

UNIVERSITY OF THESSALY

COMPARISON OF QUADRICEPS STRENGTHENING PROGRAMS THROUGH OPEN
AND CLOSED KINETIC CHAIN EXERCISES IN PATIENTS WITH KNEE
OSTEOARTHRITIS AND EFFECT ON PAIN AND FUNCTION

Master's Thesis submitted to the faculty for the partial fulfillment of the
obligations to obtain the master's degree of the Master's Program <<Exercise
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ΠΑΝΕΠΙΣΤΗΜΙΟ ΘΕΣΣΑΛΙΑΣ
ΤΜΗΜΑ ΕΠΙΣΤΗΜΗΣ ΦΥΣΙΚΗΣ ΑΓΩΓΗΣ ΚΑΙ ΑΘΛΗΤΙΣΜΟΥ

ΣΥΓΚΡΙΣΗ ΠΡΟΓΡΑΜΜΑΤΩΝ ΕΝΔΥΝΑΜΩΣΗΣ ΤΕΤΡΑΚΕΦΑΛΟΥ ΜΕΣΩ
ΑΣΚΗΣΕΩΝ ΑΝΟΙΚΤΗΣ Η ΚΛΕΙΣΤΗΣ ΚΙΝΗΤΙΚΗΣ ΑΛΥΣΙΔΑΣ ΣΕ ΑΣΘΕΝΕΙΣ ΜΕ
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ΛΕΙΤΟΥΡΓΙΚΟΤΗΤΑ

των

Μπούτλας Δημήτρης
Φούντας Κωνσταντίνος

Μεταπτυχιακή Διατριβή που υποβάλλεται στο καθηγητικό σώμα για τη μερική
εκπλήρωση των υποχρεώσεων απόκτησης του μεταπτυχιακού τίτλου του
Προγράμματος Μεταπτυχιακών Σπουδών <<Άσκηση και Υγεία>> του
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Υπεύθυνη Δήλωση

Οι Μπούτλας Δημήτρης και Φούντας Κωνσταντίνος γνωρίζοντας τις συνέπειες της λογοκλοπής δηλώνουμε υπεύθυνα ότι η παρούσα εργασία με τίτλο:
<< ΣΥΓΚΡΙΣΗ ΠΡΟΓΡΑΜΜΑΤΩΝ ΕΝΔΥΝΑΜΩΣΗΣ ΤΕΤΡΑΚΕΦΑΛΟΥ ΜΕΣΩ ΑΣΚΗΣΕΩΝ ΑΝΟΙΚΤΗΣ Η ΚΛΕΙΣΤΗΣ ΚΙΝΗΤΙΚΗΣ ΑΛΥΣΙΔΑΣ ΣΕ ΑΣΘΕΝΕΙΣ ΜΕ ΟΣΤΕΟΑΡΘΡΙΤΙΔΑ ΓΟΝΑΤΟΣ ΚΑΙ ΕΠΙΔΡΑΣΗ ΣΤΟΝ ΠΟΝΟ ΚΑΙ ΤΗΝ ΛΕΙΤΟΥΡΓΙΚΟΤΗΤΑ>> αποτελεί προϊόν αυστηρά προσωπικής εργασίας και όλες οι πηγές που έχουμε χρησιμοποιήσει έχουν δηλωθεί κατάλληλα στις βιβλιογραφικές παραπομπές και αναφορές. Τα σημεία όπου έχω χρησιμοποιήσει ιδέες, κείμενο ή/ και πηγές άλλων συγγραφέων, αναφέρονται ευδιάκριτα στο κείμενο με την κατάλληλη παραπομπή και η σχετική αναφορά περιλαμβάνεται στο τμήμα των βιβλιογραφικών αναφορών με πλήρη περιγραφή.

Ο Δηλών

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List of abbreviations

KOOS: knee injury and osteoarthritis outcome score

VAS: Visual analogue scale

OA: Osteoarthritis

BMI: Body mass index

PIF: Peak isometric force

TENS: Transcutaneous electrical nerve stimulation

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ΕΥΧΑΡΙΣΤΙΕΣ

Με την ολοκλήρωση της μεταπτυχιακής μας διατριβής θα θέλαμε να ευχαριστήσουμε θερμά τον καθηγητή μας κύριο Γιάκα Γιάννη για την ευκαιρία που μας έδωσε να ασχοληθούμε με ένα τόσο ενδιαφέρον αντικείμενο που αφορά την επαγγελματική μας ενασχόληση.

Επίσης ευχαριστούμε τους συμμετέχοντες που δέχτηκαν να γίνουν μέρος αυτής της εργασίας.

Τέλος ευχαριστούμε τις οικογένειες μας για την υπομονή που δείξαν και την συμπαράσταση έτσι ώστε να είναι εφικτός ο στόχος μας.

Abstract

Background: One of the most orthopedic problems nowadays is osteoarthritis. This condition is diagnosed in 20% of the adult population and the prevalence increases in 50% of adults over 65 years of age. Exercise is an effective treatment option that reduces symptoms and improves quality of life. Muscle strengthening is vital for patients with knee osteoarthritis. Something that is not well researched is which kind of exercise is the best.

Aim: The aim of this study is to determine whether and to what extent the increase of the strength of the quadriceps muscle through specialized open or closed chain strengthening protocols, affects the pain and quality of life in people with knee osteoarthritis.

Methods: The sample consisted of 30 patients (17 women, 13 men randomly separated) who were divided into 2 groups of 15 (open chain 15 people and closed chain 15 people). Pain, functionality and maximum isometric force of the quadriceps were assessed. Pain was assessed via Visual Analogue Scale (Picture 0) on a score range between 0 – 10 (0=no pain, 10=extreme pain). Functionality was assessed via questionnaire KOOS.

Results: The group of patients who performed the open chain exercises showed statistically significant difference between the two measurements with greater peak isometric force in the second measurement ($p<0,05$). In terms of pain, VAS score showed a statistically significant difference between the first and the last test with decrease in pain on the affected limb after the open chain exercises. ($p<0,05$). The KOOS questionnaire scores had a statistically significant difference also. Patients claimed to have better outcomes in function of the affected limb and decreased symptoms in their daily living ($p<0,05$). The group of patients who performed the closed chain exercises, showed also statistically significant difference in terms of peak isometric force before and after treatment ($p<0,05$). VAS score had also statistically significant difference before and after treatment with patients referring decreased symptoms in the last session($p<0,05$) Finally the KOOS questionnaire score showed statistically significant difference before and after treatment in terms of knee function in daily living ($p<0,05$).

Conclusions: Based on our study outcomes, exercise alone has the ability to reduce pain and knee function in individuals with knee OA. It is unclear if open or closed chain is more effective. It is a guideline that exercise must be included in the treatment of knee OA.

Keywords: knee osteoarthritis, open closed chain exercises

INTRODUCTION

The aim of this study is to determine whether and to what extent the increase of the strength of the quadriceps muscle through specialized open or closed chain strengthening protocols, affects the pain and quality of life in people with knee osteoarthritis.

The importance of this research is to enable those patients to improve their functionality and to highlight which of the two categories of exercise (open or closed chain) is more effective.

Osteoarthritis is a degenerative condition characterized by severe pain, stiffness and reduced range of motion and is one of the most common causes of disability and reduced quality of life. This condition is diagnosed in 20% of the adult population and the prevalence increases in 50% of adults over 65 years of age. Exercise is an effective treatment option that reduces symptoms and improves quality of life. Muscle strengthening is vital for patients with knee osteoarthritis. Adequate quads strength is very important during gait, especially during heel strike, because it reduces impulsive loading of the knee. According to the literature, strengthening the quadriceps muscle seems to have beneficial effects in terms of functionality and knee pain in patients with osteoarthritis (1). One study in 2002 by the National Health Survey of France has shown that patients with arthritis had reduced levels of physical activity (about 37%) than non-arthritis people at the same age (2).

Ageing reduces lower limb muscle strength and that is marked particularly in patient with knee osteoarthritis. However, it has not been investigated whether open chain exercises have better results than closed chain exercises or the opposite. It would therefore be profitable to investigate the comparative results of the above mentioned two kinds of exercises .

METHODS

This study was approved by The Internal Ethics Committee of the Department of Physical Education and Sports Science, University of Thessaly.

Subjects

Inclusion criteria

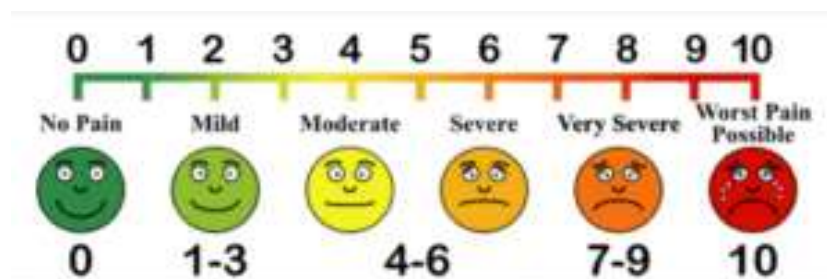
Participants must meet certain criteria. Initially they must have activity-related knee pain for more than 6 months, i.e. mechanical pain. Participants must be aged 55-75 years. Imaging should also be preceded by an imaging examination (X-ray or magnetic reassurance or computed tomography scan) that shows a reduction in the intervertebral space either lateral or medial of the joint as well as degenerative lesions that suggest to osteoarthritis condition. Joint narrowing must be estimated from minimal to moderate, in a four stages scale of osteoarthritis severity (minor, mild, moderate, severe, see exclusions below).

Exclusion criteria

Excluded from the study were: patients with severe osteoarthritis (stage 4 according to the above mentioned four stages scale of osteoarthritis severity) which has a surgery indication, patients who have undergone knee surgery (cruciate or lateral ligament arthroplasty, meniscus rupture as well as arthroplasty), patients who have suffered patella or tibial fractures, patients who suffer from cardiovascular disease, patients with systemic diseases, women during pregnancy, patients with neoplasms, patients with neurological diseases. Also, patients who had received intraarticular cortisone injections within the past 5 months.

Instruments

The sample consisted of 30 patients (17 women, 13 men randomly separated) who were divided into 2 groups of 15 (open chain 15 people and closed chain 15 people). Pain, functionality and maximum isometric force of the quadriceps were assessed. Pain was assessed via Visual Analogue Scale (Picture 0) on a score range between 0 – 10 (0=no pain, 10=extreme pain). Functionality was assessed via questionnaire KOOS (knee injury and osteoarthritis outcome score) (3).



Picture 1 Visual Analogue scale (VAS).

There are five patient-relevant subscales in KOOS that are scored separately: Pain (nine items); Symptoms (seven items); Function in daily living (17 items); Sport and Recreation Function (five items); Quality of Life (four items). A Likert scale is used and all items have five possible answer options scored from 0 (No Problems) to 4 (Extreme Problems) and each of the five scores is calculated as the sum of the items included. Scores are transformed to a 0–100 scale, with zero representing extreme knee problems and 100 representing no knee problems as common in orthopedic assessment scales and generic measures. Scores between 0 and 100 represent the percentage of total possible score achieved.

Strength was assessed with peak isometric force via dynamometer Activforce-activ5 (picture 1). Measurements were performed at the beginning, on the first day at the physical therapy clinic and at the end after 15 sessions, with 3 sessions per week, to determine how and if pain and function are affected in relation with the increase in maximal isometric contraction.



Picture 2. Activeforce-Active 5

During measurements, patients were seated with their thigh and back supported and knee at 90° flexion. Above the ankle of the tested limb a non-elastic belt was attached and the Activ5 dynamometer was placed in line with the belt. The belt was at the other end attached at the wall bars. Patients were asked to push as hard as they can for 5 seconds, and the test performed three times. The mean peak force of the 3 tests were collected.

Data collection

The exercise protocols included squat exercises with a ball on the wall, squat exercises with TRX straps, leg extensions with cable machine, and lifting a straight leg exercises (4) (5) (6) (8).

SPSS program was used for data processing and the performed tests were Dependent sample T test. Measures included VAS, KOOS score and peak isometric force before and after treatment.

A large proportion of this sample of referred patients with knee OA reported symptom duration of 6 months or longer and advanced radiographic disease.

The peak isometric force of the painful limb was measured by Active Force. The first measurement took place before the first session and the second one after the last session. The VAS score and the KOOS questionnaire followed the same procedure.

Data analysis

The group of patients who performed the open chain exercises showed statistically significant difference between the two measurements with greater peak isometric force in the second measurement ($p < 0,05$) (Table 1).

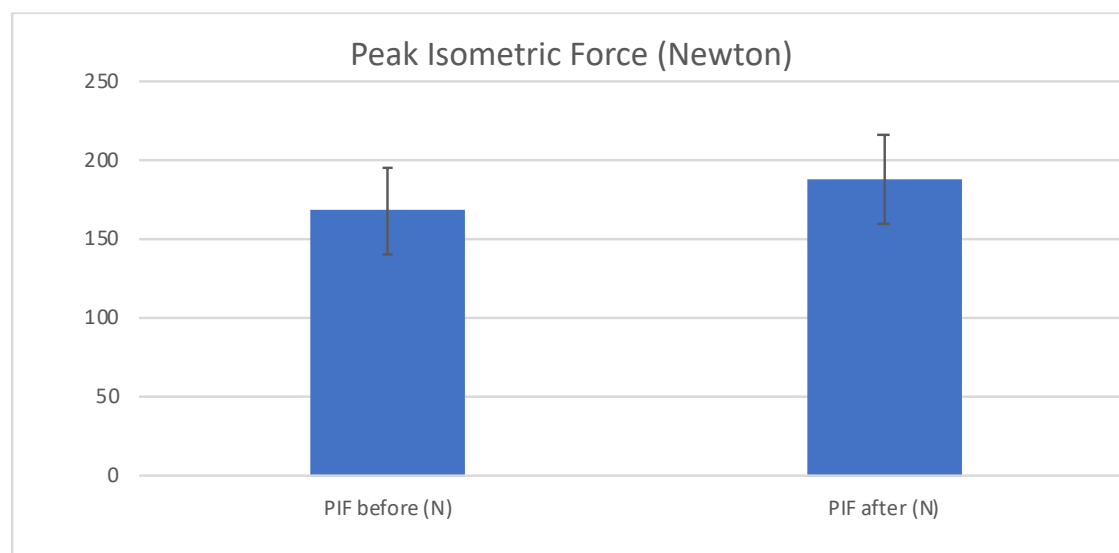


Table 1. Peak isometric force before and after, open chain group.

In terms of pain, VAS score showed a statistically significant difference between the first and the last test with decrease in pain on the affected limb after the open chain exercises. ($p < 0,05$) (Table 2)

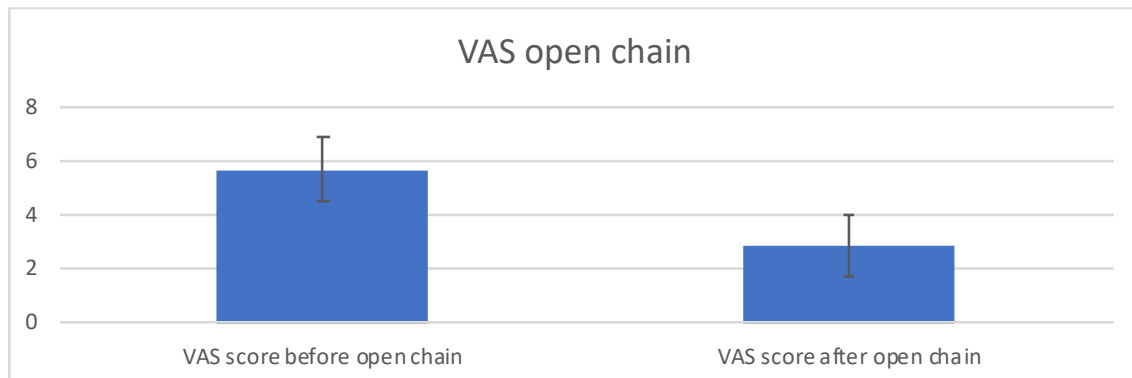


Table 2. VAS score before and after, open chain group.

The KOOS questionnaire scores had a statistically significant difference also. Patients claimed to have better outcomes in function of the affected limb and decreased symptoms in their daily living ($p < 0,05$)(Table 3).

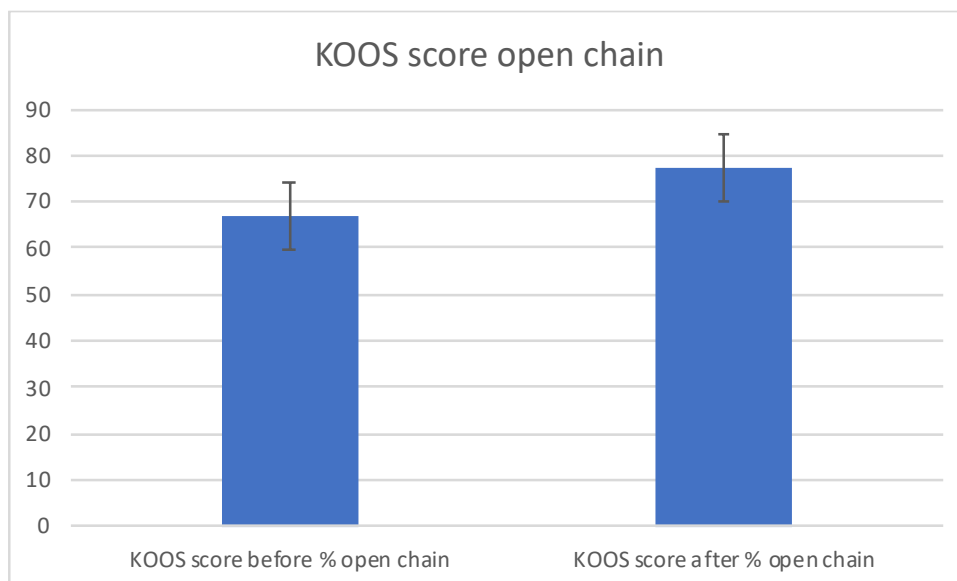


Table 3 KOOS score before and after, open chain group.

The group of patients who performed the closed chain exercises, showed also statistically significant difference in terms of peak isometric force before and after treatment ($p<0,05$) (Table 4).

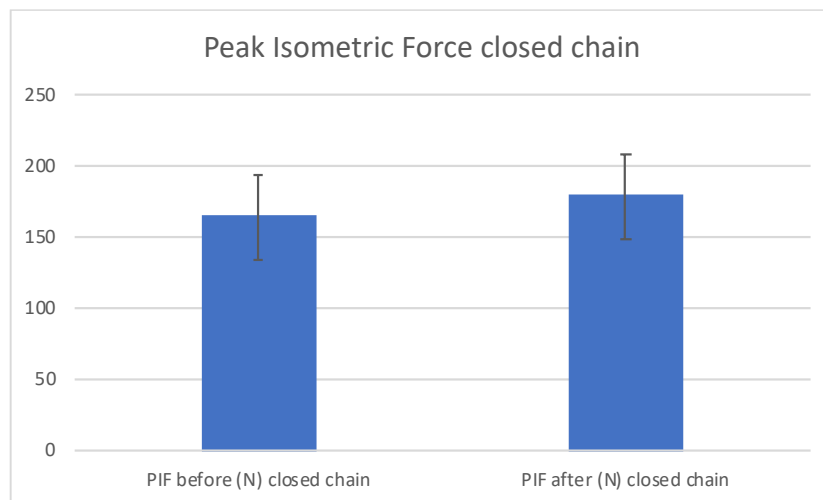


Table 4 PIF score before and after, closed chain group.

VAS score had also statistically significant difference before and after treatment with patients referring decreased symptoms in the last session ($p<0,05$) (Table 5)

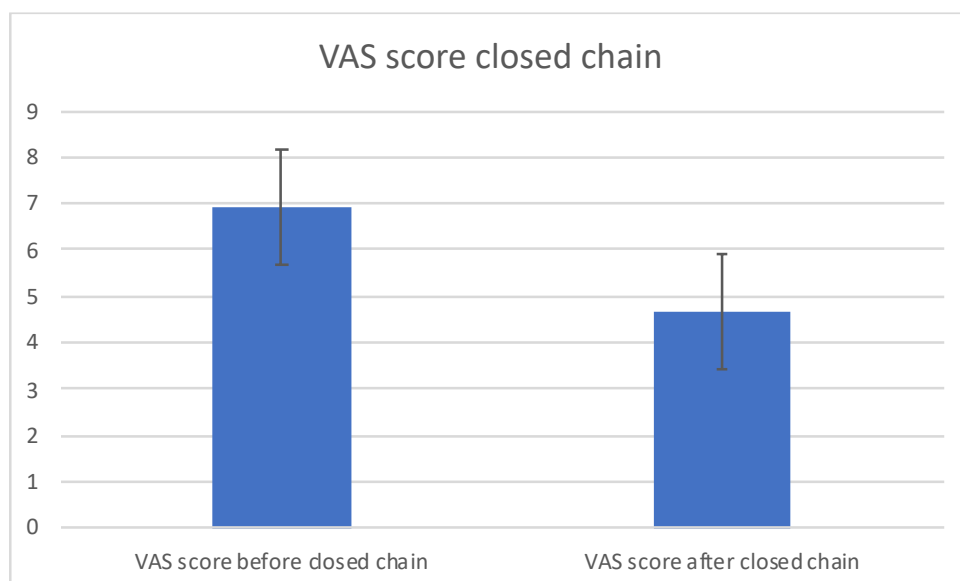


Table 5 VAS score before and after treatment, closed chain group.

Finally the KOOS questionnaire score showed statistically significant difference before and after treatment in terms of knee function in daily living ($p < 0,05$)(Table 6).

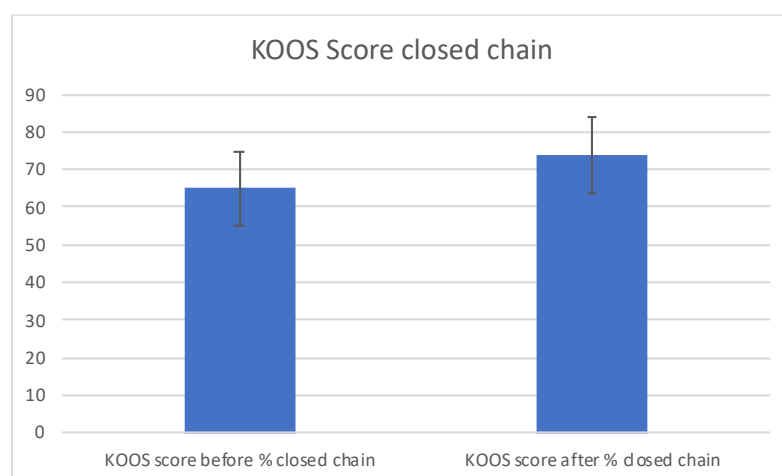


Table 6 KOOS score before and after treatment, closed chain group.

DISCUSSION

The purpose of this study was to evaluate the efficacy of the strengthening exercises on patients with knee OA. The sample was dichotomized in two groups in which the one was open chain exercises and the other one was closed chain exercises. Based on our findings there is moderate to strong evidence that overall, both closed and open chain exercises on knee osteoarthritis, may be effective in reducing pain and improving knee function. It is unclear which one of the two treatment options is more effective as both of them increased the quality of life parameters.

On the other hand, there is quite a wide space for the investigation of the efficacy of several other treatment options in patients with knee OA. This study did not include other treatment options that could be used in addition with the strengthening exercises such as manual therapy, tecar therapy, ultrasound, TENS, Laser etc. It is uncertain if we could use those outcomes on the general population because our sample was small with several exclusion criteria.

BMI score was not taken into account in this study. It is known that body weight is crucial in OA knee condition and individuals with knee OA benefit a lot from losing weight (12). It is therefore very important in future studies to include BMI scores in their investigation.

Greater pain and disability were reported by women with symptomatic knee. A possible scenario is that a greater portion of patellofemoral disease occurs in women compared with men.

There is no other studies that compare closed and open chain exercises. This study opens a window for further investigation in this section of rehabilitation and is important to determine which of those two forms of exercise is more effective for specific conditions such as overweight people or patients with or without knee injury in the past.

Another important issue of consideration is if the exercise protocols give us better or not outcomes in patients with active lifestyle.

Finally, the role and the effectiveness of exercise in knee OA is undoubtedly important, and even mild exercise is better than no exercise at all. Future investigations will probably determine which protocol is preferable for knee OA research.

CONCLUSION

Based on our study outcomes, exercise alone has the ability to reduce pain and knee function in individuals with knee OA. It is unclear if open or closed chain is more effective. It is a guideline that exercise must be included in the treatment of knee OA.

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