40±4.33	10.30±3.27	
Posttreatment 1 <sup>st</sup> month	9.60±3.64	9.75±4.10	10.05±3.64	0.930
P	0.000**	0.000**	0.285	
Posttreatment 3 <sup>rd</sup> month	3.10±1.88	9.60±3.89	11.35±3.58	≤0.001***
P	0.000**	0.000**	0.000**	

<sup>1</sup>: Visual Analog Scale, <sup>2</sup>: Western Ontario McMaster University Osteoarthritis, <sup>3</sup>: Standart Deviation, \*p<0.05, \*\*p<0.01, \*\*\*p<0.001.

patient training programs reported that patients with knee OA who were given exercise programs showed better improvement in pain and functional capacity (15). Another study showed the effectiveness of both isokinetic quadriceps exercise programs and patient training programs in functional capacity and pain in

knee OA patients. It was emphasized that exercise program was a well-tolerated treatment method; however, training programs were also very low-cost and easy-to-apply methods and had beneficial effects (14). In our study, we compared patient training and home exercise programs and exercise alone.

**Table 3. The changes in functional capacity assessment results before, at 1<sup>st</sup> and 3<sup>rd</sup> months of the therapy in all groups.**

	Group 1 (mean±SD) <sup>1</sup>	Group 2 (mean±SD)	Group 3 (mean±SD)	p value
<b>100 meter walking test</b>				
Baseline	124.20±34.22	122.15±46.57	161.55±57.59	
Posttreatment 1 <sup>st</sup> month	102.25±31.33	105.65±47.12	147.25±52.55	0.003**
P	0.000**	0.000**	0.025*	
Posttreatment 3 <sup>rd</sup> month	79.60±21.90	99.30±37.09	136.50±45.33	≤0.001***
P	0.000**	0.000**	0.005*	
<b>Ascending-descending stairs test median (min-max)<sup>2</sup></b>				
Baseline	18 (3-42)	33.5 (10-94)	29 (12-71)	
Posttreatment 1 <sup>st</sup> month	17 (3-40)	28 (10-92)	27 (12-120)	0.029*
P	0.008*	0.003*	0.071	
Posttreatment 3 <sup>rd</sup> month	15.5 (2-40)	31.5 (10-77)	26.5 (14-65)	0.004**
P	0.000**	0.038*	0.043*	
<b>Sitting-standing up test</b>				
Baseline	4.30±1.86	5.30±2.05	7.00±3.21	
Posttreatment 1 <sup>st</sup> month	4.00±1.52	5.25±1.99	6.70±2.81	0.001**
P	0.096	0.564	0.705	
Posttreatment 3 <sup>rd</sup> month	3.55±1.35	5.00±1.83	5.65±1.34	≤0.001***
P	0.000**	0.030*	0.038*	

<sup>1</sup>: Standart Deviation, \*p<0.05, \*\*p<0.01, \*\*\*p<0.001  
<sup>2</sup>median (min-max): median (minimum-maximum).

**Table 4. Comparison of the WOMAC functional and total score in patients in different treatment groups and within the groups at 1<sup>st</sup> and 3<sup>rd</sup> months.**

	Group 1 (mean±SD) <sup>2</sup>	Group 2 (mean±SD)	Group 3 (mean±SD)	p value
<b>WOMAC<sup>1</sup> functional score</b>				
Baseline	32.30±10.97	41.00±13.02	38.55±14.36	
Posttreatment 1 <sup>st</sup> month	24.00±10.02	36.00±12.69	34.65±14.23	0.006**
P	0.000**	0.001**	0.000**	
Posttreatment 3 <sup>rd</sup> month	13.35±5.11	36.05±12.60	35.75±14.10	≤0.001***
P	0.000**	0.000**	0.000**	
<b>WOMAC total score</b>				
Baseline	43.90±15.49	56.55±18.15	53.15±18.37	
Posttreatment 1 <sup>st</sup> month	32.80±14.28	49.20±17.67	47.70±18.54	0.005**
P	0.000**	0.000**	0.000**	
Posttreatment 3 <sup>rd</sup> month	17.50±7.05	49.05±17.40	49.25±17.61	≤0.001***
P	0.000**	0.000**	0.000**	

<sup>1</sup>: Western Ontario McMaster University Osteoarthritis, <sup>2</sup>: Standart Deviation, \*p<0.05, \*\*p<0.01, \*\*\*p<0.001.

Contrary to other studies, significant improvements in pain and functional capacity were observed in the group given both exercise and training programs together. Our results support the importance of such training programs in making patients aware of their diseases, the necessity of behavioral changes to regulate their daily living activities and the importance of exercise programs. Besides, training programs in addition to exercises motivate patients. The limitation of our study is not to have a group with only patient training program to compare with the group with exercise alone. Another limitation was the small sample size. Power analysis and sample-size calculation in trials should be always considered at the beginning of the research study, however, this analysis have not been performed which was the third limitation of our study.

## Conclusion

As a result, an effective way of prescribing home-based exercise program seems to be giving both in visual demonstration and written materials together. In addition, accompanying training lectures were found to provide an additional benefit in improving the effectiveness of the therapy in patients with knee OA. Therefore, the patients should be informed about the disease, the importance of exercise in knee OA and should be prescribed exercise programs with both illustrated brochures and practice under the supervision of a physiotherapist.

## Conflict of Interest

Authors reported no conflicts of interest.

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