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Effects of the applied ancient boxing exercise on leg strength and quality of life in patients with osteoarthritis

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This study aimed to investigate the effect of ancient boxing exercise on the strength of leg muscles and quality of life in patients with osteoarthritis. The subjects were divided into 2 groups, control group (CG) and experimental group (EG). The average aged of control and experimental group were 60.3±6.8 and 59.0±7.8 years, respectively. All volunteers were interviewed for basic information, evaluation of the criteria of research and sign consent to participate in the research. The outcome measurement consisted of five time sit to stand test, 6-min walk test, flexibility by sit and reach test, Berg Balance Scale, Timed Up and Go Test, knee injury and osteoarthritis outcomes score (KOOS) and quality of life of World Health Organization Thai brief version (WHOQOL-BREF-THAI). Prior and posttest measurements were performed at 0, 4, 8, and 12 weeks, and those who received ancient boxing exercise were given 60 min 3 times per week for 12 weeks. The results of the study showed that postexercise leg muscle strength, physical performances, quality of life and KOOS increased significantly after exercise. In conclusion, the ancient boxing exercise could increase the strength of leg muscles physical performances, quality of life in people with knee osteoarthritis. This exercise can be used as a long lasting exercise in the future.

Keywords: Osteoarthritis, 6-Min walk test, Exercise therapy

INTRODUCTION

Osteoarthritis (OA) is a degenerative joint disease causing disability due to limitations of joint movement, particularly in people age over 50 years. OA is commonly occurred in after 40 years of age and typically develops gradually over a period of years. Patients with OA may have joint pain on only one side of the body and it primarily affects the knees, hands, hips, feet, and spine (Grindrod et al., 2010). As the cartilage is worn away, the bone forms spurs, areas of abnormal hardening, and fluid-filled pockets in the marrow known as subchondral cysts. As the disorder progresses, pain results from deformation of the bones and fluid accumulation in the joints. The pain is relieved by rest and made worse by moving the joint or placing weight on it. In early OA, the pain is minor and may take the form of mild stiffness in the morning. In late stage, pain may exist even in rest or without activities (Duman et al., 2012).

Treatment of patients with OA is based on an individualization concept (Valdes and von der Heyde, 2012). Patients with OA are encouraged to exercise as a way of keeping joint cartilage lubricated. Exercises that increase balance, flexibility, and range of motion are recommended for OA patients. These may include walking, swimming and other water exercises, yoga and other stretching exercises, or isometric exercises. In addition, there is an exercise in eco-cultural folk Thailand which are of interest for applications in the exercise because exercise that relies on a long cultural tradition every year. Give the familiar and can be used to guide sustainability principles include aerobic exercise, aerobic dance, folk dance and ancient boxing exercise of Sakon Nakhon province, Thailand.

Boxing is an ancient art, ancient, folk and popular field that Sa-

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kon Nakhon was used as a landing exercise widely. The dance adapted from traditional boxing posture both solo dance and dance parade, the dance moves are continuing. Interchanges weight. The balance of movement and moving arms, legs tightly interrelated. It is an exercise that has little impact. For patients with OA in the beginning to be applied as moderate exercise, which is different from aerobic exercise with other species. Highlights of the ancient boxing the application of traditional boxing dance music with traditional folk music in the northeast in the province. Familiar with traditional ways of life beat with excitement inspiring and imitating the behavior of animals adapted to the dance. The basic movements of body movements are amble to the drum sound Canyon. A beautiful blend of art a charm of an ancient boxing. The event was enjoyed and encourage motivation to exercise.

For this reason, researchers are interested in studying the effects of ancient boxing application that improves the strength of muscles on the lower extremities and quality of life (QoL) in patients with OA. Moreover, there are no researcher study about this type of exercise in spite of it is the value Thai traditional and culture. The results of this study are expected to be a guideline to consider the exercise as an alternative for patients with OA in the future. This study aimed to investigate the effect of the ancient boxing exercises on the lower extremity muscle and QoL in patients with OA.

MATERIALS AND METHODS

Study design

This research study was a randomize control trial. The various phases of this project consisted of boxing exercise applied program effects to muscle strengthening of lower limbs, OA knee person's QoL, and statistical analysis.

Volunteer recruitment

All subjects were recruited from the community and randomly allocated into two groups, control group and the experimental group. The control group received health education and the experimental was informed about the nature and risks of the experimental procedure before obtaining their consent to participate. Before each experiment, all subjects participated in routine medical examinations in which medical history (by completion of a health questionnaire), anthropometric measurements (height, body weight), blood pressure (BP), resting heart rate were taken.

Inclusion criteria (American College of Sports Medicine et al., 2009)

- Patients with OA (male and female), age 40 years old or older
- Walk independent
- Good activity dairy living
- No medical complication in exercising
- Non continues to exercise at least 2 month

Exclusion criteria (American College of Sports Medicine et al., 2009)

- Neurological problem such as stroke, epilepsy, brain injury etc.
- Uncontrolled angina pectoris
- Chronic obstructive pulmonary disease and pulmonary inefficient
- Acute or chronic infected
- Uncontrolled metabolic disease such as diabetes mellitus, thyroid
- Uncontrolled hypertension
- Visual analogue scale > 5

Ethics approval

All subjects were inform of the experimental protocol and possible risks involved. They will inform verbally and in writ before sign the consent form after receiving the data of experiment. The study was conducted between October and November 2017, following the Khon Kaen University ethic committee for human research based on the Declaration of Helsinki and the ICH good clinic practice guideline. This trial was registered with the clinical trial, number HE 592198.

Outcome measurement

Physical measurements/Anthropometric test

Height measurement (cm):

Equipment; Height was assesses by fixing an 8-foot measuring tape to the wall.

Measurement; The participant stop erect with shoes off and back against the wall and placing a ruler on top of the head perpendicular to the measuring tape while the participant will take a deep breath and held on.

Body weight measurement (kg):

Equipment; A scale platform which measure in kilograms.

Measurement; Participants take off shoes and was assesses by stand erect on the scale platform. The digital read out provided body weight in kilograms.

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BP measurement (mmHg):

Equipment; Sphygmomanometer was used to measure systolic and diastolic BP in mmHg. The BP was used to determine normal hypertension or hypotension (Coleman et al. 2005).

Measurement; Participants sit down and rest for 5 min and the left arm was place on a table, a cuff was place around upper of left arm close to brachial artery pressure in front of left arm, then the start button was press and BP measure.

Physical performance test (Janyacharoen et al., 2013)

This research study measure the physical performance of four tests.

Strength; leg strength:

Lower body strength was assesses by have the participant perform the 5-time sit to stand (FTSST). The leg press involves multiple joints including hip extension, knee extension and ankle plantar flexion that was consider a good criterion or measuring lower body strength resembling common daily activities of older adults such as rising from a chair, bathtub or car. Csuka and McCarty (1985) first describe the use of the sit-to-stand test as a measure of lower-extremity strength (force generating capacity off muscle). The sit to stand test is now commonly use to assess lower extremity strength and balance (Lord et al., 2002; Bohannon, 1998). All subject began by crossing their arms on their chest and sitting with their back against the chair (43 cm height, 47.5 cm depth). The examiner provided the following instructions according to the standardized laboratory protocol, "I want you to stand up and sit down 5 times as quickly as you can when I say "Go". Timing began when the examiner said "Go" and stopped when the subject's buttocks touched the chair on the fifth repetition. The investigator instructed the subject to stand up fully between repetitions of the test. Subject was instructed not to touch the back of the chair during each repetition. Subjects were allowed to place their feet comfortably under them during testing. Occasionally, it was note that subjects moved their feet during the testing, especially those who was have difficulty with their balance during testing (Whitney et al., 2005).

Flexibility:

Measurement used a tool call a trunk flexometer that was a simple measure.

Equipment; Trunk flexometer where the top had a rod length of 60 cm was placed in parallel to the floor. The center of rod length is "0", distance from both the positive and negative.

Measurement;

(a) The subject took off shoes and long sat with their knees fully extended, trunk upright and the feet hip width apart.
(b) The subjects moved their arms forward with the hand place on top of each other to perform the test.
(c) The subject reached directly forward, palms down, along the measuring scale twice and held position for a maximum reach for one second and two times, and choose the greater time.
(d) Record of the distance between "0" to the end of middle finger were taken. (Ross et al., 2010)

Endurance measurement

The 6-min walk test (6MWT) was use to measure the maximum distance that a person could walk in 6 min, as a field test to predict maximum oxygen uptake. The 6MWT is now commonly used to assess function in patients with cardiovascular or pulmonary disease (Ross et al., 2010)

The 6MWT was conduct along a 30-m linoleum hallway marked in 1-m increments. A line was made at each of the walkaway to indicate where the person will to turn.

Subject walked alone during the 6MWT unless the researcher felt that they were unsafe. Subjects wore a hearth rate monitor or carried a pulse oxygen monitor in order to track the resting heart rate between trials.

Subjects will instruct to "walk as far as possible in 6 min." They were given standardize encouragement at 1, 3, and 5 min during the walk: "You're doing a good job"(1 min), "You're halfway done" (3 min), "You have 1 min to go" (5 min). The subject performed a practice trial and then rested until heart rate returned to the baseline level. A second 6MWT trial followed the rest period. The distance walked during each trial was recorded to the nearest meter. Data from the second 6MWT trial was used in the analysis, as it was performed suggesting that two tests were necessary to achieve reproducible result.

Balance measurement

Timed Up and Go Test

The Timed Up and Go Test (TUGT) measures the time it take a subject to stand up from an armchair, walk a distance of 3 m, turn, walk back to the chair, and sit down. It was developed originally as a clinical measure of balance in elderly people and was scored on an ordinal scale of 1 to 5 based on an observer's perception of the performer's risk of falling during the test.

The TUGT measures the time it takes a subject to stand up from an armchair, walk a distance of 3-m distance which was marked off on the floor in front of a firm chair with arms (seat

height of 46 cm); a large cone was placed on the marker at the end of the 3 m. The test was begun with each subject sitting, back against the chair, arms resting on the lap, and feet just behind the distance marker on the floor. Subjects were instructed as follows: "On the word 'go,' stand up, walk comfortably and safely to the cone on the floor, walk around the cone, come back, and sit all the way back in your chair." They were informed that the trial was timed. Timing began on the word "go" and ended when the subject's back rested against the chair upon returning. A practice trial was performed and then followed by 2 recorded trials. Data obtained during the 2 record trials were averaged for used in data analysis (Podsiadlo and Richardson, 1991).

Berg Balance Scale

The Berg Balance Scale consist of 14 functional items used to measure balance control and stability in sitting, standing and postural transition activities. The test includes items for evaluation of static balance such as standing and sitting without support. Assessments of dynamic balance include transferring, sitting to standing and picking up the object from the floor. Score of the test represent balance ability of daily activities.

QoL measurement

This study used World Health Organization Thai brief version (WHOQOL-BERF-THAI) measured the QoL for the volunteers and divided into four domain such as physical, psychological, social, and environment.

Knee and injury and OA Outcome Score (Chaipinyo and Karoonsupcharoen, 2009)

The knee injury and osteoarthritis outcomes score (KOOS) questionnaire was developed in the 1990s as an instrument to assess the patient's opinion about their knee and associated problems. Since the first publication in 1998, the psychometric properties of the KOOS have been assessed in more than twenty individual studies from all over the world. Furthermore, KOOS has been evaluated and compared to other instruments in several reviews (Roos et al., 2003)

KOOS is widely used for research purposes in clinical trials, large-scale databases and registries. KOOS is also extensively used for clinical purposes. In the clinic, KOOS is used to monitor groups and individuals over time. Due to its comprehensiveness, when the questionnaire is completed prior to a consultation, it can be used to guide the consultation as to the symptoms and difficulties experienced by the patient.

KOOS consists of five subscales; pain, other symptoms, function in daily living (activity of daily living, ADL), function in sport and recreation and knee related QoL. The previous week is the time period considered when answering the questions. Standardized answer options are given (5 Likert boxes) and each question is assigned a score from 0 to 4. A normalized score (100 indicating no symptoms and 0 indicating extreme symptoms) is calculated for each subscale (scoring instructions are available in a separate document.

Research protocol

The participant was give written consent forms to participate in the study after being informed of all risk, discomforts, and benefit associated with the procedures to followed in the study. The study protocol was approved by the ethics committee at the Faculty of Medicine, Khon Kaen University.

The control group participant was give advises of the benefits of the exercise program and home program in daily living, no specific intervention.

The experimental group performed 60 min/time, 3 times/wk, 12 weeks in total ancient boxing exercise program for the intervention period. The exercise program consisted of a warm up period by stretching for 15 min, moderate ancient boxing exercise for 30 min, and cool down period of stretching for 15 min. Each session was by a trained instructor who was experienced in ancient boxing exercise. All ancient boxing exercise programs were performed slowly to ensure the safety of the subject, and emphasis was placed on good posture, as well as on social interaction and enjoyment. The supervisors did not force any participant to perform the ancient boxing if he or she felt anxious about doing so and encouraged them to walk out if the participant had difficulty in doing so.

Statistical analysis

The data analyses were executed using the SPSS ver. 17.0 (SPSS Inc., Chicago, IL, USA). Descriptive statistics (mean ± standard deviation) was applied to explain baseline demographics. Repeated measurement analysis of variance to compare between group and week was applied to explain physical performance and QoL. The level of significance was set up at $P < 0.05$.

RESULTS

This research was a randomized controlled trial to investigate the effects of ancient boxing exercise on strength of lower extrem-

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Table 1. Anthropometric and baseline characteristics of subjects in control and experimental group

Variable	Control group (n=20)	Experimental group (n= 20)	*P*-value
Age (yr)	60.3±6.8	59.0±7.8	0.64
Body weight (kg)	63.9±11.2	60.6±9.6	0.30
Height (cm)	154.2±5.3	154.2±6.2	0.41
SBP (mmHg)	125.5±18.0	120.6±18.0	0.30
DBP (mmHg)	68.6±11.6	66.3±10.4	0.42
HR (beat/min)	82.8±8.6	79.2±9.8	0.14

Values are presented as mean±standard deviation.
SBP, systolic blood pressure; DBP, diastolic blood pressure; HR, heart rate.

Table 2. Physical fitness before and after exercise in week 4th, week 8th, and week 12th in experimental and control groups (CG: n=20, EG: n=20)

Variable	Group	0 week	4th week	8th weeks	12th week
Flexibility (cm)	CG	15.0±4.0	15.2±4.9	15.2±4.9	15.2±4.9
	EG	15.9±5.6	18.3±4.7*,#	18.7±4.6*,#	19.1±4.5*,#
FTSST (sec)	CG	10.5±2.3	10.4±1.9	10.4±2.0	10.5±2.0
	EG	12.4±1.3	9.0±1.3*,#	8.4±1.1*,#	8.2±1.2*,#
BBS (score)	CG	39.3±2.9	39.7±3.0	39.7±3.0	39.9±3.1
	EG	40.3±4.3	43.9±4.2*,#	43.6±4.6*,#	44.0±4.4*,#
TUG (sec)	CG	11.2±1.2	11.2±1.2	11.2±1.2	11.2±1.2
	EG	12.4±1.4	11.0±1.7*,#	10.5±1.6*,#	10.5±1.7*,#
6MWT (m)	CG	354.5±32.1	374.5±42.1	376.0±43.8	376.0±44.2
	EG	333.0±30.4	386.0±33.6*,#	400.0±29.0*,#	407.7±30.8*,#

Values are presented as mean±standard deviation.
CG, control group; EG, experimental group; 6MWT, 6-min walk test; FTSST, 5 time sit to stand; BBS, Berg Balance Scale; TUGT, Timed Up and Go Test.
*Significantly difference from corresponding at week 0 ($P<0.05$). #Significantly difference from corresponding control group ($P<0.05$).

ities and the QoL. Volunteers in this study were 40 patients with OA who were diagnosed by Waritchaphum hospital and forwarded for physiotherapy at both male and female physical therapy clinics. There were 40 subjects enrolled in the study. Of those, 20 subjects (18 female and 2 male subjects) and 20 subjects (18 female and 2 male subjects) were participated in the ancient boxing exercise or experimental group and control group, respectively. No subjects were withdrawn from the study.

Anthropometric and baseline characteristics of subjects had no statistically different in both groups (Table 1). Physical performances (Table 2), QoL (Table 3), and KOOS scores (Table 4) had statistically different when compared between group and within group.

DISCUSSION

This experimental study aimed to investigate the effect of ancient boxing exercise on the strength of lower extremities and

Table 3. Quality of life before and after exercise in week 4th, week 8th, and week 12th in experimental and control groups (CG: n=20, EG: n=20)

Variable	Group	0 week	4th week	8th weeks	12th week
Physical domain	CG	18.8±2.0	19.0±2.0	19.0±2.0	19.0±2.0
	EG	18.8±0.2	19.6±0.2	20.3±1.9*,#	20.3±1.9*,#
Psychological domain	CG	19.5±1.2	19.4±1.4	19.4±1.4	19.4±1.4
	EG	19.1±1.5	19.5±1.3	20.2±1.3	20.2±1.3
Social relationships	CG	13.0±1.3	13.0±1.3	3.0±1.3	13.0±1.3
	EG	13.1±1.5	13.4±1.9	14.1±1.9*,#	14.2±2.0*,#
Environment	CG	19.1±2.0	19.3±2.1	19.3±2.1	19.3±2.1
	EG	19.4±2.5	20.8±2.2*,#	21.2±2.2*,#	21.2±2.2*,#

Values are presented as mean±standard deviation.
CG, control group; EG, experimental group.
*Significantly difference from corresponding at week 0 ($P<0.05$). #Significantly difference from corresponding control group ($P<0.05$).

Table 4. KOOS score before and after exercise in week 4th, week 8th, and week 12th in experimental and control groups (CG: n=20, EG: n=20)

Variable	Group	0 week	4th week	8th weeks	12th week
Pain	CG	43.0±1.2	43.1±1.2	43.1±1.2	43.1±1.2
	EG	45.3±1.6	53.6±3.8*,#	63.8±4.9*,#	69.2±5.1*,#
Symptom	CG	50.4±2.6	50.4±2.6	50.5±2.4	50.6±2.5
	EG	52.8±3.5	59.4±5.5*,#	63.5±4.8*,#	68.8±3.7*,#
ADL	CG	58.0±5.0	58.0±5.0	58.0±5.0	58.1±4.9
	EG	63.4±3.5	68.3±4.4*,#	72.0±2.7*,#	74.4±2.9*,#
Sport and recreation	CG	52.1±7.2	52.1±7.2	52.1±7.2	52.1±7.2
	EG	62.0±4.9	67.5±3.5*,#	70.4±4.2*,#	74.3±5.0*,#
Knee related quality of life	CG	51.6±1.2	51.6±1.2	51.6±1.2	51.6±1.2
	EG	54.9±1.4	60.1±3.5*,#	65.3±4.9*,#	68.3±8.9*,#

Values are presented as mean±standard deviation.
CG, control group; EG, experimental group; ADL, activity of daily living.
*Significantly difference from corresponding at week 0 ($P<0.05$). #Significantly difference from corresponding control group ($P<0.05$).

QoL in people with OA. Pre- and posttest measurements were performed at 0, 4th, 8th, and 12th week.

For this research, the study was conducted on the effects of physical exercise with ancient boxing dance increased strength of the lower leg muscles and QoL in people with OA. Volunteer groups have an age range between the pain level of the knee does not exceed five levels. The severity of the knee is from beginner to intermediate frequency of receiving an exercise program with ancient boxing dance 3 times a week for a total of 12 weeks, the level of exercise with the ancient boxing dance is in the form of aerobic exercise. It took 60 min for each time of exercise.

Muscle strength is an important predictor of disability, frailty, risk of falls, and dependency (Hootman et al., 2004; Hurley et al., 2000). FTSST, a test to evaluate lower leg muscles (Goldberg,

2012), was significantly improved after the ancient boxing exercise compared with control group (Table 2). These results may be explained by the characters of the ancient boxing dance; focused on leg exercises in the pace with not very fast rhythm. There is no cushioning body movement crossing the legs but lifting the legs according to the music rhythm resulting in improvement of leg muscle strengthening. As previously reported, lifting legs increased muscle strength (Ettinger et al., 1997) resulting in reducing pain and slow progression of OA (Segal et al. 2015).

The ability to maintain postural balance depends on the complex interaction between sensory and musculoskeletal systems. It is well established that the aging process affects these system, compromising balance and causing in stability (American College of Sports Medicine et al., 2009). Balance test while the Berg Balance Scale is a test that people are tested on.

Or have less movement to see the ability of the balance while reaching for. Or sit in the distance. A score of between 45 and 63 points will translate into a test that states that the test subjects were at moderate risk of falling. However, if the test score was more than 45 points, the result was that the test subjects had a higher risk of falls (Berg et al., 1992). The results of the voluntary fall in risk of falls were found to be moderate.

Stability test while the test body is moving from one point to another (TUGT) is the stability test that predicts the risk of falling. The study found that. If the test is less than 10 sec, the test results indicate that the test taker has a lower risk of falling. The results of the tests ranged from 11 to 12 sec. The results showed that the risk of falling was moderate. If the test result is more than 20 sec, the test results in a very high risk of falls. The current study of the researcher found that after the exercise group was completed, the exercise program showed a significant reduction in TUGT and Berg balance test changes at week 4. This means that the exercise group had a lower risk of falls (Berg et al., 1992).

Regarding the effects of ancient boxing exercise on the cardiovascular system, it has still to be determined whether it can improve cardiovascular fitness and/or aerobic endurance, which were classified according to their intensity as beginner and intermediate level. During the higher intensity session (i.e., intermediate level), the observed oxygen uptake and the heart rate levels were equivalent to 44% and 62% of their maximal values, respectively. Since benefits of aerobic exercise are achieved when it is performed between 50 and 70% of maximal heart rate or 40%–60% of the maximal/peak oxygen uptake (American College of Sports Medicine et al., 2009), it is possible that moderate-high intensity ancient boxing exercises could also improve cardiovascular fitness.

Although the 6MWT does not determine the maximal/peak oxygen uptake, it is widely used to evaluate functional capacity of the elderly due to its practicality and low cost (Araújo et al., 2006). Considering that the 6MWT assesses the submaximal level of aerobic capacity, it may better reflect the functional exercise level necessary to perform ADL than does subjects' maximal exercise capacity, especially in old age. So, the effects of ancient boxing exercises on cardiovascular fitness observed here should be interpreted with caution, since other physical characteristics (i.e., lower-limb strength) can also influence performance in the 6 MWT.

The KOOS questionnaire is widely recognized within the orthopedic literature as being the gold-standard method for assessing short and long-term patient-relevant outcomes associated with OA progression. Baseline KOOS scoring for OA patients recruited to the present study was low (female range, 20.0–58.0; male range, 35.0–58.0 across all subscales), and well below normal values (ranging from 61.0 to 88.4 across all subscales) previously reported within the literature. This is important to note because it places in context the degree of knee pain and level of functional impairment experienced by our participants relative to what would typically be considered normal for a knee OA patient population. Data suggested that our participants experienced significant joint pain and symptoms, as well as great deal of difficulty when performing common ADLs such as running, jumping, squatting or going up/down stairs, and were representative of a patient population at significant risk for exacerbation of joint symptoms following regular exercise. Following completion of the 12-week exercise regime, KOOS scoring improved for all participants, and in the case of the all participants, scoring moved more in line with normative values reported in the knee OA literature for three of the five subscales.

It is important to acknowledge that the present study also had several limitations. First, the methodological approach excluded direct examination of knee joint articular cartilage, or pathological biomarkers associated with articular cartilage health. Second, concerns about how a patient's physical perception of support (i.e., the air pressure) may confound subjective scoring of the pain and function are valid. Finally, the question of whether this type of exercise intervention is cost-effective, or superior to other methods of low impact, non-weight bearing exercise warrants further investigation. To our knowledge, there is currently no evidence to suggest that the cost effectiveness of any one form of exercise (i.e., aquatic, cycling, resistance training) is superior to another for the management of symptoms associated with OA knee (van Baar et al., 2001).

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The ancient boxing exercise is considered a local culture of the Sakon Nakhon people. The dances of the dance are delicately beautiful, fun, but not bump. Dance styles are used in all parts of the body, especially the lower leg muscles. Due to the ancient dance of the ancient dance, the leg muscles used to roast. To switch legs Suitable for application to exercise that focuses on the strength of the leg muscles. Researchers expect that in the future they will be able to develop a form of exercise that can be applied to people with severe knee OA. To be used in all ages and to create a sustainable exercise in the future.

In conclusion, this research applied folk art as part of the exercise. It is adapted to suit the age range, symptoms of OA to provide benefits to people with OA in the initial stage to prevent the spread of disease strengthening the muscles around the knee. The exercise is used that is familiar to the local people, resulting in motivation for continuous exercise. The group has been exercising, having good health, good physical health meet up together in groups. Encourage community gathering. This exercise can be used as a long lasting exercise in the future. The good thing to do is to keep the progression of OA firmly.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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