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Research Article

The Quadriceps Muscle's Response to Eccentric Versus Concentric Strengthening Exercises in Knee Osteoarthritis Patients

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Abstract

Aims and objectives: To find out the Quadriceps Muscle's Response to Eccentric versus Concentric Strengthening Exercises in Knee Osteoarthritis Patients.

Methodology: In this study, 23 subjects with bilateral knee OA, A grade 2 or 3 OA, as judged by Kellgren and Lawrence18 based on weight bearing radiographs, volunteered. Before the study, all volunteers underwent a medical examination (cardiovascular, respiratory), and those without any health problems were included in the study. Three groups of patients were randomly assigned: concentric (CON, n 9), concentric-eccentric (CON-ECC, n 8), and non-treatment (NONTX, n 6). Subjects were treated by concentric, concentric-eccentric exercises and outcome were measured and documented.

Results: A significant decrease in pain scores was observed in both training groups, and functional capacity was also significantly increased.

Conclusion: According to this study, patients with OA knee pain can improve functional capacity and decrease pain by undergoing training programs.

Keywords: OA Knee; Eccentric; Concentric Strengthening Exercises

Abbreviation

OA: Osteoarthritis; CON: Concentric; ECC: Eccentric; NONTX: Non-Treatment

Introduction

The most prevalent progressive musculoskeletal condition that can affect joints is osteoarthritis (OA), which primarily affects the hips and knees as the primary weight-bearing joints. The major symptoms and findings of knee osteoarthritis (OA) are pain and physical disability [2]. Several studies [3-5] have shown that patients with knee OA have weakness of lower-extremity muscles, particularly the quadriceps muscle. The degree of quadriceps muscle weakness has been associated both with the amount of pain in the knee and the amount of physical disability [1]. OA is characterized by structural modifications to primarily articular cartilage and the subchondral bone, as well as Hoffa's fat Therapeutic exercise programs as a treatment for knee OA are frequently utilized in clinics due to the fact that resistance training has been shown to reduce pain and disability in patients with knee OA [9-12]. However, the kind of exercise that works best for people with knee OA is still unknown. The muscle contraction that occurs when lifting a weight is the most common analogy for concentrated training. When the muscle contracts to lift the load, as in a bicep curl, the fibers of the muscle shorten. When the muscle fibers lengthen to lower a load, as in a bicep curl, this is called an eccentric muscle action. In order to safely return the weight to the starting position, the fibers are both contracting and lengthening simultaneously. In strength training with free weights, body weight exercises, and non-hydraulic exercise machines, eccentric muscle actions are common. Both types of muscle movements are involved in the majority of everyday activities. For instance, strolling up the steps works the quadriceps concentrically while strolling down the steps works the muscle whimsically. Moreover, getting a youngster or clothing container are complete body concentric activities while bringing down the kid or clothing bin are flighty developments. Since we use our muscles in both ways in everyday life, strength-training programs should also include both types of activities. Strength training protocols should include both concentric and eccentric muscle actions, as stated in the American College of Sports Medicine (ACSM) Position Stand on Resistance Training Progression, which was pub-

lished in 2002. Muscle strength results from the proper activation of specific muscle fibers, which are recruited in response to the demands of the resistance-training program. Researchers have examined the advantages of training eccentric muscle actions alone as opposed to concentric muscle actions, as well as the advantages of concentric and eccentric combined training programs. The findings have demonstrated that training eccentric muscle actions has numerous advantages. Among these advantages are: The knee muscles contract concentrically or eccentrically during daily activities, such as standing up from or sitting down in a chair, to control the movement of the limb and/or to prevent joint overloading [7]. Greater Strength [5], Greater muscle hypertrophy [6], and muscle growth. Although concentric and eccentric muscle contractions are frequently used in daily activities, only isometric, isokinetic, and isotonic resistance exercise was investigated in patients with knee OA for muscle strength, pain, and disability in previous studies [4,12,15]. In addition, it has been suggested that resistance training performed using eccentric muscle contractions may be more effective than training performed using concentric or isometric muscle contractions in increasing muscle strength in healthy individuals [13,15]. The greater effectiveness of eccentric or coupled concentric-eccentric training.

Methodology

23 volunteers participated in this study who had bilateral knee OA of grade 2 or 3 as determined by Kellgren and Lawrence18 based on weight bearing radiographs. All volunteers were examined (cardiovascular and respiratory) prior to the study, and no health issues prevented them from participating. The patients were divided into three groups at random: non-treatment (NONTX, n. 6), concentric-eccentric (CON, n. 9), and concentric-eccentric (CON-ECC, n. 8).

Outcome measures

- **Functional Capacity Measurements:** Patients utilized a 10-point numeric rating scale (NRS; 0 for minimum functional capacity and 10 for maximum functional capacity) to assign a subjective score for standing, walking, ascending and descending stairs, and getting out of a chair. Additionally, functional capacities were assessed through standardized stair climbing and descending tests, a 15-meter walk, and getting up from a chair.
- **Walking test:** On the command "go," the patients were instructed to walk as quickly as possible along a level, unobstructed corridor. Before the starting line, the patients stood. A hand-held stopwatch was started when the subjects reached a first mark, which was 15 meters from the start mark, and stopped when they reached a second mark.
- **Rising from a chair test**: The patients were instructed to rise from a chair without arm support ten times as quickly as possible. The stopwatch was started with the command "go" while the patients were standing by the chair. It stopped when the patients reached the starting position for the tenth time. The patients were instructed to stand up with their knees fully extended and sit on the chair with their bottoms together.
- **Stair climbing test:**The patients were instructed to ascend ordinary straight stairs with 12 steps, each 17 centimetres high and 23 centimetres wide, as quickly as possible under the command "go" without arm support. When patients placed their second foot on the top step (12^{th}) of the stairs, the stopwatch stopped. The command "go" started the stopwatch.
- **Descending stair test**: As previously mentioned, the patients stood at the top of the stairs. When taught to slide the steps without arm support, the stopwatch was begun the order "go" and halted when patients put their second foot on the floor at the lower part of the steps. For each functional test, there were two trials with a 5-minute rest, and the best one was accepted. Between each test, there was a 15-minute break. Before the tests for familiarization, the patients were given an explanation of the procedures in detail and given permission to perform a few trials without exerting too much effort.
- **Knee pain:** The severity of pain at night, after inactivity, while sitting, rising from a chair, standing, walking, and stair climbing, as well as during the day and after inactivity, was assessed using a 10-point NRS (0: no pain, 10: unbearable pain). 3 During the functional capacity tests, patients were also asked to rate their knee pain on a 10-point scale-0 for no pain and 10 for unbearable pain.

Procedure

The CON group engaged in 12 concentric extension and flexion movements during isokinetic training; the CON-ECC bunch performed 6 concentric expansion and offbeat augmentation developments, then 6 concentric flexion and erratic flexion developments. Patients in the CON group trained in a reciprocal manner for the knee extensors and flexors using conventional continuous mode. The instructions for the CON-ECC group were as follows: "Push as hard and as fast as possible against the lever arm (concentric contraction) and at the end of extension; For knee extensors, continue to push against the lever arm as it returns to the starting position (eccentric contraction). In the CON-ECC group, knee extensors and flexors were given a rest of two minutes, and in both training groups, legs were given a rest of five minutes. In standardized conditions, the entire set of measurements was carried out prior to and following the training. Throughout the eight-week experimental period, the patients in the NONTX group performed their usual physical activities without receiving any training. However, they

were tested twice. During the tests and training, the researchers urged patients to exert maximum effort. During the experimental period of eight weeks, none of the patients took any medication and none of the patients had clinical joint effusion, as determined by palpation of a bulge sign.

Results

There was no significant difference between the groups in the patients' selected characteristics or OA grade. None of the subjects in the preparation bunches griped of a need to quit preparing during about two months of preparing, and they finished the entire preparation plan.

Functional capacity

Training significantly improved the CON-ECC and CON groups' subjective ratings of daily functions. After eight weeks, the changes in rating that occurred as a result of training in both groups were significantly different from those that occurred in the NONTX group. After the training, however, there were no significant differences in changes between the CON and CON-ECC groups. The CON-ECC group performed better than the CON group in terms of functional measurements after training, with the exception of standing from a chair. Particularly in the CON-ECC group, the most pronounced changes were observed in stair climbing and descending. The training also significantly improved the functional capacities for the 15-minute walk, getting out of a chair, and climbing and descending stairs. After eight weeks, the CON-ECC and CON groups' functional capacity changes were significantly different from the NONTX group's, with the exception of the 15-minute walk in both training groups and the descending stairs in the CON group. For descending stairs, the CON-ECC group experienced the greatest percentage change.

Pain

After eight weeks of training, the CON-ECC and CON groups' subjective ratings of pain for the selected daily activities decreased, but the NONTX group's ratings did not change. When compared to the NONTX group, the changes in pain scores were significantly different in the training groups. However, there was no significant difference in total score change between the CON group and the CON-ECC group. Both training groups saw a reduction in pain during the functional tests as well, but the effect of training mode on scores was less evident than in daily activities.

Discussion

In conclusion, functional capacity and pain scores significantly decreased in both training groups. It is difficult to attribute the improvements in the training groups to the learning curve for the procedures of the tests because patients in the NONTX group were tested twice during the eight-week period and did not exhibit these significant changes. When compared to the NONTX group, the CON-ECC group achieved greater improvements in functional measurements, particularly for stair climbing and descending; However, following training, the CON group performed better in pain measurements than the CON-ECC group. Concentric strength improved significantly in the CON group, whereas eccentric strength improved significantly in the CON-ECC group, suggesting a correlation between the type of contraction used in the training and muscle strength gains. Because it was thought that eccentric contractions might be harmful to the knee, a rigorous strength training program that included them has not been attempted before in patients with severe OA. Another reason to be concerned is the possibility that pain could make these programs less effective or worse. In both groups, the subjective ratings of pain scores significantly improved for daily activities; however, the CON group experienced greater success in pain reduction. Both training groups improved functional capacity based on subjective ratings, but the CON-ECC group saw the greatest improvement. As was to be expected, concentric-eccentric training outperformed concentric training when it came to stair climbing and descending capacity. The study's findings appear to be significant because it was reported that OA patients' descending and ascending stair performance is the most impaired function compared to healthy subjects. In a similar group of patients with OA knee, Fisher., *et al*. [9]. used 16-week isometric plus isotonic training programs. After 8 weeks of training, they found improvements in walk time that were comparable to Fisher's [9] results, but functional capacity that improved more than twice as much as Fisher's was found in this study. After 16 weeks, they found improvements in functional capacity that were approximately 18% and 14%, respectively. In addition, our study's functional capacity improvements were approximately two times greater than Fisher's [9] study's improvements after 16 weeks. With a value of 30% for 16 weeks of training and a value of 10% for 8 weeks of training, Fisher's [9] observed the most significant improvements in pain when walking, standing, getting up from a chair, and climbing stairs. In this study, after eight weeks of training, these parameters improved by 53% and 69%, respectively, in the CON and CON groups.

Conclusion

The findings demonstrated that patients with OA knee can benefit from the training programs used in this study to increase functional capacity and lessen pain. Additionally, the findings demonstrated that for patients with osteoarthritis of the knee, extensive training with a high number of eccentric contractions and repetitions is safe, effective, and well tolerated. For patients with bilateral OA knee, a training program that targets the quadriceps and ham-

string muscles may be more effective in reducing symptoms and improving overall function. Training for older people with knee OA should include both concentric and eccentric muscle actions because they are used in succession in most daily activities.

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