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ORIGINAL RESEARCH

Effect of Salat Activity on Knee Pain, Range of Motion and Muscle Strength after Total Knee Arthroplasty: A Single-Blinded Randomized Controlled Trial

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Abstract

Objectives: The aim of this study was to investigate the effect of salat activity on knee pain, muscle strength and range of motion after posterior stabilized total knee arthroplasty.

Material-Method: This prospective randomized study was conducted in KTO Karatay University and Medova Hospital, Konya, Türkiye, between March 2019 and June 2019. Thirty volunteers between the ages of 55 and 75 who had undergone total knee arthroplasty participated in this study. Participants were randomly divided into two groups as Physical therapy group and Physical therapy + salat group. The participants in the physical therapy group were provided hot-cold application, transcutenous electrical nerve stimulation (TENS), active-assisted range of motion, stretching and strengthening exercises during four weeks. Physical therapy+salat group performed salat activity in addition to the treatment. The knee joint patency was measured using a digital goniometer, muscle strength using a manual muscle tester, knee pain with the visual analogue scale (VAS).

Results: There was no difference in knee flexion and extension muscle strength between the groups before and after treatment ($p > 0.05$). There was no difference in VAS values between the groups before and after treatment ($p > 0.05$). Knee flexion angle increased significantly in the physical therapy+prayer group compared to the post-treatment physical therapy group ($p<0.003$). There was no significant difference between the groups in knee extension angle before and after treatment ($p>0.05$).

Conclusion: In this study, it was found that Salat activity after knee arthroplasty improved knee joint range of motion.

Keywords: Arthroplasty, Exercise, Knee, Randomized Controlled Trial, Salat

INTRODUCTION

Islam is one of the major religions in the world. The number of its believers worldwide is expected to increase by 35% between 2010 and 2030 that would reach up to 2.2 billion.[1] Salat activity is a form of worship that is compulsorily performed five times a day by the people who practice Islam. During the salat activity, the person performs different body movements while reading the Arabic prayer.[2] The salat activity begins when a person turns their face to the Qibla and takes their hands to their ears and then join them at the navel or chest (standing or Qiyam). After standing for 60-90 seconds, the hands are placed on the knees, and the person tilts their body forward (bowing or ruku). The action of tilting forward takes approximately 5-10 seconds before returning to the standing position. Subsequently, the prostrate (sujud) movement is made. In the prostrate position, the forehead, knees and hands are in contact with the ground. The prostrate position lasts 5-10 seconds on average. Then the person moves from prostrate to sitting position (tahiyat). Full flexion of the knees occurs in the sitting position. The sitting and prostrate positions are repeated twice. The sum of these movements is called rakat. There are a total of 40 rakats in fivetimes of Salat activity per day.[3,4] Brown and Lee [5] defined exercise as planned and repetitive movements of the body. Exercise helps in the maintenance of physical fitness and has many beneficial effects on health. Salat activity is a kind of exercise because it includes planned and repetitive body movements. In the literature, there are studies that indicate the physical and mental positive effects of salat activity on human health.[6]

Total knee arthroplasty is one of the most common skeletal-muscle surgeries worldwide.[7] The most common post-operative problems are pain in the knee, joint restriction and decreased muscle strength. In the first months after the surgery, power loss of the quadriceps muscle can be around 60%.[8,9] In the early post-operative period, the most important factor that affects the patient`s ability to walk is the range of motion. To gain normal range of motion as soon as possible is important in rehabilitation.[10] For these reasons, taking the patient into the rehabilitation programme as early as possible reduces the time of recovery, hospitalisation time and cost.[11] The post-operative rehabilitation programme includes elevation, cryotherapy, continuous passive motion (CPM), neuromuscular electrical stimulation (NMES), transcutaneous electrical nerve stimulation (TENS), bandaging, water therapy, strengthening and stretching exercises.[12] In particular, post-operative stretching and strengthening exercises are important in restoring joint range of motion and muscle strength.[13,14] Salat is an activity that involves large muscle groups and joints in the lower extremities.[4] Nevertheless, there are no studies that examined the effects of salat activity after total knee arthroplasty in the literature. The aim of this study was to investigate the effects of salat activity on pain, range of motion and muscle strength after posterior stabilized total knee arthroplasty.

MATERIALS AND METHODS

Ethical considerations

A prospective randomized controlled trial was conducted. The study protocol was approved by the KTO Karatay University`s Non-Clinical Research Ethics Committee dated 25/09/2018 and with the decision of 2018/004. The research was conducted in accordance with the principles of the Declaration of Helsinki. Before the conduct of the study, detailed information was given about the procedures to be performed and each participant signed the informed consent.

Patients

A total of 30 volunteers with sedentary lifestyle aged between 55- and 75 years participated from the Orthopedic Services of the Medova hospital in Türkiye, from March 2019 to June 2019. All patients had primary osteoarthritis. The patients who could not achieve adequate recovery (patients with an average knee flexion of 90 degrees and a VAS assessment of more than 7 units) with the home exercise programme were also included in the study, whereas those with post-operative lower extremity infection, circulatory disorder, wound complications and instability were excluded. All patients were performing regular salat activities before surgery. This prospective randomized study was conducted in KTO Karatay University and Medova Hospital, Konya, Türkiye, between March 2019 and June 2019.

The participants were randomly divided into two groups, physical therapy group (PT-G) (n = 15) and physical therapy + salat (PT + S-G) group (n = 15). The participants in both groups were included in the study 30 days after the operation with the approval of the specialist that performed the surgery. The participants in the PT-G were provided hot-cold application (hot: 20 min, cold: 10 min) , TENS (treatment parameters were: alternating current, rectangular impulse, impulse duration 100 µs, frequency of 100 Hz, 20-min duration of a single treatment) , active-assisted range of motion (knee flexion-extansion) , stretching and strengthening exercises (contraction of isometric knee and hip muscles,lifting straight leg and hip abduction-adduction with tolerated weight, knee flexion and extansion, ankle flexion and extansion. All moves consisted of 3 sets of 10 repetitions) based on the oedema status by a physiotherapist five days a week for four weeks. Participants in the PT-G were also given a classic home exercise program for their application 5 times a day while PT+S-G was not given. In addition, the participants were told to salat activity on chair during the study period. The same PT protocol was applied to the participants in the PT + S-G, but the participants performed five salat activities each day for 4 weeks. Participants in the PT + S-G received support from their relatives for a certain period of time (average 7 days) in the prostration position. In this process, the physiotherapist informed the patient and their relatives on a daily basis and ensured the correct execution of the procedure. Patients in the PT + S-G their daily salat activities on video record during the study and sent the images they took daily to the specialist physiotherapist. In this way, it was provided to perform salat activities correctly. Before and after the study, knee flexion-extension muscle strength was measured with a manual muscle testing device (LaFayette Instrument Company, Lafayette, IN, USA), knee range of motion with digital goniometer and pain sensation in the knee with VAS.

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Randomisation and blinding

The study process is shown in figure 1. The study was designed as single-blind. The participants were randomly divided into groups with the help of a computer program. The researcher who made the measurements has no information about the groups. When the data entry was completed, the principal investigator added the group assignment to the data set. The statistician performed the statistical analysis without knowing the groups.

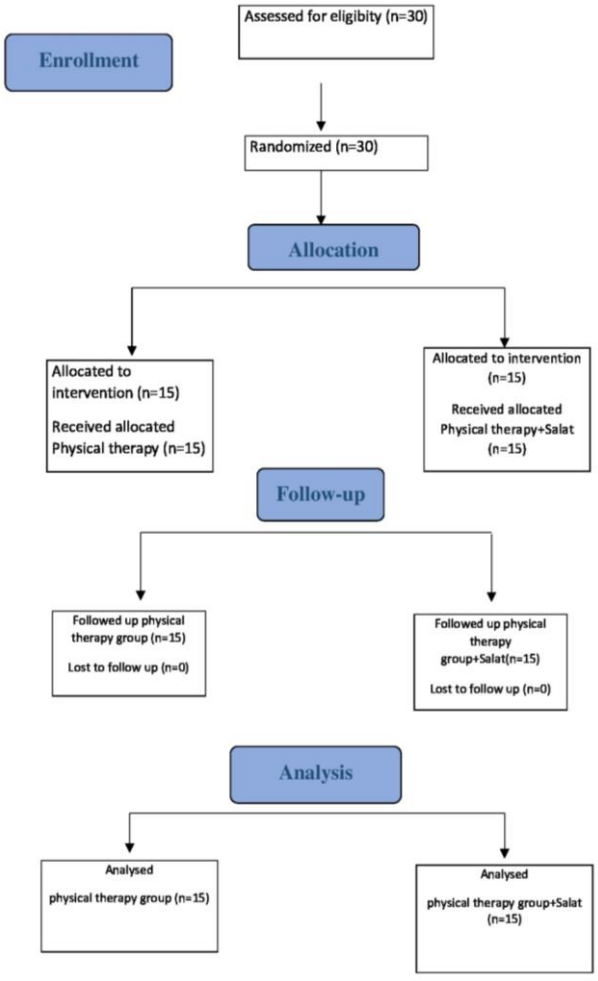

Figure 1. The patient selection process and study flow

Outcomes

The quadriceps and hamstring muscle strength was measured with LaFayette brand digital hand dynamometer. For quadriceps force measurement; The test was initiated with the participants sitting on a flat floor with their hips and knees flexed at 90 °, feet free and without support. The participants were verbally informed about the test application technique before starting the test. The dynamometer was placed perpendicular to the leg, 1-2 cm above the level of the malleoli. During the test, the "break test" technique, which requires isometric contraction, was applied.[15] For hamstring strength measurement, the participant was asked to lie prone on a flat table, with the knees flexed at 90° and without support. The muscle strength was measured using the same technique mentioned above. All measurements were taken twice by the same researcher from both legs of the participants in kg with the same hand and the best measurement was accepted. The patients' postoperative knee flexion ranges were measured with a digital goniometer (Halo digital goniometer, LaFayette). Goniometric measurements were taken with the patient in the prone position. The center of the goniometer was placed on the lateral epicondyle of the femur. Measurements were made so that the fixed arm passes through the midline of the femur and the movable arm passes through the midline of the fibula. Compensatory movements of the patient were not allowed. At the start of the study the digital goniometer was calibrated by measuring a 90° angle. The VAS is a simple scale that evaluates the severity of pain. It consists of a straight line of 10 cm. A value of 0 means no pain, a value of 10 means severe pain.[17]

Surgical procedure

Operation used a standard median parapatellar approach. All surgeries utilized the Scorpio PS posterior-stabilized system (Stryker, Mahwah, New Jersey).

Sample size and statistical analysis

Sample size calculation was made using a statistical power analysis program (G*Power Version 3.0.10, Franz Faul, Universität Kiel, Germany). It was calculated according to the previous study examining the effect of TENS and exercise on knee pain.[18] Pain level was used to estimate the sample size. The analysis indicated that fifteen participants for each group were enough to detect a large effect of Cohen's d:(0.75) with an alpha error probability of 0.05 and the power of 80%. SPSS for Windows 25.0 (IBM SPSS Statistics for Windows, Version 25.0., IBM Corp., Armonk, NY, USA) was used for the statistical analysis of the data. Normally distributed data were evaluated by Student`s *t* test, and non-parametric tests were used. Mann-Whitney U test was used for the intergroup analysis, and Wilcoxon signed rank test was used for comparison of first and last values in the intra-group analysis.

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The descriptive statistics were expressed as mean ± standard deviation. A *p* value less than 0.05 was considered statistically significant.

RESULTS

There were 13 women and 17 men as participants in this study. The mean age of the PT-G was 63.8±1.03, and that of the PT+S-G was 59.6±1.45. There was no statistically significant difference in knee angles, pain intensity and muscle strength between the two groups at the beginning of the study (pre-study group comparison: p=0.568 for knee flexion angle, p=0.836 for knee extension angle, p=0.243 for pain intensity, p=0.516 for knee flexion strength, p=0.789 for knee extension strength).

The muscle strength values of the participants before and after the treatment are given in Table 1. There was a statistically significant difference in knee flexion strength and knee extension strength post-treatment compared with pre-treatment in both groups ($^1p<0.001$). Nevertheless, there was no significant difference in the muscle strength between the PT+S-G and PT-G ($^2p>0.05$).

Pre- and post-treatment VAS values of the participants are given in Table 2. There was a statistically significant difference in VAS values post-treatment compared with pre-treatment in both groups ($^1p<0.001$). However, there was no significant difference in the VAS values between the PT+S-G and PT-G ($^2p>0.05$).

Table 1. Muscle strength values of the groups before and after treatment
*According to Wilcoxon signed rank test

Groups	**Physical therapy group**			**Physical therapy + Salat group**			
	Before treatment	After treatment	In group P^1	Before treatment	After treatment	In group P^1	Between groups p^2
Knee Flexion Strength (kg)	5.99 ± 0.71	7.61 ± 1.08	**< 0.001***	6.20 ± 1.48	7.53 ± 1.09	**<0.001***	0.771
Knee Extension Strenght (kg)	8.34 ± 1.01	10.2 ± 1.06	**< 0.002***	8.30 ± 1.07	10.03 ± 0.79	**<0.001***	0.724

Table 2. VAS values of the groups before and after treatment

Groups	**Physical therapy group**			**Physical therapy + Salat group**			
	Before treatment	After treatment	In group P^1	Before treatment	After treatment	In group P^1	Between groups p^2
VAS (cm)	7.92 ± 1.57	2. 35 ± 0.87	**< 0.001***	8.73 ± 1.09	2.40 ± 1.45	**< 0.001***	0.219

*According to Wilcoxon signed rank test

The knee joint patency values of the participants before and after treatment are given in Table 3. There was a statistically significant difference in knee joint patency values in both groups after the treatment ($^1p<0.001$).

The knee flexion angle increased significantly in the PT+S-G compared with the PT-G ($^1p<0.003$). Nevertheless, there was no significant difference between the PT+S-G and PT-G regarding knee extension ($^2p>0.05$).

Table 3. Knee joint patency values of the groups before and after treatment

Groups	**Physical therapy group**			**Physical therapy + Salat group**			
	Before treatment	After treatment	In group P^1	Before treatment	After treatment	In group P^1	Between groups p^2
Knee flexion angle (°)	90.46 ± 8.70	124.93± 3.63	**< 0.003***	91.44 ± 10.29	140.06 ± 1.81	**< 0.001***	**< 0.003****
Knee extension angle (°)	13.6 ± 3.88	4.80±1.85	**< 0.001***	12.40 ± 5.60	4.46 ± 2.66	**< 0.001***	0.802

*According to Wilcoxon signed rank test
**According to Mann-Whitney U test

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DISCUSSION

This study showed that salat activity had a positive effect on knee joint range of motion in the participants with total knee arthroplasty but it did not affect knee pain and muscle strength.

The incidence of knee osteoarthritis (OA) and rheumatoid arthritis (RA) has been steadily increasing in the last decade. As a result, severe knee pain, muscle weakness and gait disturbances are seen.[19] Total knee arthroplasty (TKA) is considered to be an appropriate and effective method for the treatment of knee OA and RA. The main purpose of the TKA procedure is to reduce knee pain and improve knee function. Great attention should be paid to post-operative knee mobility or range of motion (ROM) to accommodate daily living activities.[20] After the TKA procedure, approximately 1.3% of the patients have severe joint restriction.[21] Rowe et al.[22] stated that the knee flexion angle should be more than 120° to reduce the risk of fall after surgery and to perform daily activities in the most appropriate way Similarly, in our study, knee flexion angle was more than 120° after the treatment in the PT + S-G. Classical TKA can relieve the patient's pain, but the flexion range is usually around 100° -110° .[23] In recent years, the search for more flexion after TKA has continued. Passive-active knee flexion-extension exercises and CPM device are the most commonly used methods for post-operative knee ROM.[24] Nevertheless, rehabilitation exercises may cause pain, and severe pain may delay healing.[25] Exercises with the use of the CPM device cause less pain, but the CPM device is difficult to carry and is expensive [21]. In the salat activity sitting position (tahiyat), the knees are in full flexion (approximately 130°-150°) for an average of 30-60 seconds.[26] The patient performs a controlled knee flexion five times a day during the salat activity. Also, during the salat activity, the person moves independently so that he or she can perform the knee flexion appropriately by setting the pain limit during the knee flexion. Muslim patients with knee osteoarthritis have been shown to have a significantly better flexion range than non-Muslim patients with knee osteoarthritis.[27] In addition, it is known that worshiping has a positive spiritual effect. Many studies show that salat in the postoperative recovery period positively affects patients.[28,29] Our findings reveal that salat activity improves knee flexion angle.

In this study, no statistically significant difference in the muscle strength and VAS values was observed between the groups. This may be because the salat activity is described as a moderate exercise. To date, there is no study on energy expenditure during the salat activity. Nevertheless, it is stated that performing similar activities, such as yoga and tai chi result in about 4 calories per kilogram per hour spent (for example, in a 70 kg individual; 70 × 4 = 280 cal / hour).[30] In a recent review, the effects of weightless forward bending, squatting exercises and salat activity on lower extremity muscles were examined. It was found that there was no significant difference between the activities of voluntary maximal contraction of rectus femoris, biceps femoris and gastrocnemius muscles.[26] Safee et al.[31] examined the electromyography (EMG) levels of the rectus femoris, biceps femoris and gastroknemius muscles during salat activity or squatting exercise, consequently, they found no significant difference among the activities. In another study, the myoelectric activity of the gastrocnemius muscle during salat activity or plantar flexion of the ankle was examined and no significant difference was found between the activities.[32] Similarly, although there was a statistically significant difference in the muscle strength in both groups, there was no significant difference between the groups.

There are many studies that indicate standard physiotherapy exercises (e.g. strengthening, stretching or aerobic exercise) in post-operative rehabilitation reduce knee pain and stiffness and improve quality of life.[32,33] In this study, the VAS values decreased significantly in both groups but there was no statistically significant difference between the groups. This may be due to the fact that salat activity increases parasympathetic activity and suppresses sympathetic activity. The sympathetic system is activated in stress situations that cause pain. Stimulation of the sympathetic system causes the release of endogenous opoioids from the prefrontal region, anterior cingulate gyrus, insula, amygdala and hypothalamus in the brain. Suppression of the sympathetic system may cause pain to increase and prolong.[34] In a recent review, it was reported that parasympathetic activation is high and sympathetic activation is low in religious people, and they also have low cortisol levels.[35] Doufesh et al. [3] studied the effect of salat activity on the autonomic nervous system in a study conducted with 30 Muslim men. As a result of the

study, the researchers found that salat activity increased the parasympathetic activity and suppressed the sympathetic activity The results of this study revealed that pain sensation decreased in both groups, but this decrease was caused by the PT. The present study had some limitations. First of all, we designed a 4-week program and presented the short-term effects. Secondly, we did not have a long-term follow-up. Further studies needed for the observation of long-term gains after the intervention.

CONCLUSION

In conclusion, in this study, it was observed that salat activity improved knee joint ROM in patients with TKA but it had no effect on pain and muscle strength. In the literature, studies on the biomechanical aspect and health effects of salat activity are limited. Therefore, future comprehensive studies on the biomechanics of salat activity and their health effects are needed.

Source of finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

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Author contributions: All authors contributed equally while this study preparing.

Conflict of interest: No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, shareholding and similar situations in any firm.

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