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Research

Effectiveness of Specific Training on Physical Functional Improvement and Walking Speed in Patients with Knee Osteoarthritis

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ABSTRACT

Background: Osteoarthritis (OA) is a musculoskeletal disorder which is a progressive change in joints that is slow and intermittent, usually in the field there are exercises to strengthen muscles which are only supported by the agonist muscles while the antagonistic muscles also participate and even more dominant, the most approved intervention to be able to activate both muscles is a special task. The purpose of this study is to study whether there are functional requirements for specific tasks to improve the functioning and running of osteoarthritis patients.
Subjects and Method: This study method uses the type of experimental research with a single case research method using A-B-A research design. The study was conducted in January 2020 located at the University of Muhammadiyah Surakarta. A patient with knee OA was selected using consecutive sampling. Functional ability and walking speed were tested by West Ontario and McMaster Osteoarthritis Index (WOMAC).
Results: Specific training improved physical function and speed walking in patients with knee osteoarthritis. There was no effect of specific training on pain and stiffness.
Conclusion: Task specific training improves functional ability and walking performance in aptient with knee osteoarthritis.

Keywords: Osteoarthritis, task specific training, visual surface electromyograph, augmented feedback, functional ability

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BACKGROUND

Osteoarthritis is a degenerative disease that causes abnormal changes in the joints, characterized by joint cartilage damage, thickening of the subcondral bone, formation of new bone (osteophytes) in the joints and joints of the wall (Manoharan et al., 2018). Specific task training is a technique of combining movement in relation to helping patients obtain optimal control strategies to improve motor control and receive some feedback (Teasell et al., 2008). The concept of specific task training is to activate joint muscles together. Muscle co-activation or muscle co-contraction is the activation of agonist and antagonistic muscle stimulants. Agonists can be activated, and antagonistic coactivation occurs in different on/off cycles.

However, in those with severe tibiofemoral OA, coactivation occurs during the gait phase (Hubley et al., 2008). Co-activation occurs when active flexor compilations occur during the extended moment (Frey et al., 2013). Muscle Coactivation Becomes an Important Motor Control Strategy for Increasing Relaxation and Increasing Movement (Segal et al., 2015).

Visual Surface Electromyography (SEMG) Biofeedback is a tool that allows to see the activity of muscles that are being activated. The SEMG biofeedback visual device can convert potential movements into visual or sound signals that are easily understood by patients can increase or reduce the level of voluntary activity, and are effective in increasing the active participation of patients during treatment (Merletti and Farina, 2016).

To activate muscles, use the Clue/ Augmented Feedback external method. This method is used in clinical practice and can provide an important role in motor learning and can be categorized into knowledge about outcomes and knowledge about performance (Yu and Kang, 2017).

Measurement instruments related to functional abilities using West Ontario and McMaster Osteoarthritis Index (WOMAC). The WOMAC index is a self-administered composite questionnaire based on a three-dimensional scale consisting of measures (I) pain, (II) joint stiffness and (III) degree of difficulty in completing daily work (Faik et al., 2008). Because the WOMAC index is the best validated outcome measure and is most widely used in subjects with knee osteoarthritis (Sathiyanarayanan et al., 2017).

For measurement instruments related to Walking Speed using a 10 meter walking test. The 10 meter walking test is a measuring tool used to measure walking speed in units of meters per second over short distances (Palmer, 2015). The 10 meter walking test can be used to determine functional mobility, gait and vestibular function.

Assessment instruments related to their abilities use the 6-minute Running Test because it supports the ability of the patient, and also provides an individual's level of endurance (Teixeira et al., 2011). The purpose of this research is to study whether there are functional requirements for specific tasks to improve the functioning and running of osteoarthritis patients.

SUBJECT AND METHOD

1. Study Desain

This research uses an experimental study with a single case report approach. The research design uses A-B-A design. Analysis of the data used in a single research study that uses descriptive static analysis. The sampling technique was carried out using the consecutive method of 1 person who met the inclusion criteria.

2. Inclusion Criteria

The Inclusion and exclusion criteria are used as follows: 1) Willing to be a sample by filling in informed consent, 2) Identified bilateral or unilateral knee OA, 3) History taking and no injury experience, 4) Meet the clinical diagnosis category (Aged more than 45 years, Pain when doing activities, Morning stiffness lasts less than 30 minutes).

3. Exclusion Criteria

As well as exclusion criteria refusing to be the subject of research and there are fractures in the lower extremities.

4. Operational Definition of Variable

ABA design is the development of AB design. A-B-A design displays a causal relationship between the dependent variable and the independent variable. Initial baseline (A1) was given measurements to the patient before being given the intervention. Then the patient is given intervention (B) in the form of task specific exercises combined with visual surface electromyography biofeedback which

is carried out continuously as much as 2x meetings. After intervention (B), the researcher measures the second baseline (A2) until stable data are obtained. The second baseline (A2) was carried out to measure the results of the patient's evaluation after being given an intervention.

5. Studi Instrument

The study was guided by SEMG biofeedback visual and WOMAC Osteoarthitis.

6. Data Analysis

The data in the study were analyzed using descriptive analysis.

RESULTS

a) Functional Capabilities with SEMG

In the pain subscale of the WOMAC questionnaire for the first day until the third day only questionnaires were given which showed results which were 6 on the first day, 8 on the second day, and 3 on the third day. Then the fourth day and five respondents were given intervention and WOMAC measurement results obtained are 3 on the fourth day and 2 on the fifth day. Furthermore, on the sixth and seventh days only questionnaires were given with results, namely 1 on the sixth day and 1 on the seventh day. Total pain score on WOMAC (0-20), 0 if mild and 20 if severe. The graph score on the WOMAC also shows a decrease, this can also be attributed to Standard Error of Measurement (SEM) data showing 7 results and Minimally Clinically Important Difference (MCID) 7. These results indicate a statistical change but no clinical change. (See figure 1 for Chart Pain WOMAC).

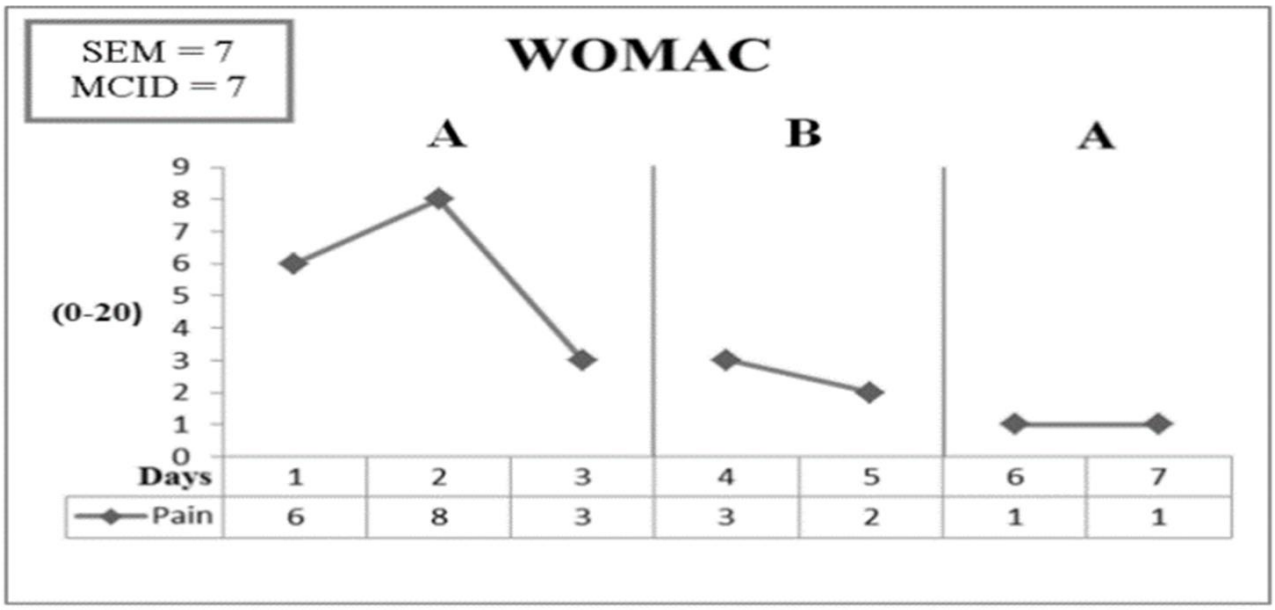

Figure 1. Chart Pain WOMAC

In the subscale stiffness on the WOMAC questionnaire for the first day until the third day, only a questionnaire was given showing the results, namely 2 on the first day, 2 on the second day, and 1 on the third day. Then the fourth day and five respondents were given intervention and WOMAC measurement results obtained are 1 on the fourth day and 1 on the fifth day. Furthermore, on the sixth and seventh days only questionnaires were given with results, namely 2 on the sixth day and 1 on the seventh day. Total stiffness score on WOMAC (0-8), 0 if mild and 8 if severe. The graph score on the WOMAC also shows changes, this can also be attributed to SEM data showing results 1 and MCID 1. These results indicate no statistical and clinical

changes (See figure 2 for Chart Stiffness WOMAC).

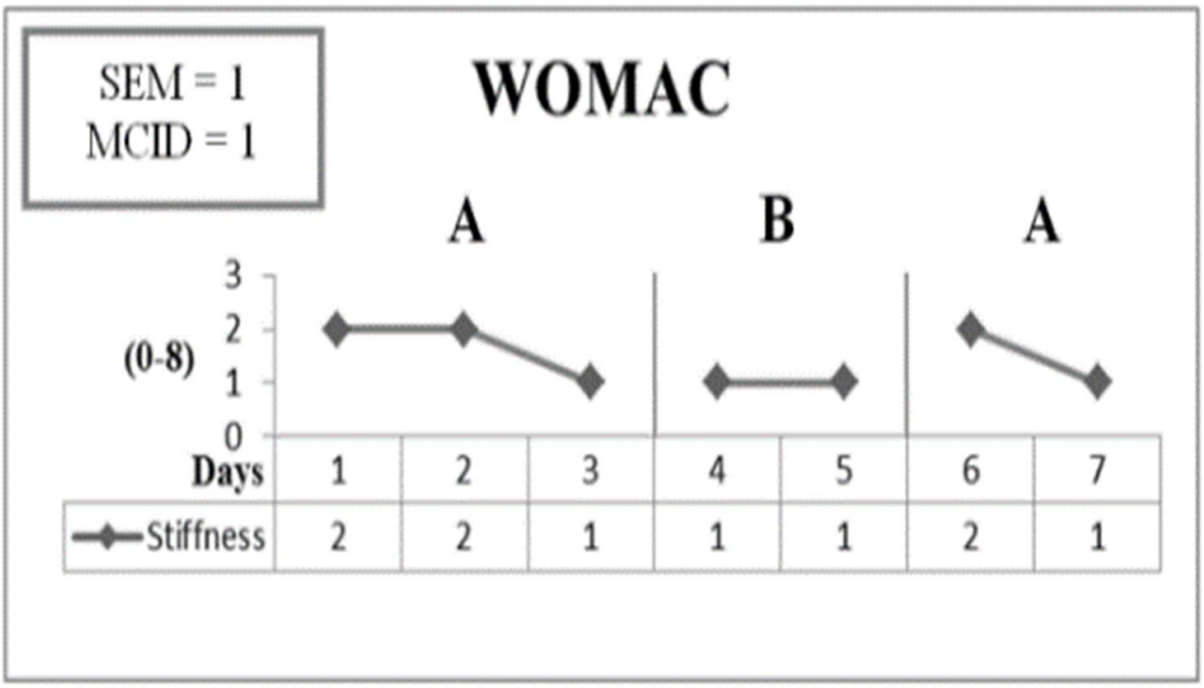

Figure 2. Chart Stiffness WOMAC

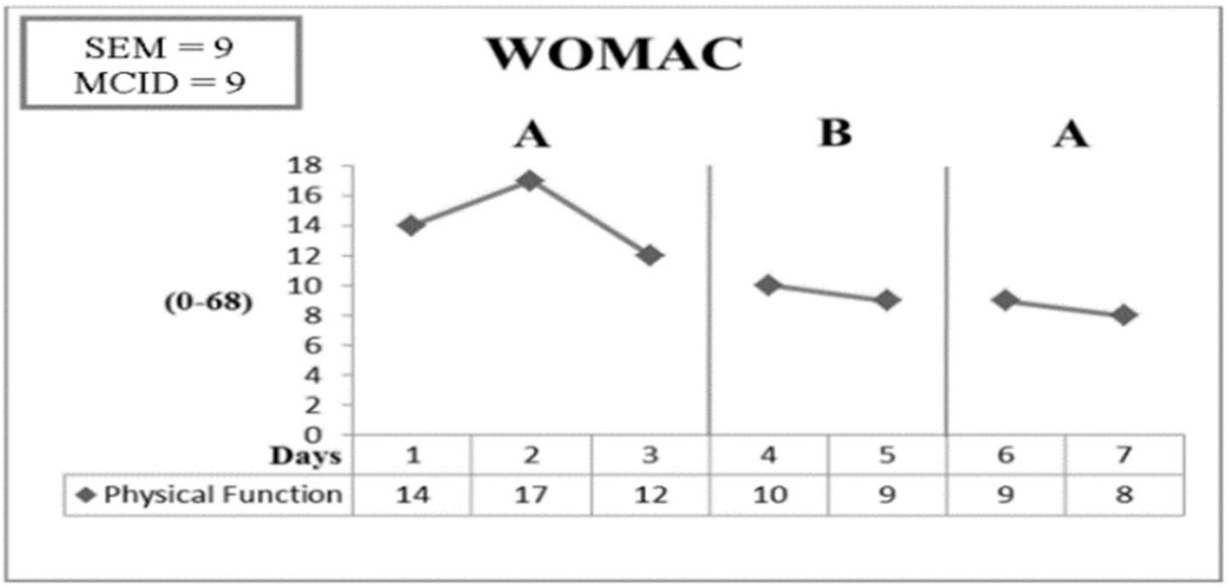

Figure 3. Chart Physical Function WOMAC

In the subscale physical function on the WOMAC questionnaire for the first day until the third day, only questionnaires were given which showed results, namely 14 on the first day, 17 on the second day, and 12 on the third day. Then the fourth day and five respondents were given intervention and WOMAC measurement results obtained are 10 on the fourth day and 9 on the fifth day. Furthermore, on the sixth and seventh days only questionnaires were given with the results, namely 9 on the sixth day and 8 on the seventh day. Total physical function scores on WOMAC (0-68), 0 if light and 68 if

heavy. The graph score on the WOMAC also shows a decrease, this can also be attributed to SEM data showing results 9 and MCID 9. These results indicate a statistical and clinical change. (See figure 3 for Chart Physical Function WOMAC).

b) Walking Speed with SEMG

Cooperative response is shown by the subject during the research process. The explanation of the response shown by the subject is as follows:

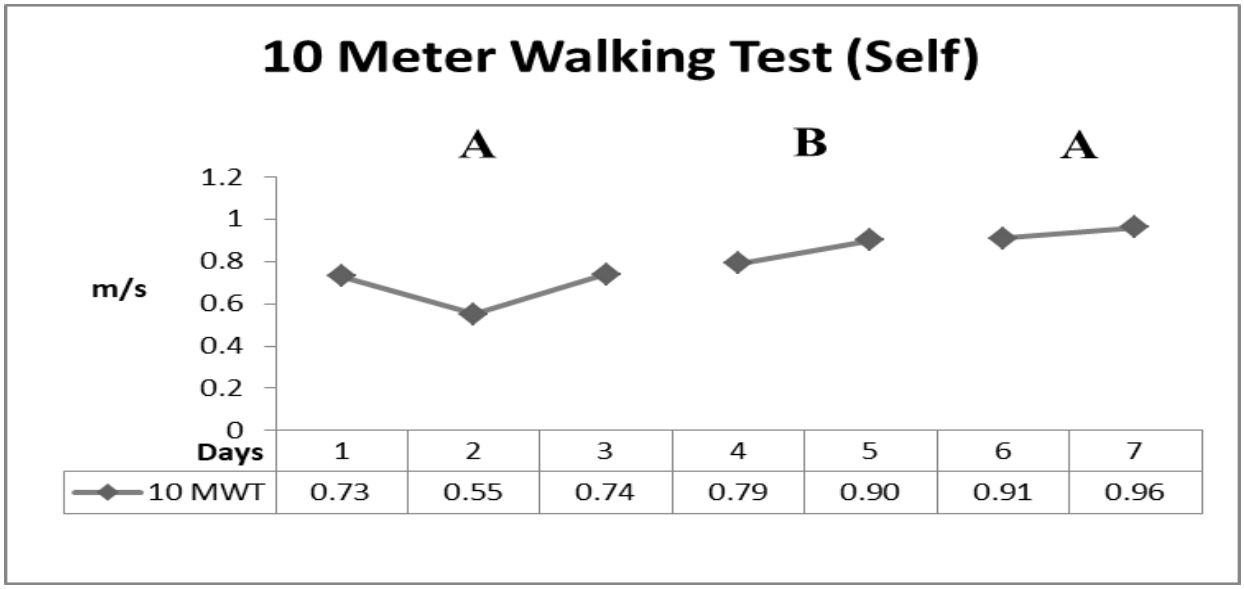

Figure 4. Chart 10 Meter Walking Test (Self)

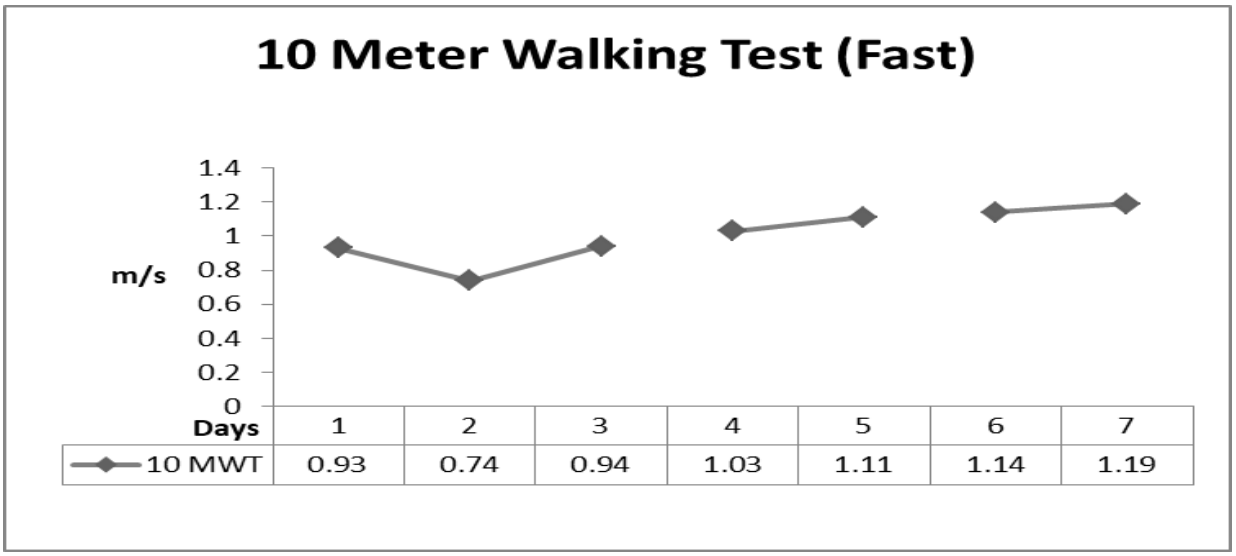

Figure 5. Chart 10 Meter Walking Test (Fast)

In the calculation of walking speed self-pace obtained overall results in an increase from the first day to the seventh day. Average walking speed of 0.79 m/s. Where the lowest speed was found on the second day of 0.55 m/s, down 0.23 m/s from the first day. Starting from the third day until the last day there was a progressive increase. The highest speed is reached on the seventh day. The highest speed increase occurred on the third day which increased 0.21 m/s from the second day. Whereas the lowest increase in

speed was calculated from the fourth to fifth day of 0.01 m/s. The average speed increase of 0.86 m/s.

In addition, the calculation of the speed of walking fast walking obtained overall results have increased from the first day to the seventh day. Average walking speed of 1.01 m/s. On the second day found the lowest speed of 0.74 m/s, down 0.19 m/s from the initial value of 0.93 m/s. (See figure 4 for Chart 10 Meter Walking Test (MWT) (Self) dan see figure 5 for Chart 10 Meter Walking Test (Fast).

c) Mileage Walk with Augmented feedback (External Clue)

In Figure 6. the data obtained during the walking distance inspection are as follows, the first and second day measurements were taken with 6 MWT and no intervention was given, 213.5m and 214.8m were obtained. Then proceed with the measurement as well as the provision of task-specific training interventions based on co-contraction exercise with external clue on the third, fourth and fifth days, the results obtained 227.5 m, 243.3 m, and 242.7 m. Period I the difference on the second day before the intervention was given and the third day after the intervention received a 12.7 m result, the second period on the second and fifth days resulted in a difference of 27.9 m. Finally, measurements were taken again on the sixth day and seven results were obtained 258.2 m and 256.8 m, period III difference on the second day and the seventh got 42 m results. Significant changes were found in the results of the distance traveled while walking using the 6 Minute Walking Test. (See figure 6 for Measurement chart of 6 Minute Walking Test).

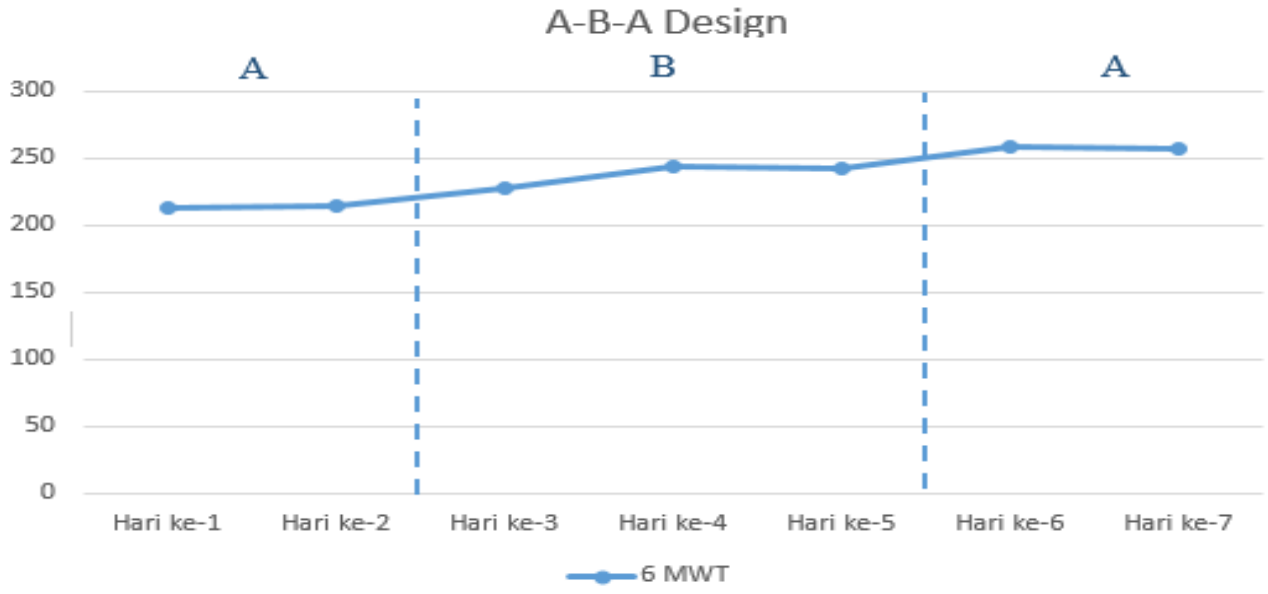

Figure 6. Measurement chart of 6 Minute Walking Test

d) Functional Capabilities with Augmented feedback (External Clue)

This study, overall data obtained during the pain examination on WOMAC there were no significant changes, where the first day and second day were only given WOMAC questionnaire results obtained the first day 8 and the second day 7, the third, fourth, fifth day were given a WOMAC questionnaire and intervention obtained results 8, on the sixth and seventh days the WOMAC questionnaire was given only the results of the sixth day 9

and the seventh day 3. (See figure 7 for Chart Pain WOMAC).

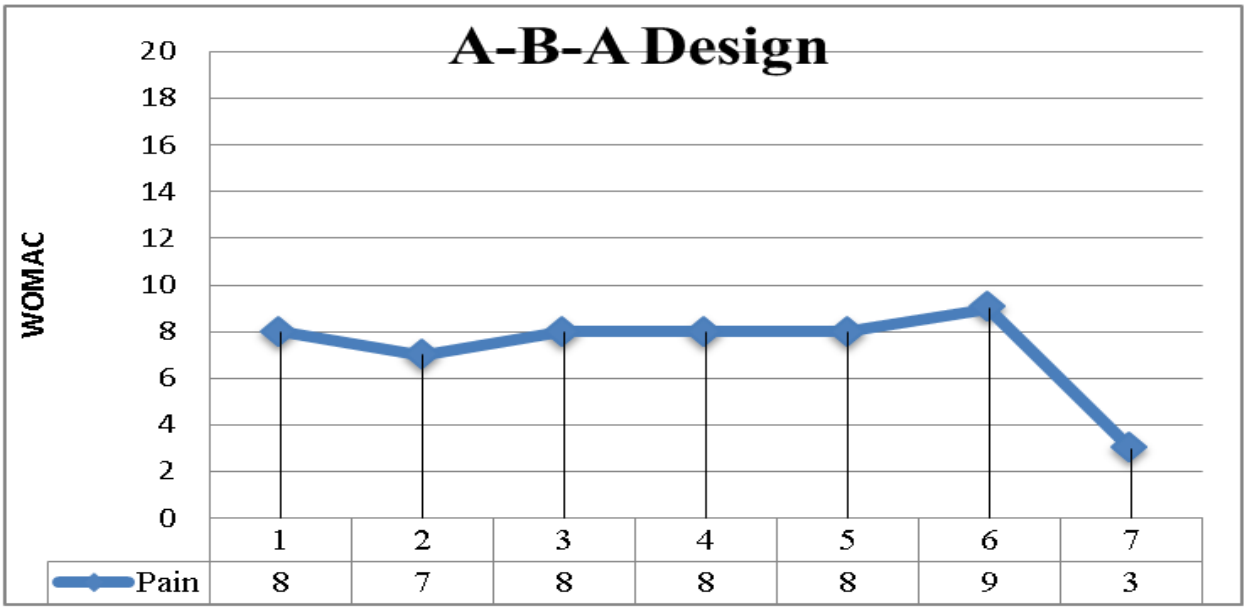

Figure 7. Chart Pain WOMAC

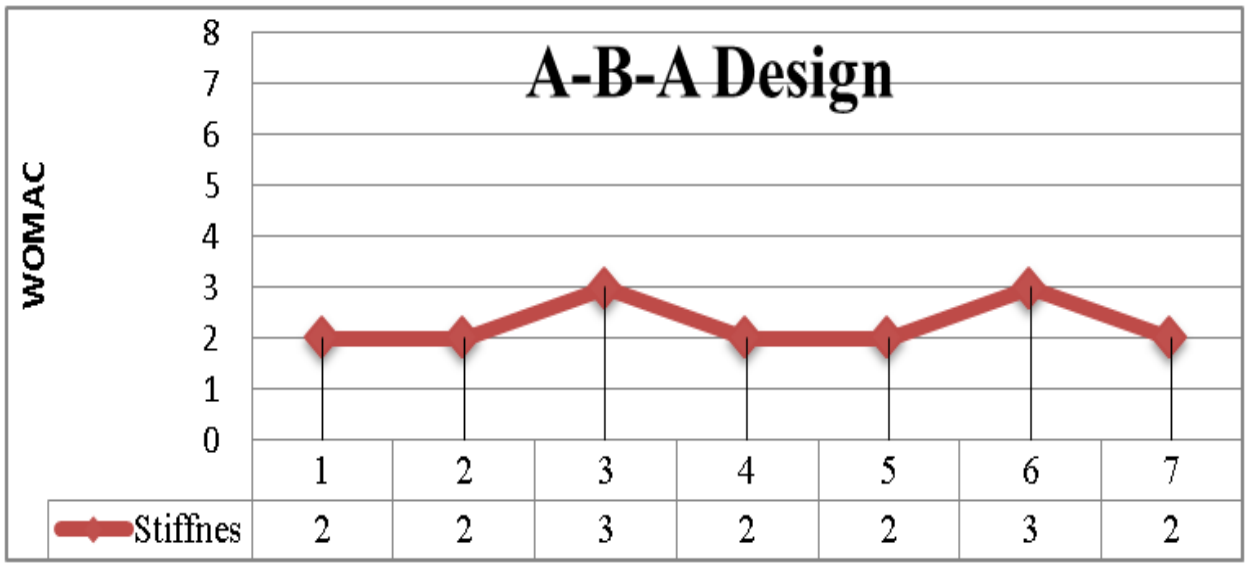

Figure 8. Chart stiffness in WOMAC

This study, overall data obtained during the Stiffness examination in WOMAC there were no significant changes, where the first day and second day were only given WOMAC questionnaire results obtained on the first day 2 and the second day 2, third, fourth, fifth day, were given a WOMAC questionnaire and intervention obtained results third day 3, fourth 2, fifth 2, on the sixth and seventh days the WOMAC questionnaire was given only the results of the sixth day 3 and the seventh day 2. (See figure 8 for Chart Stiffness WOMAC).

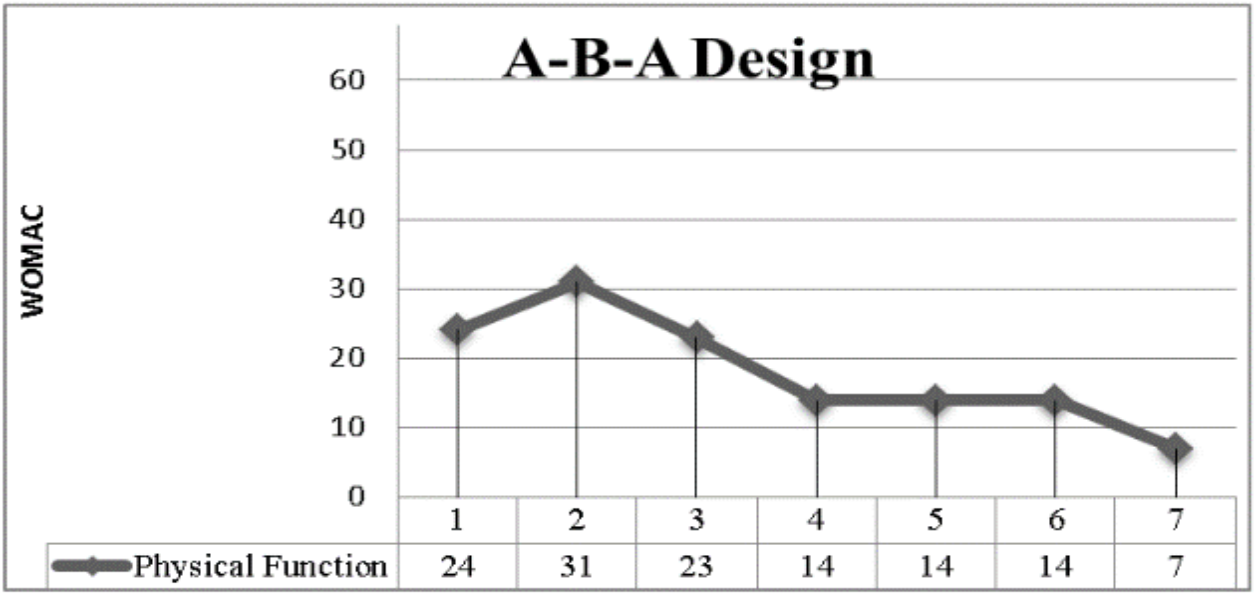

Figure 9. Chart Physical Function WOMAC

Data obtained during examination of Physical Function in WOMAC can be said to be a decrease, where the first day and second day are only given WOMAC questionnaire, the results obtained are the first day 24 and the second day 31, the third, fourth, fifth day are given a WOMAC questionnaire and the intervention obtained the third day 23, the fourth 14th, the fifth 14th, on the sixth and seventh days given the WOMAC questionnaire, the results obtained on the sixth day 14 and the seventh day 7. The results above showed a significant change on the seventh day. (See figure 9 for Chart Physical Function WOMAC).

e) Electromyograph (EMG)-biofeedback

Table 1. Different of Normal Walking and EMG-biofeedback

Average Voltage		Normal Walking		EMG-biofeedback assisted	
		Mean	SD	Mean	SD
Peak	Day 1	53.8 µV	11.5	110 µV	10.3
Mean		-1.12 µV	0.57	-0.22 µV	1.07
Peak	Day 2	79.5 µV	4.26	125 µV	24
Mean		-0.04 µV	0.757	-0.35 µV	1.08

In the table above is the result of quadriceps femoris muscle activation, especially in the vastus medial oblique. So we get data that shows the average results of muscle activation (See table 1 for EMG-biofeedback).

DISCUSSION

In clinical practice Sakellariou et al., (2017) imaging is believed to be the main modality for diagnosing progressive OA, this is supported by research which states that radiography plays an important role in clinical trials and epidemiological observational studies (Hayashi et al., 2018). However, imaging of knee OA is recommended if there is only rapid development of unexpected symptoms or changes in clinical characteristics that need to be clarified (eg increasing severity of OA). The use of systematic imaging in the diagnosis process is not

recommended in cases with a typical clinical presentation because there is no strong evidence supporting additional effects on the diagnosis using imaging. Guidline recommends that OA knee can be diagnosed clinically practically, without conducting diagnostic tests or imaging, if the patient can meet all of the following criteria or is called typical symptoms ie age 45 years or more, pain during activity, and joint stiffness of less than 30 minute.

Statistically a SEM in WOMAC is determined if a SEM value of 5.1 can be achieved from the WOMAC results. SEM is a minimum value if it exceeds this value the change can be claimed that the measurement or questionnaire of this WOMAC changes significantly in the form of statistics or data. This statement is supported by (McManus, 2012). For stiffness on the combined functional ability SEMG there is no significant change because the SEM value is not achieved that is 1 and Minimally Clinically Important Difference (MCID) is 1. Furthermore, for pain on the combined functional ability SEMG SEM value is achieved but 7 and the MCID value is 7. But the MCID number This is not achieved, so it cannot be implemented clinically.

Then MCID in WOMAC can be determined if the MCID value of 8.8 can be achieved from the WOMAC results. MCID is a minimum value if it exceeds this value the change can be claimed that this WOMAC measurement can change significantly and can be implemented clinically. This statement is supported by (Rai et al., 2015). The physical function for functional ability combined with SEMG achieves the SEM value of 9 and MCID of 9, so that this intervention can be statistically proven and can be implemented clinically to be used in improving the physical function of knee OA patients.

EMG uses surface electrodes to detect changes in skeletal muscle activity, which is then fed back to the user usually by visual or auditory signals. EMG-biofeedback can be used to increase weak or paretic muscle activity or can be used to facilitate the reduction of spastic patterns. EMG-biofeedback has been shown to be useful in musculoskeletal and neurological rehabilitation. One study suggested that the addition of EMG-biofeedback to conventional exercise programs resulted in a much shorter time in walking aid compared to conventional exercise alone (Giggins et al., 2013). Biofeedback techniques were effectively used because they made voluntary initial muscle contractions easier. An EMG-biofeedback-assisted exercise program is recommended to increase the effectiveness of exercise and patient motivation (Yılmaz et al., 2010).

This study has advantages such as being able to see activated muscle activity, respondents can also see their own muscle activation so they do not feel bored while doing exercises, then this exercise also does not make researchers tired because it only gives instructions to respondents.

But besides having advantages, the task specific research combined SEMG for functional abilities also has drawbacks such as WOMAC used in research that still uses English so it is difficult to understand and there is a possibility of bias, not using an enumerator, the level of evidence in this study is still low because it uses a single case report so that the risk of bias is still high, the time for giving interventions is small so that there is a bias and cost effective results need to be studied.

Then statistically, the Standard Error of Measurement (SEM) 10 meter walking test for walking speed combined with SEMG in individuals with knee OA of 0.06 m/s. While the results of the study showed changes in speed at self-pace and fast walk-

ing by 0.41 m/s and 0.45 m/s respectively. This can be interpreted that there is a significant increase in walking speed after exercise intervention is given.

On the other hand, the MCID on the 10 meter walking test for walking speed with SEMG in individuals with knee OA of 0.13 m/s. This result is smaller than the value of increased walking speed when self-pace or fast walking. So it can be concluded that the intervention given by researchers can be implemented in clinical practice.

In addition, the international clinical guidelines state that land-based concept training is highly recommended for all individuals with knee OA to reduce pain, improve function regardless of age, severity of structural disease, functional status or pain level. It was added by (Qurat-ul-Ain et al., 2018) who proved that task specific was more effective than conventional therapy in increasing walking speed and mobility. Explanation of the importance of this exercise is supported by an Randomized Controlled Trial (RCT) study that states that task specific exercises are developed specifically for individuals with knee OA, it is important to know which functional tasks are most problematic for those who experience knee OA so that task specific exercises are designed to target task assignments this (Tate and Milner, 2010). So we can conclude that task specific exercises can be implemented to exercise increased mobility in individuals with knee OA.

Yılmaz et al. (2010) in a study revealed that the addition of visual surface EMG biofeedback components to task specific exercises had a positive effect on improving muscle function and strength. This is also supported by research from Weakley et al., (2019) which states that in the process of musculoskelatal rehabilitation required visual biofeedback to reduce boredom in patients. In other words, the authors assume that the addition of visual biofeedback can have a positive impact on the rehabilitation process.

Weaknesses in task specific research combined SEMG for walking speed are too few research subjects, it is hoped that with the addition of research subjects can get better results. The level of evidence is still low where new researchers use a single case report so that further research is expected to increase to a RCT. In terms of funding, because to do this research does not require a small fee. The advantage of this study is that patients can see firsthand the activity of the muscles that are being activated and the presence of enumerators which makes the bias in this study to be low.

In Augmented feedback (External Clue) assessment of diagnosis of knee osteoarthritis can also use X-ray examination to evaluate the presence of osteophytes (Braun and Gold, 2012). Performance-based measurements such as the 6 minute walking test both subjective and objective are very inexpensive and easy to do, can provide valuable information such as the severity of the disease and the prognosis of the disease. Supporting the observation of Ateef, et al., (2016) noted in his study, that the excellent long-term condition of exellent test-retest reliability (Intraclass Correlation Coefficients (ICC) 0.94) of 6 MWT was reported in knee osteoarthritis. In clinical practice to be useful in research, SEM is used to identify errors associated with research results, because SEM is reported on a points scale that is to improve interpretation of patient results and changes (Kennedy et al., 2005).

Knowledge of MDCs for physical performance and tests reported by patients are commonly used to monitor the severity of knee osteoarthritis, needed to interpret changes in individuals in the context of clinical practice (Naylor et al., 2014). Minimum Detectable Change (MDC) and 6

MWT Standard Error of Measurement (SEM) with Augmented feedback (External Clue) on walking distance experienced significant changes due to the achievement of SEM 26.29 m, but the MDC value of 61.34 m could not be reached so that it could it was concluded that this intervention using Co-contraction exercise with External Clue could not yet be implemented in clinical practice.

Muscle co-activation around the knee joint in knee osteoarthritis patients aims to stabilize the joint during walking. In the feedback process, it provides information about movement errors and how the patient corrects errors has a positive effect on improving walking ability (Yu and Kang, 2017) 8m on the last day. This measurement experienced a significant improvement in the patient's walking quality.

The strengths of this research with Augmented Feedback (External Clue) are that this study is cost effectiveness, namely the value of the success of the intervention is greater than the costs incurred. Although further research is needed regarding the cost effectiveness and the renewal value of this research intervention is very high because there is no similar study.

The drawback is the enemurator in this study has not experienced to treat knee osteoarthritis patients or use the 6 Minute Walking Test and the level of evidence for this study is still low because it uses a single case report so it has a high risk of bias.

For WOMAC measurement on Augmented feedback (External Clue) MCID and WOMAC SEM on pain and stiffness with Augmented feedback (External Clue) there were no significant changes due to not achieving MCID values of 8.8 and a SEM value of 5.1, it can be concluded that the intervention using Co-contraction exercise with External Clue on the indication of pain and stiffness has not changed and cannot be implemented in clinical practice, but at the Physical Function point there is a change and has a value of more than MCID and SEM can be concluded that interventions using Co-contraction exercise with External Clue can be used when the patient is indicated for improvement in Physical Function.

The advantages of this study with Augmented Feedback (External Clue) are cost effectiveness in which the value of the success of the intervention is greater than the costs incurred, although it needs further research related to cost effectiveness. The interventions used were the highest recommendation results from several guidelines for knee OA. The renewal value of this intervention is very high because no similar studies have been found.

However, besides having advantages, this study also experienced shortcomings such as the WOMAC used in this study is still officially translated in Indonesian, so there is a possibility of bias on the enemurator. The enemurator in this study had no experience in treating knee osteoarthritis patients or using WOMAC. The level of evidence for this study is still low because it still uses a single case report so that it has a high risk of bias.

Based on the results of SEM and MCID in WOMAC shows that the provision of task specific training combined with visual SEMG and with Augmented feedback (External Clue) can provide a significant increase in functional abilities in patients with knee osteoarthritis. However, there were no significant results for patients with pain and stiffness disorders, so this exercise is only intended for individuals who have mild pain and stiffness but the main goal is for physical function in osteoarthritis patients. Then, task specific exercises combined with biofeedback visual SEMG have an effect on increasing walking speed in

individuals with knee osteoarthritis. The results of this study are expected to be used by physicians to improve effective and efficient walking speeds in individuals with knee osteoarthritis.

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There was no sponsorship in this study.

CONFLICT OF INTEREST

There is no conflict of interest in this study.

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CONFLICT OF INTEREST

There is not conflict in this study.

FUNDING AND SPONSORSHIP

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