

The Effectiveness of Quadriceps Exercise, Home-Based Exercise Program and Home-Based Exercise Program in Combination with Physical Modalities for Treatment in Osteoarthritis Knee: A Randomized Control Study

Sangarun Dungkong*

Department of Orthopaedic Surgery, Siriraj Hospital, Mahidol University, Bangkok 10700, Thailand

ABSTRACT

Objectives: Therapeutic exercise is one of the most commonly used non-pharmacological methods for treating knee osteoarthritis (OA). This study proposed to compare the effectiveness of quadricep exercise, home-based exercise program and home-based exercise program in combination with physical modalities.

Method: Patients with primary knee OA had been selected to receive the treatment. They were randomly allocated into three groups: Quadriceps Exercise, Home Exercise Protocol and Home Exercise Protocol with Physical Modalities. The outcomes were measured regarding six-minute walk test (6MWT) and Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) for pain, stiffness and function at baseline, six weeks and 12 weeks.

Results: 123 patients were recruited to participate this study and randomly divided into three groups. The results show the progressive improvement of each group. The mean of 6MWT had no significant difference among the studied groups at 12 weeks. WOMAC scores of the groups were not significantly different.

Conclusion: These three exercise protocols can be used for patients with osteoarthritis knee. The outcomes in terms of 6MWT and WOMAC scores were not significantly different. They were proved that the protocols allow to improve the patients' physical performances within 12 weeks.

Keywords: Osteoarthritis knee; Home exercise; Randomized control trial

INTRODUCTION

Knee osteoarthritis (OA) is reported to be an importance worldwide health problem [1]. OA knee causes pain, joint stiffness, and decreased quadriceps strength which affects the activities of daily living, namely sitting, standing, walking and climbing stairs [2,3]. Many non-pharmacological methods for treatment of OA knee are recommended by Osteoarthritis Research Society International (OARSI) including exercise (land-based and water-based), self-management and education, strength training, and weight management [4].

Therapeutic exercise is the most commonly used method for conservative treatment of OA knee. Various protocols of exercise program are available, including range of motion, stretching, strengthening, balance, joint coordination and functional

training exercise [5]. Quadriceps strengthening (QS) exercise is an effective method for reducing pain and improving knee function in OA patients. However, QS exercise which is focusing only on a single group of muscle strengthening may not adequate to improve overall lower limb's function. Many programs of knee exercise have been developed and required specific equipment or multiple visit at physical therapy clinic [2,3,6].

Cost-effectiveness analysis for treatment of OA knee in the healthcare system are an importance issue to develop the treatment guideline for non-operative management. Home-based exercise program has advantages to reduce the cost of patient's transportation, time and work load in the physical therapy center or hospital. There have been many studies about the benefits of home-based exercise program for OA. A systematic

Correspondence to: Sangarun Dungkong, Department of Orthopaedic Surgery, Siriraj Hospital, Mahidol University, Bangkok 10700, Thailand, Tel: 66860626440; E-mail: sicoeos@gmail.com

Received date: July 23, 2020; **Accepted date:** August 10, 2020; **Published date:** August 17, 2020

Citation: Dungkong S (2020) The Effectiveness of Quadriceps Exercise, Home-Based Exercise Program and Home-Based Exercise Program in Combination with Physical Modalities for Treatment in Osteoarthritis Knee: A Randomized Control Study. Int J Phys Med Rehabil. 8:567. DOI: 10.35248/2329-9096.20.08.567

Copyright: © 2020 Dungkong S. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

review by Anwer et al. [7] reports the effectiveness of home-based exercise program regarding 19 studies which found significant improvements in pain and function in patients with knee OA. However, they showed the methods of home exercise program interventions were varied between these studies. For clinical practice in the varying of patient's culture, economic status and health care system, the effectiveness of home-based exercise program should be evaluated and compared to the standard of care before established as the treatment guideline.

Physical modality, ultrasound (US), interference current (IF), hydrocollator pack (HY), short wave diathermy (SWD), have shown their benefits to relieve pain, decrease inflammation and improve blood circulation. However, OARSI categorized these modalities as the uncertain appropriateness method for treatment of OA knee since their outcomes were varied [4].

The purpose of this study aimed to evaluate the effectiveness of knee exercises protocol and physical modality for primary knee osteoarthritis patients compared between 3 groups, which are: QS exercise, home exercise program and home exercise program combine with physical modality.

METHODS

123 patients with primary OA knee were recruited by the Department of Orthopedic Surgery, Faculty of Medicine Siriraj Hospital (NCT02600702). The inclusion criteria were age above 50 year who were diagnosed with OA knee according to the American College of Rheumatology [8]. Radiographic was used to evaluate OA knee grade II-III based on the Kallgren and Lawrence [9]. Subjects had to participated in an exercise program and had ability to do 6-minute walk test. The exclusion criteria were patients with body mass index over 35 kg/m², had history of active coronary artery disease, knee joint infection, peripheral vascular disease or other diseases of the lower extremity which effect to knee function. Patients who had scheduled for surgical treatment of OA knee were also excluded.

A randomized controlled trial (RCT) had been conducted with an allocation of study population to three groups by using a randomized computer program. Each patient group was randomly assigned by sequential opaque envelopes. The groups included Quadriceps Exercise (QS group), Home Exercise Protocol (HP group) and Home Exercise Protocol with Physical Modalities (HPPM group); there were 41 individuals assigned to each group. One of patients in HP group was lost to follow up after 6 weeks.

INTERVENTION

The patients in QS group were treated by pain medication and one suggested knee exercise which was long arch quadriceps exercise done twice a day.

The patients in HP group were treated by Siriraj home-based knee exercise protocol. The protocol consisted of eight exercises including towel stretch, heel slide, straight leg raise exercise, short arcs quadriceps exercise, long arcs quadriceps exercise, strengthening hamstring group muscle, strengthening hip extensor group muscle, side leg raises and balance training. Each exercise was performed by holding for 5-10 seconds, 10-15 set

per time, twice a day. Low impact exercises such as swimming, cycling or walking were also suggested for the patients to perform by their own convenience and preference. It was recommended to start with 10-minute duration and then gradually increase the duration to up to 30 minutes, three times a week [1,10-15]. Patients returned to physical therapy clinic for reviewed their progress and compliance of the protocol by physical therapist at 6 weeks.

The third group-HPPM, was treated by home exercise protocol including with physical modalities. Participants in this group had to personally attend 10 exercise sessions (2 times per week for the first 5 weeks of treatment period) at the physical therapy clinic to be treated with physical modalities and supervised clinical exercises.

All groups were received pain medication including paracetamol and Nonsteroidal Anti-inflammatory Drugs (NSAIDs) as needed.

MEASUREMENT

The primary outcome measured in this study was six-minute walk test (6 MWT). Secondary outcomes were Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) for pain, stiffness and function. All measurements were assessed by trained research assistant who blinded for patients allocated groups at base line, 6 weeks and 12 weeks.

STATISTICAL ANALYSIS

Descriptive data of 6MWT was expressed in terms of mean and standard deviation (SD). Whilst quantitative data, including sex, was explained using number and percentage. The normal distribution test was with Kolmogorov-Smirnov for normality test. The comparison between 6MWT and WOMAC was done by using the analysis of variance (ANOVA). Comparison of qualitative data, namely sex was conducted using Chi-square test.

RESULTS

123 participants were randomly allocated to three groups: QS, HP and HPPM, 41 cases per group. There were two cases in the HP group did not match the inclusion criteria, and one case in the HPPM group was lost to follow up. Demographic and baseline clinical characteristic of each group were not significantly different. All patients were diagnosed with knee osteoarthritis. Mean age of patients in this study was 62.8 years, and approximately 92.5 percent of participants were women.

When evaluating the result of six-minute walk test, a baseline figure of each group was set at the beginning. The baseline of 6MWT for QS, HP and HPPM groups were 199.1 ± 42.9, 242.5 ± 80.6 and 206.3 ± 58.6 meters, respectively. Comparing the baseline among three groups, the result of 6MWT was found to be significantly different (p=0.005). Participants had completed the test when visiting the clinic at 6 and 12 weeks. As a result, it had been found that every group had shown the progressive improvement. Within 12 weeks, the mean of 6MWT results had been developed approximately 31.2, 32.3 and 34.7 meters in QS, HP and HPPM groups, respectively. There was no significant

difference of the progress compared between these groups ($p=0.773$). Mean baseline WOMAC scores of QS, HP and HPPM groups were 78.8 ± 37.4 , 67.0 ± 42.2 and 88.3 ± 45.5 , respectively. After week 12, the scores were reduced to 44.4 ± 24.1 in QS group, 37.9 ± 31.0 in HP groups and 37.9 ± 31.0 in HPPM group ($p=0.484$).

DISCUSSION

There are several non-pharmacological protocols that are recommended to be used to treat knee osteoarthritis. According to OARSI, the treatment includes exercises, strength training, weight management and physical modalities [4].

A meta-analysis shows that a number of randomized controlled trials had been studied on the outcome of three interventions: strength training, exercise therapy and exercise therapy with mobilization [11]. Similar to this randomized-controlled trial, the participants were divided into three groups: quadricep exercises, home-based exercises and home-based exercises with physical modalities. The meta-analysis also reports that most RCT studies had utilized WOMAC to evaluate the effects on pain and function [11]. Whilst the outcome focused in this study was analyzed by using 6MWT as a primary result and WOMAC as a secondary.

The results of this study demonstrated the improvement of outcomes according to the results of 6MWT and WOMAC between 6 and 12 weeks. When comparing the results between these three groups, there was no significant differences. A few studies found that exercise protocols result similar outcomes in terms of 6MWT and WOMAC, each protocol could be used to improve patients' physical performances [2,6]. The use of each studied program may depend on the preferences of physicians and patients. The exercise protocol shall be customized to be suitable with each patient.

The limitations of this study were that the significantly different baseline when comparing between the focused groups. As a suggestion for further study, the cost analysis of each protocol should be determined. Home-based exercises shall be able to reduce travel expenses because it requires smaller number of clinic visitation for receiving exercise consultation.

CONCLUSION

In conclusion, the effectiveness of the studied protocols comparing with each other was controversial. This study shows that these three protocols could be recommended to treat patients with OA knee since the outcomes were not significantly different. The studied programs were safe and effective. This study had proved that the different protocols of treatment could effectively improve the patient performances within 12 weeks.

ACKNOWLEDGMENTS

The effectiveness of quadriceps exercise, home-based exercise program and home-based exercise program in combination with physical modalities for treatment in osteoarthritis knee: A randomized control was support by the Routine to Research Unit (R2R:277/14) Faculty of Medicine Siriraj Hospital at Mahidol University.

REFERENCES

1. Deyle GD, Allison SC, Matekel RL, Ryder MG, Stang JM, Gohdes DD, et al. Physical therapy treatment effectiveness for osteoarthritis of the knee: a randomized comparison of supervised clinical exercise and manual therapy procedures versus a home exercise program. *Phys Ther*. 2005;85(12):1301-1317.
2. Nejati P, Farzinmehr A, Moradi-Lakeh M. The effect of exercise therapy on knee osteoarthritis: A randomized clinical trial. *Med J Islam Repub Iran*. 2015;29:186.
3. Ghosh PK, Ray D, Chatterjee B, Acharya S, Adhikary S, De A. Comparative study of the effectiveness between balancing exercises and strengthening exercises with common use of TENS to improve functional ability in Osteoarthritis involving knee joint. *IAIM*, 2015;2(10):1-17.
4. 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(3):363-88.
5. Ay S, Evcik D, Kutsal YG, Toraman F, Okumuş M, Eyigör S, et al. Compliance to home-based exercise therapy in elderly patients with knee osteoarthritis. *Turk J Phys Med Rehab*. 2016;62(4):323-8.
6. Huang L, Guo B, Xu F, Zhao J. Effects of quadriceps functional exercise with isometric contraction in the treatment of knee osteoarthritis. *Int J Rheum Dis*. 2018;21(5):952-9.
7. Anwer S, Alghadir A, Brismée J-M. Effect of home exercise program in patients with knee osteoarthritis: A systematic review and meta-analysis. *J Geriatr Phys Ther*. 2016;39(1):38-48.
8. Hochberg MC, Altman RD, April KT, Benkhalti M, Guyatt G, McGowan J, et al. American College of Rheumatology 2012 recommendations for the use of nonpharmacologic and pharmacologic therapies in osteoarthritis of the hand, hip, and knee. *Arthritis Care Res*. 2012;64(4):465-74.
9. Felson DT, Zhang Y, Hannan MT, Naimark A, Weissman BN, Aliabadi P, et al. The incidence and natural history of knee osteoarthritis in the elderly, the framingham osteoarthritis study. *Arthritis Rheum*. 1995;38(10):1500-5.
10. Mascarini NC, Vancini RL, Andrade MldS, MagalhãesEdP, de Lira CAB, Coimbra IB. Effects of kinesiotherapy, ultrasound and electrotherapy in management of bilateral knee osteoarthritis: prospective clinical trial. *BMC MusculoskeletDisord*. 2012;13(1):182.
11. Jansen MJ, Viechtbauer W, Lenssen AF, Hendriks EJM, de Bie RA. Strength training alone, exercise therapy alone, and exercise therapy with passive manual mobilisation each reduce pain and disability in people with knee osteoarthritis: A systematic review. *J Physiother*. 2011;57(1):11-20.
12. Mondam S, SrikanthBabu V, Raviendra Kumar B, Prakash J. A comparative study of proprioceptive exercises versus conventional training program onosteoarthritis of knee. *Res J Recent Sci*. 2012;1(12):31-5.
13. Foley A, Halbert J, Hewitt T, Crotty M. Does hydrotherapy improve strength and physical function in patients with osteoarthritis: Arandomised controlled trial comparing a gym based and a hydrotherapy based strengthening programme. *Ann Rheum Dis*. 2003;62(12):1162.
14. DiNubile N. Strength training. *Clinsports Med*. 1991;10(1):33-62.
15. Bandy WD, Irion JM, Briggler M. The effect of time and frequency of static stretching on flexibility of the hamstring muscles. *Phys Ther*. 1997;77(10):1090-6.