



The Effectivity of Physiotherapy Modification Technique on Pain, Muscle Weakness, Joint Stiffness, and Abnormal Walking Pattern on People with Knee Osteoarthritis

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Abstract

Knee osteoarthritis is a degenerative and progressive joint disease characterized by damage to joint cartilage and joint structure accompanied by new bone growth on the edge of the joint (osteophytes). Patients with knee osteoarthritis have complaints of pain, morning stiffness, and inflammation in the joints, limited scope of joint motion, decreased muscle strength, joint instability and functional ability problems. Physiotherapy modification technique is one of the physiotherapy techniques that can be used to deal with pain problems, joint stiffness, decreased muscle strength, and abnormal walking patterns in patients with knee osteoarthritis. This study aims to determine whether there is an effect of physiotherapy modification techniques on changes in pain, muscle strength, joint stiffness and walking patterns in patients with knee osteoarthritis. This study is a quasi-experimental research with time series design. Twenty-five subjects who met inclusion criteria were recruited to participate. The outcome measure used were Visual Analogue Scale (VAS) to measure pain, Range of Motion (ROM) to measure joint stiffness, Manual Muscle Test (MMT) to measure muscle strength, and the gait cycle measurement to measure walking pattern.

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Measurements were made at baseline, after 3 times and 6 times of treatments. Data analysis was using paired T test and Wilcoxon test. The results showed that there was a decreased pain intensity, increased knee flexion/extension ROM and muscle strength, and improved walking pattern after being given 3 times and 6 times of treatments ($p < 0.001$). In conclusion, physiotherapy modification technique has a significant effect on decreasing pain, increasing muscle strength, and improving joint stiffness and walking pattern of people with knee osteoarthritis.

Keywords: knee osteoarthritis; physiotherapy modification technique; pain; muscle strength; joint stiffness; walking pattern.

1. Introduction

Osteoarthritis is a type of arthritis caused by damage to cartilage from one or several joints in the body. Osteoarthritis is a degenerative and progressive disease involving two-thirds of people over 65 years of age, with a prevalence of 60.5% in men and 70.5% in women. Knee osteoarthritis and hip are ranked 11th as contributors to disability [1].

Patients with knee osteoarthritis usually have complaints of pain, limitation of joint motion, and decreased joint proprioceptive and strength of the quadriceps muscle. Risk factors of osteoarthritis including family history of osteoarthritis, being overweight, and doing work that requires squatting or kneeling more than 1 hour / day. The work of lifting goods, climbing stairs or walking long distances are also risk factors [2].

The prevalence of osteoarthritis in Indonesia is 5% at the age of less than 40 years, 30% at the age between 40 and 60 years and 65% at the age of more than 60 years. Nearly 80% of osteoarthritis at the age of 60 years is osteoarthritis of the knee joint and an estimated 1-2 million elderly people suffer from disabilities due to osteoarthritis [3]. The growth of new bones, cartilages and other tissues can cause enlarged joints and coarse cartilage characterised by crackling sound when walking [4].

Physiotherapy modification technique is a collection of several physiotherapy techniques including traction, stretching, pump articular or relax passive movement, and strengthening. Traction can stimulate biological activity by synovial fluid flow activity which can bring nutrients to joint surface and fibrocartilage. Repetitive movements in the traction movement can improve the microcirculation and increase the fluid volume and water content in the matrix, and the soft tissues around the joint become more elastic [5]. Stretching exercise is aimed to stretch the shortened muscles to make it more relaxed and increase the ROM of joints [6]. Relax passive movement is a passive movement that is limited due to pain. Its effects and usage are to prevent tissue adhesion, maintain joint motion and muscle extension, stimulate joints, bones, and muscles, prevent muscle shortening, and facilitate blood circulation and metabolic processes in tissues, as well as obtain muscle relaxation effects [7]. Strengthening exercise can increase muscle strength, range of motion, and functional activity of patients. Strengthening exercises is recommended to be begun with isometric exercise, gradually increased with isotonic exercise using load as tolerated by the patients [8]. The aim of this study is to examine the effectivity of physiotherapy modification technique to improve pain, joint stiffness, muscle weakness and abnormal walking

pattern in people with osteoarthritis [7].

2. Materials and Methods

2.1. Description of the Study Area

This study was conducted at Physio Sakti Clinic, Makassar. This study was a quasi experimental with control time series design.

2.2. Population and Sample

The population in this study were patients with osteoarthritis of the knee joint. Subjects consisted of 25 people who met inclusion and exclusion criteria.

2.3. Inclusion Criteria

The inclusion criteria were

1. People diagnosed with knee osteoarthritis according to clinical examination and or radiological examination
2. People who have complaint of pain, muscle weakness, joint stiffness, and abnormal walking pattern due to their knee osteoarthritis
3. People who never have physiotherapy treatment before in other places for their knee osteoarthritis

2.4. Exclusion Criteria

The exclusion criteria were

1. People who were in pain medication for their knee osteoarthritis
2. People who have other condition that can interfere with their participation in this study such as lumbal disc herniation, post total knee joint replacement, cardiovascular problems, or other conditions related.
3. People who refuse to participate in this study

2.5. Collecting Data and Procedure Intervention

Data collection was carried out by researchers using measurement instruments and interview guidelines. Information about the characteristics and general condition of the subjects, including name, age, status, occupation, and history of injury is obtained through interviews.

Pain intensity data was measured using VAS, ROM was measured using a goniometer, muscle strength was measured using MMT, and walking pattern was measured using Gait Cycle Measurement.

All patients were treated similarly with physiotherapy modification technique for 6 times, three times a week.

2.6. Data Analysis

The data was tested for normality using the Shapiro Wilk test. Normally distributed data was tested using paired T test. Non-normally distributed data was tested using the Wilcoxon test.

2.7. Ethical consideration and clearance

Ethical approval for this study was obtained from the Ethics Committee, Hasanuddin University, Department of Nursing, Makassar, Indonesia.

3. Results

The result of this study is presented in the form of characteristics of subjects in each variable examined, including the mean value, standard deviation, minimum, maximum, and median. The mean age of the study sample is the range of 61-70 years. The study subjects were 68 women and 32 men (Table 1).

Table 1: Age Characteristics of Respondents

Category	N	Mean	Minimum	Median	Maximum
Age	25	2,56	1	2	5

Information: n = number of samples;

Based on the data in Table 2, the data of VAS was not normally distributed according to Shapiro-Wilk test. The median value of VAS is decreased after 3 times and 6 times of treatment, from 8.00, to 4.00 at 3 three times, and to 2.00 at six times. The data of knee flexion ROM is normally distributed according to Shapiro-Wilk test. There is a significant increase of knee flexion ROM after 6 times of treatment, from 91 at baseline to 110.08 at 3 times and 127.6 at 6 times ($p < 0.01$).

Data of knee extension ROM, muscle strength, joint stability and balance are not normally distributed according to Shapiro-Wilk test. The median value of the knee extension ROM decreased after 6 times of treatment, from 15.00 at baseline to 5.00 at 3 times, and 0.00 at 6 times.

The median value of muscle strength is increased after 6 times of treatment, from 3.00 at baseline, to 4.00 at 3 times and 5.00 at 6 times. The median value of joint stability is increased after 6 times of treatment, from 4.00 at baseline to 7.00 at 3 times and 10.00 at 6 times.

The median value of balance is also increased from 24.00 at baseline to 37.00 at 3 times and 47.00 at 6 times. All changes are statistically significant according to Wilcoxon test with $p < 0.01$.

Table 2: Comparison of pre- and post 3 times treatments and 6 times treatments after intervention of Physiotherapy Combination to patients with osteoarthritis knee osteoarthritis.

Group	Min	Median	Max	p
VAS				
<i>Pre-test</i>	5	8,00	10	
<i>Post-test 3 times</i>	3	4,00	7	0,0001
<i>Post-test 6 times</i>	0	2,00	3	0,0001
Group	Means ± SD		change	p
ROM knee flexion				
<i>Pre-test</i>	91,00±14,327			
<i>Post-test 3 times</i>	110,08±9,385		19,08	0,0001
<i>Post-test 6 times</i>	127,60±5,972		36,6	0,0001
Group	Min	Median	Max	P
ROM knee extension				
<i>Pre-test</i>	8	15,00	20	
<i>Post-test 3 times</i>	0	5,00	10	0,0001
<i>Post-test 6 times</i>	0	0,00	5	0,0001
MMT				
<i>Pre-test</i>	2	3,00	4	
<i>Post-test 3 times</i>	3	4,00	5	0,0001
<i>Post-test 6 times</i>	3	5,00	5	0,0001
Gait Pattern				
<i>Pre-test</i>	1	3,00	4	
<i>Post-test 3 times</i>	2	4,00	4	0,0001
<i>Post-test 6 times</i>	4	5,00	5	0,0001
Stability				
<i>Pre-test</i>	3	4,00	6	
<i>Post-test 3 times</i>	5	7,00	9	0,0001
<i>Post-test 6 times</i>	8	10,00	10	0,0001
Balance				
<i>Pre-test</i>	6	24,00	36	
<i>Post-test 3 times</i>	22	37,00	48	0,0001
<i>Post-test 6 times</i>	35	47,00	54	0,0001

4. Discussion

At the age of 50 years and over, the frequency of knee osteoarthritis is more common in women (after menopause). This shows that hormonal factors play a role in the incidence of knee osteoarthritis, especially estrogen. One function of the estrogen hormone is to help synthesize chondrocytes in the bone matrix. Therefore, if estrogen decreases, chondrocyte synthesis decreases which ultimately decreases proteoglycan and collagen synthesis [9]. Based on the risk factors for work-related knee osteoarthritis, workers who overload the knee joint are at greater risk than workers who rarely overload the knee joint. For example, for workers whose jobs require squatting or kneeling more than 1 hour/day, lifting things, or climbing stairs at risk of developing osteoarthritis [10].

Osteoarthritis begins with erosion and progressive but slow damage to joint cartilage. Joint cartilage experiences erosion that occurs at the centre of weight bearing. During the initial stage, usually without symptoms of pain because the cartilage is avascular and less nerve cell, but the pain becomes constant at the next stage. Joint

cartilage then undergoes fibrillation which causes softening, cracking and fragmentation. The joint surface of the cartilage becomes uneven, splits with tears and ulcerations arise. With the development of the disease, the joint cartilage can be peeled or completely lost so that the underlying bone becomes open. Broken cartilage fragments can be trapped between the joint surfaces which will cause locking and inflammation resulting in pain and proliferation on the edge of cartilage. The synovial membrane has hypertrophy and oedema occurs which results in joint cartilage degeneration. Synovial fluid secretion decreases so that nutrient-prone joints are reduced and so is lubrication in the joints. In conditions of lack of synovial fluid, the cartilage layer that closes the ends of the bones will rub against each other. The friction will make the layer thinner and will eventually cause pain [3].

Reduced range of motion can occur in joint due to hypermobility of ligament capsule. The knee joint becomes unstable or hypermobile as the result of the thinning joint cartilage which makes the space between joints to narrow and the ligament capsule relaxes. In further development, the joint will experience tibial valgus deformity, where the joint capsule undergoes degeneration and chronic inflammatory processes. This results in decreased elasticity and contractures of muscles lead to limitations of motion and pain [3].

The limitation of motion and pain can cause disruption of daily activity leading to the joint immobilisation. During immobilisation, reduced movement and strain on the ligament capsule, there are decrease in microcirculation and changes in the collagen fibres of the connective tissue around the joint, as well as in the intercellular substance of glycosaminoglycan (GAG). The level of fluid and GAG decreases makes the tissue be less elastic and fibrosis develops. This occurs due to excessive formation and accumulation of collagen. Furthermore, it can cause collagen fibres to form a random pattern waving and abnormal crosslinks which results in joint stiffness, muscle contracture and pain [3].

Decreased muscle strength can be caused by lack of activity due to pain and limitation of motion. This will cause a decrease in the number of motor units, impaired circulation in the muscles, and reduced muscle performance, such as quadriceps muscle weakness [11]. Walking pattern in people with knee osteoarthritis is usually abnormal, such as antalgic gait or limping pattern, in which the mid stand phase arises to avoid pain. This is caused by synovial membrane tension or loading on the bone surface due to stimulation of the periosteum that rich in pain-stimulating nerve fibres [3].

In physiotherapy modification technique, traction and articular pump/relax passive movement provides pain reduction effect in patients with knee osteoarthritis. Traction is a technique that can improve microcirculation of the synovial fluid in the joint and improve nutrient support of the joint. Pumping articular is the patient movement powered by a physiotherapy in which patients' muscles are relaxed and carried out to the extent of pain tolerated by patient. The movement aims to exercise muscles passively, the muscles become relaxed, pain is reduced, the limitation of motion and elasticity problems of the muscles can be prevented. Stretching exercise can increase functional activity due to stretching can increase blood flow to the muscles. This can increase blood flow which brings nutrients to the muscles and remove metabolic waste from the muscles as well as accelerates recovery of muscle injury. It also can improve muscle flexibility and reduce limitation of motion. Regular strengthening exercise can cause muscle hypertrophy due to the increased number of myofibrils, myofibril size,

capillary blood vessel density, tendon and ligament nerves, and myosin contractile protein. Changes in muscle fibres do not occur at the same level. A greater increase occurs in white muscle fibres (fast twitch) resulting in an increase in the speed of muscle contraction. The increase in the size of muscle fibres ultimately increase the speed of muscle contraction resulting in an increase in muscle strength [12]. Increased muscle strength can improve the gait pattern road in patients with knee osteoarthritis, if pain decreases, ROM and muscle strength increases. Before correcting gait pattern first researchers also pay attention to the level of stability and balance.

The limitation of this study is that randomization was not carried out on the subject due to the small number of subjects. To maintain the validity of the research, a time-series design was used. Another limitation is that it is difficult to determine which technique is the most influential of several modification techniques used as physiotherapy interventions.

5. Conclusions

As a conclusion, there is a significant effect of physiotherapy modification technique: traction, stretching, pump articular, and strengthening, on pain, joint stiffness, muscle weakness, and abnormal gait patterns in people with knee osteoarthritis. Therefore, modification techniques must be used simultaneously to produce the expected results in patients.

6. Abbreviations

VAS: Visual Analogue Scale; ROM: Range of Motion; MMT: Manual Muscle Testing

7. Competing interest

The authors declare that they have no competing interest

8. Recommendations

From the results of this study, the authors recommend that in the application of the results of this study, the modification techniques should be considered as a unit and not applied separately.

References

- [1]. Rheumatology, A.C.o., Criteria for Classification of Idiopathic Osteoarthritis (OA) of The Knee Joint. Online. 2012.
- [2]. Hamijoyo, L., Pengapuran Sendi atau Osteoarthritis. All Right Reserved: Perhimpunan Reumatologi Indonesia., 2014
- [3]. Anwar, Efek Penambahan Roll – Slide Fleksi Ekstensi Terhadap Penurunan Nyeri Pada Osteoarthritis Sendi Lutut. Jurnal Fisioterapi, 2012. Volume 12, No 1.

- [4]. Salma, Waspada 12 Penyakit yang merusak Tulang Anda. Jakarta: Cerdas Sehat. , 2013.
- [5]. Negara, J., Penambahan Traksi/Translasi pada Latihan Gerak Aktif pada Osteoarthritis Lutut Wanita Lanjut Usia. Program Studi Fisioterapi Pasca Sarjana UNUD Bali, 2013.
- [6]. Kisner, C., L.A. Colby, and J. Borstad, Therapeutic exercise: foundations and techniques. 2017: Fa Davis.
- [7]. Priatna, H., Exercise Theraphy Surakarta. Akademi Fisioterapi Surakarta., 1985.
- [8]. Hunter, D.J., Focusing osteoarthritis management on modifiable risk factor and future therapeutic prospects. . Therapeutic Advances in Musculoskeletal Disease: 34-47, 2009.
- [9]. Suriani, S.d.L., I.S. , Latihan Theraband Lebih Baik Menurunkan Nyeri Daripada Latihan Quadriceps Bench Pada Osteoarthritis Genu. Jurnal Fisioterapi, 2013 Volume 13, Nomor : 46-54.
- [10]. Wardhani, R.R., Pengaruh Manual Terapi Traksi Terhadap Peningkatan Lingkup Gerak Sendi Pada Osteoarthritis Lutut. . Program Studi S1 Fisioterapi Stikes Aisyiyah Yogyakarta, 2014
- [11]. Jansen, M.J., Viechtbauer. W, Lenssen, A.F, Hendriks, E.J.M and Bie, R.A. , Strength training alone, exercise therapy alone, and exercise therapy with passive manual mobilisation each reduce pain and disability in people with knee osteoarthritis. Journal of Physiotherapy, 2011 Volume 57. .
- [12]. Syamsia, F.N., Pengaruh Pemberian Stretching Dan Strengthening Exercise Terhadap Perubahan Aktivitas Fungsional Pada Penderita Osteoarthritis Genu. Prodi Fisioterapi Universitas Hasanuddin. Makassar, 2017.