

# The Role and Types of Strengthening Exercises in OA knee: A Narrative Review

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## Abstract

**Objectives:** To give an overview on the existing literature about role and types of strengthening exercises for treatment in OA knee.

**Method:** Meta-analysis/ summative reviews/ RCTs exploring various forms of exercises, with a focus on the strengthening exercises, published between 2000-2017 were reviewed using narrative approach

**Result and conclusion:** All forms of strengthening exercises appeared to positively influence pain and physical function with an improvement of Quality of Life. Exercises on land were more effective in strengthening than those done in water, though the latter presented with lesser adverse effects. Specific muscle strengthening was more beneficial as compared to entire lower limb or general strengthening exercises. There was inadequate literature on the dosage of the exercises.

**Key words:** Exercises, Strength training, strengthening, Osteoarthritis knee.

## Introduction

OA is second most commonly seen rheumatologic problem worldwide [1]. As per recent study, prevalence of knee OA in India is 28.7% [2]. As life expectancy is increasing, the number of individuals with OA is also increasing. It is the 4th leading cause of years lived with disability (YLD) leading to 3% YLD in total [1,2]. Individuals with OA knee commonly report handicap in functional and social activities, relationships, socio-economic status, emotional well-being and body image [3].

During past decade lot of emphasis has been given on non-pharmacological management of this condition. Strengthening exercises have emerged as an effective treatment modality to reduce these impairments and enhance QOL in such individuals. However there seem to be lot of variety in content/types and dose of the rehabilitation protocols suggested for OA knee. This makes it difficult for the therapist to choose the most appropriate type of exercise while rehabilitating an individual with OA knee.

Present narrative review tries to address this aspect with the focus on answering following questions-

1. What is the role of strengthening exercised in OA knee?
2. What is the supporting evidence regarding muscles to be strengthened in OA knee?
3. Which types of strengthening exercises are prescribed in OA knee individuals?
4. What is the most appropriate dosage for exercise prescription OA knee?
5. Are there any adverse effects/precautions/contraindications for exercise prescription in OA knee?

## Methodology

Electronic data bases (Medline, PEDro, CINHAL, PubMed, EMBASE) were searched with key words strengthening, OA knee, exercises, protocols, types by two independent researchers.

Following qualities were considered for eligibility of article to be included in study –

- Study type-Meta analysis/ summative reviews/ RCTs.
- Study characteristics-full citations and reasoning for methodology, mentioning of relevant articles, safety information, Effect size, exercise protocols and annexure description, published between 2000-2017.
- Interventions given-strength training by supervisor or at home, land based exercises and alternate exercise types, interventions

along with exercises, at least 4 weeks of intervention duration.

- Participants characteristics-both gender, expert/radiological diagnosis of OA knee.
- Outcomes included-WOMAC, KOOS, pain rating, walking capability, chair stand test, radiological representation, biomechanical/ biochemical markers.

References of studies qualifying inclusion criteria were checked for additional articles meeting inclusion criteria. Studies without blinding, case series and those comprising individual with co morbidities were excluded. Total 82 studies were found out of which 38 were reviewed. These studies were categorized according to study questions and were reviewed in narrative way.

## Evidence for proposing strength training in OA knee-

Literature search indicated no dearth of evidence suggesting the beneficial role of engaging in a structured exercise regimen [4]. Different forms of exercise demonstrate high benefit and lower risk scores when compared to the other non pharmacological interventions used in treatment of OA [5,6]. Most of the studies emphasized teaching regular, individualized exercise regimen with use of biopsychosocial approach towards initial assessment and management for treatment in case of hip and knee OA [4-20]. Exercises (irrespective of the form) are highly

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recommended for short term benefits on pain and physical function. Guidelines from the American College of Rheumatology (ACR), European League Against Rheumatism (EULAR), MOVE consensus, Osteoarthritis Research Society International (OARSI) are consistent in recommending aerobic exercise, muscle strengthening, and preservation of joint mobility as central components of the non pharmacologic approach to the treatment of knee OA. Further, these guidelines stress that there are no statistical differences in the benefits derived from pharmacologic and non pharmacologic modalities in the treatment of knee OA [5-9,21,22].

### **Role of Strength training in knee OA**

High intensity, home based strength training can produce substantial improvements in strength, pain, physical function and quality of life in patients with knee OA [23]. A review of 18 RCTs concluded that, participation in a resistance training program can potentially counteract the functional limitations seen in knee OA. Over 50–75% of the studies included in this review found knee OA symptoms, physical function, and strength to be improved in clinically meaningful ways with resistance training when compared with usual care [12, 4]. Improved cartilage properties (glycoseaminoglycans release) due to strengthening may be the reason for positive symptomatic effects of exercises in OA individuals. A study done to evaluate the efficacy of moderate, supervised exercise showed an improved knee-cartilage GAG content in patients at risk of OA also suggested the same [24].

### **Which muscles to strengthen?**

Quadriceps strength was observed to be 22% greater in women without radiographic osteoarthritis than in women with osteoarthritis in a previous study. It also concluded that, quadriceps strength decreases as osteoarthritis severity increases [25]. Studies endorse quadriceps weakness as a common clinical sign in persons with moderate-to-severe osteoarthritis and results in physical disability [2,3]. It is found to be one of the primary risk factors for knee pain, disability and progression of joint damage in person with OA knee [25]. According to one study, quadriceps strengthening also appeared

to prevent incident radiographic change or slow the progression of knee OA [10]. A program focusing on quadriceps strengthening yielded the greatest effect on physical function. Medium effects were seen for exercise programmes that employed general lower limb strengthening and strengthening combined with aerobic exercise. Small benefits were detected for walking exercise programmes [9]. Studies investigating the effects of strengthening in patients with knee OA have generally focused on improving quadriceps strength.

### **The role of the hip musculature**

Little attention has been paid to other lower limb muscle groups such as the hip abductors and adductors. The hip muscle strength has the potential to alter knee load and hip abductor muscle weakness may result in impaired frontal-plane pelvic control during gait, leading to greater medial compartment loading in people with knee OA. A recent longitudinal cohort study found that people with a lower external hip adduction moment (suggesting weaker hip abductor muscles) demonstrated more rapid knee OA progression [26]. Another study reported a significant isometric strength deficit for all hip muscles in people with symptomatic medial knee OA when compared with asymptomatic controls. This finding supports the inclusion of hip strengthening exercises in rehabilitation programs [27]. One study endorsed importance of hip abductor-adductor strength for reducing knee adduction moment [28]. Contrary to above reports, two studies reported enhanced symptomatic relief and functional improvement with hip muscle strengthening (when compared to a control group with no intervention) but it did not affect medial knee load as measured by the knee adduction moment [29, 11]. Thus, it is questionable if hip muscle strengthening influences structural disease progression or it helps just to enhance function. One needs to be cautious while using this information as it remains unclear if hip muscle weakness precedes the onset of knee OA or occurs as a consequence of disease. A systematic review highly recommended a regular, tailor made exercise regimen that includes strengthening (sustained isometric) exercise for both legs concentrating on

quadriceps and proximal hip girdle muscles (irrespective of site or number of large joints affected) [5].

### **Types:**

The current review presents with a variety of direct and indirect methods by which strengthening can be brought about.

### **A. Land Based Exercise Regimens**

Lower limb muscle strengthening and general aerobic exercise were recommended by most international guidelines [8,22,9]. High-quality evidence suggested that, land-based therapeutic exercise provide benefit in terms of reduced knee pain and quality of life and moderate-quality evidence of improved physical function among people with knee OA [9].

#### **a) Dynamic or static**

Dynamic or isotonic training was the most common exercise modality. Machine-based resistance training, free weights Therabands, and/or other items around the home (chairs, stairs, etc.) were used in most of the studies [12]. Another study suggested the use of isotonic exercises in initial phase and isokinetic exercises in later stage of rehabilitation to enhance walking ability [18].

#### **b) Weight bearing or non weight bearing**

Two other studies compared different strengthening regimens: weight bearing quadriceps exercises versus non-weight bearing quadriceps exercises in one study and concentric-eccentric strengthening exercises versus isometric strengthening exercises in the other [15,14]. Neither of the studies found significant differences between types of strengthening exercises [9]. In individuals with knee OA, performance of exercises in weight bearing has the potential to aggravate symptoms (pain, swelling, and inflammation) due to excessive loading of the knee joint [2,15]. This may also be a reason for the higher drop out rates among patients with OA knees subjected to high intensity of exercises in the weight bearing position.

#### **c) non weight bearing strength training or proprioceptive training**

In a comparison of Non Weight Bearing program, Proprioceptive training was found to be superior to enhance neuromuscular function, most notably joint reposition sense

and walking speed on a spongy surface. Strength Training was demonstrated to be more effective to improve knee extension strength and functional performance, including going up and down stairs [30].

#### e) Land based vs aquatic

In a RCT comparing land and aquatic exercises, it was found that only land-based exercise showed some improvement in pain and muscle strength compared with the control group, while no clinical benefits were detectable after aquatic exercise compared with the control group. However, aquatic exercise had significantly less adverse effects compared with a land-based programme [13].

#### f) Aerobic walking vs home based exercises

A systematic review of RCTs comparing aerobic walking or home based quadriceps strengthening exercise with a non-exercise control group found that both, aerobic walking and home based quadriceps strengthening exercise reduce pain and disability from knee osteoarthritis but no difference between them was found on indirect comparison [19].

#### B. Water Based Exercise Regimens

A systematic review of Randomised controlled trials or quasi-randomised clinical trials showed that Aquatic exercise appeared to have some beneficial short-term effects for patients with hip and/or knee OA while no long-term effects have been documented [31].

##### a) Hydrotherapy or land based-

In a RCT it was observed that, hydrotherapy was superior to land based exercise in relieving pain before and after walking during the last follow-up. Water-based exercises are a suitable and effective alternative for the management of OA of the knee [16].

##### b) Hydrotherapy or gym based exercises

Another study concluded that, hydrotherapy group had significantly enhanced scores for distance walked and the physical component of the SF-12 as compared to gym group which improved significantly greater in walk speed and self efficacy satisfaction [32].

In summary, it appears that both land and water based exercises are effective but address different components of physical function [17].

#### C. Alternate methods

##### a) taichi –

A prospective, single-blind, randomized controlled trial of 40 conducted to evaluate the effectiveness of Tai Chi in the treatment of knee OA reported reduced pain and improved physical function, self-efficacy, depression, and health-related quality of life without severe adverse events [33]. It may be added that it yielded small benefits due to the lower intensities involved or due to limited focus on specific muscle groups [9].

##### b) Yoga-

Results of a pilot study suggested that yoga may provide a feasible treatment option for previously yoga-naive, obese patients >50 years of age and offers potential reductions in pain and disability caused by knee OA [34].

#### D. Adjuncts

A meta analysis of eight randomized controlled trials including Traditional Chinese Exercises (TCE) showed that short-term TCE could relieve pain, improve physical function and alleviate stiffness but had no significant effect on quality of life and mental health. Moreover, TCE was not associated with serious adverse events and hence can be used as an adjunct [35].

An integrated therapy dealing with the extra- and intraarticular progressive pathologic changes using isokinetic exercises alone, in combination with pulse ultrasound with and without intra articular hyaluronan therapy was found to be effective on the functional status of patients with knee osteoarthritis(OA) when compared to a control group [18]. The above finding was substantiated by another study where it was found that US treatment could increase the effectiveness of isokinetic exercise for functional improvement of knee OA, and pulsed ultrasound has a greater effect than continuous US [36].

Another study concluded that a combination of manual physical therapy and supervised exercise yields functional benefits for patients with osteoarthritis of the knee when compared with a placebo therapy of ultrasound. The authors proposed that this may delay or prevent the need for surgical intervention [37]. Adding manual mobilisation may be helpful to optimize effects obtained from supervised active

exercise programs [38].

A recent RCT showed no significant additive effect of electromyograph (EMG) biofeedback to strengthening exercise for pain, function and muscle strength in 40 participants with knee OA [39].

#### DOSAGE of exercise

Exercise 'dosage,' i.e frequency, intensity and program duration, varied considerably in studies searched for this review.

A valuable guideline to address this aspect comes in the form of a meta-analysis of 48 RCTs where it was concluded that, exercise therapy programs focusing on a single type of exercise are more efficacious in reducing pain and patient-reported disability than those mixing several types of exercise with different goals within the same session [20].

One explanation of the disadvantage of mixing types of exercise with different goals within the same session may be the molecular response, where resistance training increases the myofibrillar protein response and aerobic exercise increases the content of mitochondria in the muscle. This molecular response decreased when both aerobic and resistance exercise were performed within the same session [40]. Thus one needs to be sure of the response expected while prescribing any form of exercise.

#### Intensity

Only one study compared effect of high and low resistance training on functional outcomes where, although both types of exercises enhanced function, there was no statistically significant difference in efficacy of exercises based on intensity in the participants of both groups [41].

As per EULAR guidelines, a person should exercise 'small amounts often' starting with levels of exercise that are within the individual's capability, and building up the 'dose' sensibly over several months [5].

#### Duration

Training sessions included in a systematic review lasted between 10 and 60 minutes, although most studies did not report the duration of each session [12]. Thus this field needs to be explored in future to determine exact duration which will be beneficial for enhanced functioning in OA individuals.

### Frequency

Three training sessions per week was most commonly prescribed but the range was from 2 to 7 sessions per week [20, 12]. This area needs further exploration for deciding correct frequency of exercises while prescribing a program.

### Safety and Contraindications

Some therapists raise the concern of accelerated rate of joint degeneration due to increased activities. A systematic review of RCTs highlighted the evidence that, moderate level exercises do not cause such adverse effects [7].

None of the studies reported any safety issues or adverse effects. Only one study reported increase in pain intensity with high resistance training [41]. As per MOVE consensus, strengthening exercise appear to be a safe intervention and the number of contraindications are relatively few and appear to be more relevant for patients with cardiac diseases rather than OA [4].

### Long term effects

Very few studies tried to observe long term effects of exercises after cessation of active intervention. Two studies stated that, pain relief and physical function reduces with time

at a variable rate and is not sustained in the long term (beyond 6 months) [7, 42]. A study reported positive influence of additional booster sessions after the treatment period maintenance of beneficial post treatment effects in the long term [42].

MOVE consensus also suggested adherence as an important predictor for encouraging long-term outcome from exercise in patients with knee or hip OA. EULAR and OARSI reviews also suggested dearth of literature exploring long term effects of strengthtraining in OA knee individuals [4,5,7].

### Conclusion

1. Healthcare professionals and people with OA can be reassured that any type of exercise program done regularly monitored closely by healthcare professionals can improve pain and physical function related to knee OA in short term.
2. Exercise program should be individualized to achieve better results.
3. Exercise focusing on knee extensor muscle strength only may increase the benefits of resistance training than programs aimed at improving general lower limb strength.
4. Inclusion of strengthening exercises for the postero-lateral hip muscles is beneficial in improving pain and physical outcome

measures even though its influence on the biomechanical loads is questionable.

5. Beneficial effects obtained from the strengthening exercises are likely to be influenced by the presence of a deformity, especially knee varus.
  6. Consideration must be given to patients' preference and expectations from the strength training program. Availability, feasibility and cost effectiveness of the equipment needs to be considered.
- Identification of barriers and facilitators for adherence to exercise and addressing them in order to gain maximum and long term benefit from prescribed exercise program is important. Support from family and friends, electronic feedback, self-monitoring or linking exercise regimens to other daily activities can be used as an adjunct to ensure adherence to exercises.

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