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Patrick Idowu

Effectiveness of Gluteal Muscle Strengthening in Patients with Hip Osteoarthritis: Review of the Literature

Patrick Idowu

Northern Illinois University

Dr. Dawn Brown, PT, DPT, OCS

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ABSTRACT

Background: Providing gluteal strengthening for people hip osteoarthritis (OA) is a widely used treatment approach. One of the most common deficits affecting hip OA identified by physical therapist is the weakness in the gluteal muscles. The efficacy of treatment using gluteal muscle strengthening is explored in this review.

Objective: The purpose of this study was to determine the efficacy of gluteal muscle strengthening for people with hip osteoarthritis.

Methods: Computer databases were searched for randomized controlled trials (RCTs) published on CINAHL complete, Cochrane library, EBSCO, Google Scholar and ProQuest from 2008-2016. Only RCTs investigating people with hip OA were included.

Results: Due to the less availability of RCT that focused on the effectiveness of gluteus muscles in patients with hip OA, only five RCT were included in this review. Some of the studies conducted on strengthening exercise included with other exercise regimes to show an improvement of hip OA, but there was not a specific strengthening exercise on gluteus muscles that showed a better outcome.

Conclusions: Strengthening of the gluteal muscle for patients with hip OA is a commonly used treatment by physical therapists to help patients improve muscle flexibility, functionality, and mobility in the affected area. Only two of the RCTs were identified in this review that investigated the effectiveness of gluteal muscle strengthening in people with hip OA. However, further high-quality RCTs should be evaluated to show the effect of gluteal muscle strengthening for people with hip OA.

INTRODUCTION

Osteoarthritis (OA) of the hip is a common musculoskeletal degenerative disease that leads to loss of mobility, decreases overall health, resists the activities of daily living (ADL) and instrumental activities of daily living (IADLs), and decreases the quality of life. This common condition treated by physical therapists affects 10% to 25% of the population over the age of 55.[9] Pain is usually felt in the areas of the groin or gluteus and sometimes inside the thigh when the hip is rotated inwardly. The best radiological criterion used to detect osteoarthritis of the hip is by measuring the joint space narrowing .[4] Although there is currently no cure for hip OA, various nonsurgical forms of management have been utilized to effectively treat patients with this degenerative disease.

Despite a wide variety of treatment options such as weight reduction, strengthening exercise, manual therapy, aerobic exercise, and aquatic therapy rehabilitation in

osteoarthritis, hip OA remains a prevalent health condition due to obesity, decline in age, sedentary lifestyle, injury reoccurrence, and less physical activity engagement. Strengthening the gluteal muscles is yet to be determined as one of the most effective ways to treat patients with hip OA .[2] Numerous randomized control trials have investigated the efficacy of gluteal strengthening for hip OA. The gluteus medius (GMed), gluteus maximus (GMax), gluteus minimus (GMin) function as hip abductors. and they are considered to be major stabilizers that helps support and strengthen the hip joint.[10] If these muscles are affected, it will be difficult for a person with hip OA to properly carry out their ADLs and IADLs such as squatting to bathe, walking to shop or work, climbing, and/or dancing. Gluteal strengthening exercises that address specific motor deficits allow patients to slowly regain the muscle strength needed to partake in everyday activities.[5] Physical therapists use a special test to diagnose hip OA. However, a clinical radiograph for the diagnoses of hip OA is done by a doctor and can be sent to a physical therapist if requested. An early intervention strategy can effectively improve the chance of clinical success. Physical therapists should document the flexion, abduction, external rotation (FABER or Patrick's) test, passive hip range of motion (ROM), and the strength of the hip muscles.[4] The therapist should include internal and external rotation, flexion, extension, abduction, and adduction when examining a patient with hip OA over a long episode of care.[4]

Multiple literature reviews reported minimal information and poor long-term results of randomized control trials (RCT) in the effectiveness of strengthening the gluteus muscles for patients with hip OA. The intervention management of hip OA is an important rehabilitation process for patients with this condition, but the methodological qualities of some of the RCT studies used were insufficient for the current research in hip OA. There

was no evidence reported that strengthening the gluteus muscles is the most effective exercise treatment for hip OA. However, with the inclusion of graded behavioral exercise, Tai Chi, hydrotherapy, group based gluteus strengthening exercises, aerobic exercises, and individual exercises, hip OA can effectively be improved.

METHOD

Prior to the commencement of this review, a literature review protocol was developed and methods are summarized below.

Data Sources and Searches

A computer database search for RCT studies on the effectiveness of the gluteal muscle strengthening in patients with hip OA was conducted using the following databases: CINAHL Complete, Cochrane library, EBSCO, Google Scholar and ProQuest from 2008 to 2016. Only randomized controlled trials and randomized clinical trials were included in this search. Participants were randomly assigned to different treatment plans in some of the randomized clinical trials, although the treatment intervention varied and depended on the treatment control levels in the randomized control trials. However, other relatable hip OA articles and systematic reviews were searched using the search engines above, but neither of these types of articles and systematic review conducted a randomized control trial or a randomized clinical trial. The search terms used were 'gluteus muscles', 'strengthening', 'hip osteoarthritis', 'physical therapy', 'effectiveness', 'gluteus maximum', 'gluteus minimus', 'g medius', and 'outcome'. These terms were linked with a Boolean operator, and all the identified studies included in this review had a well detailed rehabilitation procedure used in managing hip OA.[4]

Study	Age	Gender	Settings	Weight
Zacharias et al., 2016	60 to 64	Females only	Hospital	153- 182 lbs.
Fukumoto et al., 2014	<50 years and ≤50	Females only	Department of orthopedic surgery, Kyoto University Hospital.	Unspecified
French et al., 2013	40 to 80 years	Unspecified.	University of Kentucky department of orthopedic.	Unspecified
Bieler et al., 2014	60 years and above.	Male and Female.	Musculoskeletal Rehabilitation research unit.	Unspecified
Shrier et al., 2008	65 and above	Males only	SMBD- Jewish General hospital.	Unspecified

Study Design

Due to the less availability of RCT that focused on the effectiveness of gluteus muscles in patients with hip OA, only five RCTs published in full by peer-reviewed English-language journals were included. The demographic data of participants used in some of these studies included age, gender, setting, and weight.

Types of Intervention

Only trials evaluating the effect of gluteal strengthening compared with no therapy, high or low velocity, or other conservative treatments were included. Trials were included where gluteal muscle strengthening was used with other interventions.

Outcome Measures

The outcomes of primary interest for this literature review were to measure gluteal strength. Articles that were reviewed from the RCT also included hip muscle strength, hip

ROM as part of treatment measures. A model that can be used by physical therapists for examination and treatment planning for individuals with hip pain and mobility deficits or impairment is depicted in the Figure 1.[4] Some impairment measures used in figure 1 were used in most of these RCT studies. Figure 2 depicts a radiograph of the hip affected by OA.[8]

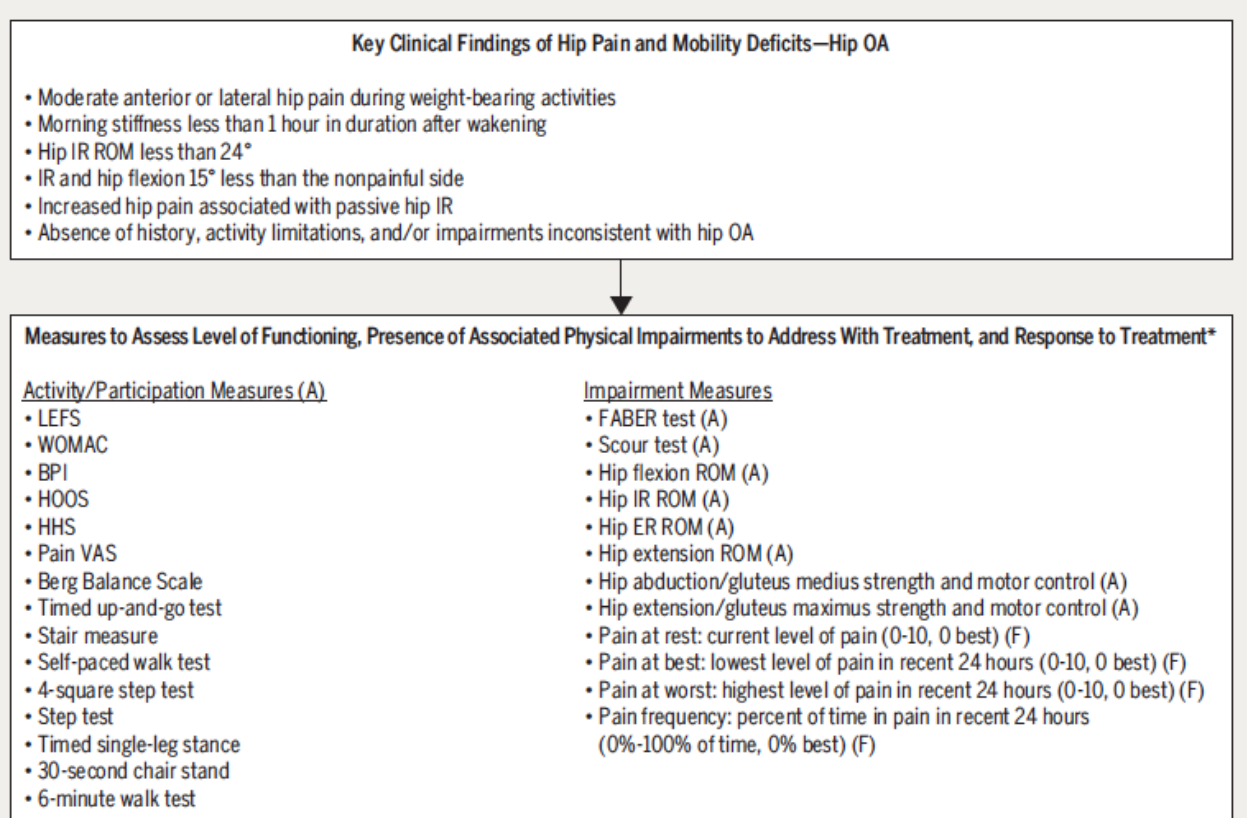

Figure 1. measures to access levels of functioning, presence of associated physical impairments to address with treatment, and response to treatment for patients with hip OA.

Figure 2. Radiograph of the hips showing (1) joint space narrowing and (2) osteophyte formation. Sinusas,K. 2012. osteoarthritis: diagnosis and treatment (photograph). Retrieved from http://www.aafp.org/afp/2012/0101/p49.html.

RESULTS

Five randomized control trials from different studies were used to determine the effectiveness of strengthening the gluteus muscles in patients with OA of the hip. These studies focused on muscle and strengthening-based exercise therapy as an intervention strategy to improve hip OA. These articles were fully examined to determine their references to gluteus or hip muscle strengthening. A step by step explanation on the result of each study is explained below.

Zacharias et al conducted a matched control study on the hip abductor muscle volume, which included 40 participants.[10] The aim of this study was to measure the quality of gluteal muscle atrophy in the hips of patients with OA by comparing it with the muscle volume of an age gender-matched control.[10] Different hip abductor muscles, volume, fatty

infiltration, and strength in patients with a unilateral hip OA were used in this study to show the existence of gluteal muscle atrophy affecting hip OA. The control group used in this study had participants who were age-matched with no radiological evidence of hip OA, scored > 40 on the Oxford Hip Score. [10] Participants in the OA group must have grade two unilateral hip OA, must be unable to walk unaided, and must score less than forty in the Oxford Hip Score. Strengthening the GMax and GMin are very important because they are essential hip joint stabilizers. The G med is responsible for hip stabilization and pelvic rotation during gait. [10] This study focused on the affected side of the muscle atrophy with medium to large effect size in an OA population when compared to the contralateral side. A significant atrophy in the GMax in the affected limb was identified in this study. The GMax plays an essential role in bipedal locomotion. A reduced functioning of the GMax can jeopardize gait cycles, limit activities of daily living, and cause difficult for individuals to sit or stand.[10] Group results such as the demographics and strength within the group, muscle volumes between the affected and unaffected limb within the group, and fatty infiltrate between affected and unaffected limbs were all compared within the group.

The first comparison was on the demographic and strength data, which showed that there were no statistical differences in age and height between the two groups. Participants who were in the OA group had a higher body mass index (BMI), a lower Oxford Hip Score, and a decreased physical activity level compared to the control group. The control group had a higher strength score for hip abduction and internal rotation compared to the OA group.[10] However, there were no statistical differences between each group when it came to the hip external rotation strength. There was a decrease in muscle volume in the limbs of the OA group. The GMax, GMed, and GMin were all less than 0.01 in the affected side of the

OA group compared to the contralateral side of the control group, which was less than 0.05.[10] Lastly, the level of fatty infiltrate between the two groups were compared, and it appeared that there was an increased level of fatty infiltration in the limbs of the OA group for GMax (P = 0.01) and GMin (P = 0.04). This study showed that there was a significant decrease in hip abduction and internal rotation for participants who were in the OA group. Hip abduction and internal rotation helped strengthen the gluteal muscles of the hip. [10] Gluteal muscle atrophy, increased gluteal fatty infiltration, and hip strength deficits were evident in the affected hip of the OA participants. This study does not effectively support the strengthening of the gluteus muscles because there was no major improvement within the groups when compared, and there was a decrease in the volumes of the muscles of participants in the OA group.

Fukumoto et al conducted a randomized control trial on 46 women diagnosed with bilateral or unilateral hip OA.[6] The severity of their hip OA was assessed using a Japanese Orthopedic Association Classification. Participants underwent an eight-week exercise program that included exercise of the hip abduction in the supine position, hip extension in the prone position, hip flexion in a sitting position, and knee extension in the sitting position. The primary outcome of this exercise program was to strengthen the gluteus muscles and evaluate whether physical performance on high-velocity training was more effective than low-velocity training in patients with hip OA.[6] Hip OA has been reported to cause a significant change in the skeletal muscles property. This significant change can lead to a loss in muscle mass, increase intramuscular adipose tissue, and alter muscle composition.[6] A comparison on the effect of muscle properties between high and low velocity training in patients with hip OA was determined in this study.[6] The results showed

that there was a greater decrease in the echo intensity of the gluteus maximus of patients who were in the high-velocity group than in the low-velocity group. However, there was a positive change in the composition of the muscle instead of the muscle mass for patients who were in the high velocity group. The results also showed that fat and fibrous tissues within the gluteus maximums may have decreased enormously due to the high velocity training.

Results from these studies supported the use of gluteus strengthening exercises in patients with hip OA.[6]Both training approaches were able to reduce hip pain and improve physical functioning. Despite this accomplishment, there was no improvement beyond the minimal detectable change for isometric strength, muscle power, clinical assessment, or muscle mass and composition.[6] High velocity and low velocity exercises were reported to be equally effective in improving muscle power in patients with hip OA. High velocity training at low resistance improved physical performance and had a greater effect on muscle composition compared to low velocity training.[6] There was evidence from this study that exercise training strengthened the gluteus muscles to improve hip OA. However, this study focused on a more specific type of exercise to determine if high and low velocity would improve hip OA.

French et al completed an RCT of 131 patients with hip OA based on the American College of Rheumatology Clinical and Radiographic Criteria to determine the effectiveness of exercise therapy compared to exercise and manual therapy.[5] Participants were included if they had OA of the hip and were between the ages of 40 to 80. The exercise therapy used for this study focused on flexibility and gluteal strengthening. The strengthening exercises concentrated on low load position, which started at a non-weight bearing position and

progressed to functional positions.[5] These strengthening exercises included isometric gluteus maximus in supine, isometric gluteus medius in supine, isometric gluteus maximus in prone, hip extension/abduction, hip flexion, external rotation of the hip, hamstring stretch in sitting or supine, and activation of the psoas major in supine. [5] The key target muscles of these exercises were the gluteal muscles, which commonly atrophy with hip OA. Participants were also encouraged to partake in aerobic exercise such as walking, cycling, and swimming for at least 30 minutes, five days a week. The primary outcome was based on the Western Ontario and Macmaster Osteoarthritis Index (WOMAC), and physical function subscale, while the secondary outcome included physical performance, pain severity, hip ROM, quality of life, and changes perceived by patients.[5] The results of this study showed that there was no significant difference between the exercise therapy and the exercise plus manual therapy group in the majority of the outcomes at the end of the 9 to 18-week exercise study. Participants reported a higher satisfaction with outcomes from the exercise plus manual therapy group rather than the exercise therapy alone. However, both groups improved in self-reported physical function, aggregate ROM, and patient-perceived improvement at the end of week nine. The study supported the use of gluteus strengthening exercises to treat patients with hip OA, but participants preferred both manual and exercise therapy because the exercise therapy group alone complained of pain after each exercise study was done.

Bieler et al conducted a RCT on individuals over the age of 60 with symptomatic hip OA.[1] Participants were included if they had symptomatic hip OA and met all of the clinical criteria of hip OA according to the American College of Rheumatology. The purpose of this study was to investigate the reliability and measures of the lower extremity muscle

strength, physical power, and functional performances in patients with hip OA.[1] The results were collected at different time intervals and were compared with the same measures of a healthy patient. The physical therapists who conducted this study focused on different measurements that helped strengthen the hip and gluteus muscles. These measurements included a maximal isometric test of the hip abductor and adductors, a muscle function assessment, a maximal isometric hip muscle strength test, a maximal isometric thigh muscle strength test, a leg extensor power test, and a functional performance assessment.[1] The results of each test conducted on patients with hip OA will be explained to determine if they were effective. First, the result of the muscle strength measurement performed on patients with hip OA during the first and second week were significantly lower at hip external rotation, flexor, abductor, and a least symptomatic lower extremity. Patients also complained of pain during each muscle strength measurement. However, the leg extensor power measurement showed no significant difference between previous and recent tests conducted for leg extensor power. Although this intra-rater test study of patients with hip OA showed a good – excellent reliability muscle strength measurement that affects the gluteus muscles of the hip, there was a continuous decline after the first and second week of the measurement.[1] The decline in strength could be due to muscle weakness associated with delayed onset of muscle soreness, which persists for up to 21 days after one hour of eccentric exercise.[1] This study does not effectively support the strengthening of the gluteus muscles due to the immersive decline after each measurement.

Shrier et al conducted a randomized clinical trial on 59 males using a progressive strengthening exercise program in patients with severe hip OA. Participants were included if they had to undergo a unilateral total hip arthroplasty (THA) and had no medical issue

that would contradict to the participating study.[7] The purpose of this study was to test the feasibility of patients with hip OA and present preliminary data that would be useful to other versions of exercise programs associated with hip OA.[7] This study focused on strengthening exercises such as strength endurance and function, range of motion of the hip, abduction, hip flexion, internal and external rotation, and hip extension. The ROM of the hip was tested using a long-armed goniometer, the abduction was tested on the angle between the inter-axis and long axis of the femur. The leg was bent for hip flexion at a 90 degrees angle between the long axis of the femur and hip until the pelvis began to move. For external and internal rotation, the ankles were bent to a 90-degree angle while a flexometer was attached to the leg. The hip extension was tested by placing the gluteus at the edge of the table with the legs hanging over the edge while the hip was passively flexed at 90 degrees to maintain a stable pelvic position. The strengthening exercises used in this study were used to help improve the muscles of the gluteus. A Western Ontario and Macmaster Osteoarthritis Index (WOMAC) was used to measure the severity of the pain.[7] The results of this study showed that patients were unable to perform the exercises due to the pain in the affected weight-bearing hip in the quadruped position when the contralateral hip was extended. A contralateral hip test was used to determine strength relative to the unaffected limb. The test for the hip adduction and abduction were dropped because patients were unable to perform the test due to pain. However, patients did well with the moderate aerobic exercise, but the majority of the patients could not bear the pain from the strengthening exercise. This result showed that strength programs are feasible in patients with severe hip OA, but patients might not be able to perform some of the core strengthening exercises due to the pain from the strength test. This study does not support

the use of gluteus strengthening exercises in patients with hip OA because patients were unable perform the exercises due to the pain of the affected OA joints.

DISCUSSION

The aim of this current study was to determine whether gluteal strengthening is effective for patients with OA of the hip. Evidence from multiple studies included in this review indicate that gluteus muscle strengthening is a key component for many different exercise regimes for patients with hip OA. However, depending on the severity of the hip OA, several factors like muscle dysfunction, limited range of motion, and obesity can lead to a significant decrease in the GMAx and GMed of patients with hip OA. It was not clear as to which factors were more significant. Multiple studies also tested the isometric hip strength in patients with hip OA to determine the hip adduction, flexor, abduction, and balance. Results from these tests showed an improvement in patients with hip OA, but other exercise activities were included. Other studies that showed a positive effect of gluteus strengthening exercises performed.

Limitations

This topic needs to be further explored. There were very few studies that specified the effectiveness of gluteus muscles in the hip OA, so it was hard finding articles that related specifically to the gluteus muscles without any other types of therapeutic interventions involved. There were more articles on the effectiveness of strengthening the gluteus muscles for patients with knee OA or both knee and hip OA. There was not an optimal exercise approach for gluteus strengthening of the hip OA alone.

CONCLUSION

Gluteal muscle strengthening for people with hip OA is a commonly used treatment by physical therapists to help patients improve ROM, muscle flexibility, functionality and mobility in the affected area. Only two of the RCTs identified in this review investigated the effect of gluteal muscle strengthening on people with hip OA. However, there have been minimal descriptions of the specific gluteus strengthening exercise regimes that should be used to effectively improve hip OA. Results from other articles and RCTs suggested the benefits of strengthening and aerobic exercises, but most studies and articles either examined only knee OA or combined knee and hip OA. Further high-quality RCTs should be conducted to show the effect of gluteal muscle strengthening for people with hip OA. This will help to determine if strengthening the gluteus muscles can be a long or short-term benefit for patients with hip OA to carry out essential activities of daily living such as squatting to bathe, walking to shop, and climbing stairs.

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