

Review Article

## Role of physiotherapy in post-operative knee stiffness: A literature review

Rajjat Kumar<sup>1</sup>, Kavita Kaushal<sup>1</sup>, Simratjeet Kaur<sup>1</sup>

<sup>1</sup>College of Physiotherapy, Adesh University, Bathinda, Punjab, India.



\*Corresponding author:

Simratjeet Kaur,  
College of Physiotherapy, Adesh  
University, Bathinda, Punjab,  
India.

[drsimrat20@yahoo.com](mailto:drsimrat20@yahoo.com)

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### ABSTRACT

**Objectives:** Restricted motion range, also known as knee stiffness, is one of the significant complications after intra-articular or extra-articular injury. Postoperatively, it is primarily due to articular fibrosis (intra and extra) and scarring adhesions in the quadriceps-femoral apparatus after ligament reconstruction, patellar tendon repair, burn, and total knee arthroplasty. Knee stiffness is both preventable and treatable with physiotherapy treatment. Physiotherapy includes electrotherapy and exercises therapy playing an important role in reduction of knee stiffness. The aim of the present study to survey the existing literature related to exercise therapy and electrotherapy programs for the management of post-operative knee stiffness.

**Materials and Methods:** A computerized search of the ELSEVIER, PubMed, and Medline database was conducted for year 2008 onward. The search was performed using English language.

**Results:** Based on the literature survey undertaken, the best approach for efficient recovery is to plan and start treatment regime preoperatively that should be continued until achieving knee symmetry postoperatively.

**Conclusion:** The findings of the current study support that both electrotherapy and exercise interventions play a significant role to overcome the consequences of post-operative knee stiffness. In addition to it, literature enlightens that advanced techniques such as unique sustained method and Graston technique are much more beneficial and advantageous over traditional and conventional methods of physiotherapy treatment to manage post-operative knee stiffness.

**Keywords:** Knee stiffness, Rehabilitation, Total knee arthroplasty, Physical therapy

### INTRODUCTION

Restricted motion range, also known as knee stiffness, is primarily due to intra- and extra-articular fibrosis and scarring adhesions in the quadriceps-femoral apparatus.<sup>[1]</sup> Causes of post-operative knee stiffness include anterior cruciate ligament (ACL) reconstruction, total knee arthroplasty (TKA), and arthrofibrosis of the knee, other musculoskeletal injuries involve the knee joint, patellar tendon repair, knee arthrotomy, and burn.<sup>[2]</sup> TKA is considered the gold standard treatment for end-stage knee osteoarthritis, but recovery is variable and most of the patients complained and demonstrate lower extremity muscle weakness, post-operative stiffness, and functional limitations.<sup>[3]</sup> Exaggerated pathologic fibrous hyperplasia (arthrofibrosis), that is, the possible cause of post-operative knee stiffness is a debilitating complication of surgery that can limit the accessory joint motion, activation of muscles and lead to overall decrease in physiologic range of motion (ROM).<sup>[2]</sup> Affected quadriceps-femoral

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relationship results into loss of knee flexion and extension movements that alter gait pattern. This, in turn, affects the ankle and hip limiting functional squatting resulting in stair climbing, running, jumping, as well as sitting.<sup>[4]</sup> Hence, the purpose of this literature is to explore the strong evidence for effectiveness of specific post-operative physiotherapy rehabilitation program to reduce post-operative knee stiffness.

## PREVALENCE OF POST-OPERATIVE KNEE STIFFNESS

European study collected samples from 21 countries showed that recently TKA procedures number increased to 109/100,000 persons, that is, more than double the numbers reported in 1998 and by 2030 the demand for primary total knee arthroplasties is projected to grow by 673% to 3.48 million procedures among US Population.<sup>[3,5]</sup> Hence, there are number of problems arise due to immobilization of knee after surgical procedures such as altered ROM, reduced functional ability, poor quality of life due to restricted ADLs, knee instability, pain, reduced flexibility, as well as strength, poor balance, abnormal gait during walking, and affected proprioception.<sup>[6]</sup> The physiotherapist can act as a facilitator to achieve and restore the lost movements of knee joint up to full extent. Hereby, an attempt is made to review all the available physiotherapy interventions to understand and evaluate the effective intervention protocols for outpatient and in-patient rehabilitation after TKA. The study will also attempt the gauge the effectiveness of post-operative outpatient care on short- and long-term functional recovery.

## METHODOLOGY

Search strategy – the articles were searched from PubMed, Elsevier, and Medline that were published or available online from 2008 onwards.

Each search included terms such as exercise, physical therapy, rehabilitation, post-operative knee stiffness, knee arthroplasty, and physiotherapy. The abstracts of the studies were studied to decide about inclusion of the article in our study.

Study selection – articles were eligible if they included: (1) Post-operative knee stiffness, (2) post-operative physiotherapy/rehabilitation protocols, and (3) systematic review, clinical suggestion, a literature review, clinical commentary, case report, prevalence, and original articles.

Type of post-operative rehabilitation influences short- and long-term functional outcomes.

In this article, studies from 2008 onwards were included and available interventions for post-operative knee stiffness management given in the reviewed articles are as follows:

## PHYSIOTHERAPY INTERVENTIONS FOR POST-OPERATIVE KNEE STIFFNESS: RELEVANT STUDIES AND LITERATURE ANALYSIS

There are several popular methods for rehabilitation of post-operative knee stiffness and the rehabilitation paradigms are often physiotherapist specific, but none of the method is universally accepted. None of the following studies discusses the parameters of specific rehabilitation techniques, but the common goal is to suggest whether physiotherapy is significant or not in post-operative stiffness.

A literature reviewed by Bistolfi *et al.* explored some relevant clinical studies that include randomized blinded study, a sequential cohort study, a pilot randomized clinical trial that shows that physiotherapy is useful before and after total knee replacement. The study also reviewed that neuromuscular electrical stimulation (NMES) may be applied both pre and postoperatively to improve strength in quadriceps muscle after total knee replacement, but parameters must be considered before the application. A longitudinal randomized control trial (RCT) revealed that NMES when applied to quadriceps muscle 2 times a day with 15 contractions had significantly improved quadriceps muscle, hamstring muscle strengths, and knee extension ROM when assessed after 3.5 weeks after surgery.<sup>[7]</sup> The other specific rehabilitation technique showed by RCT and clinical trial is whole body vibration that is used to improve muscular strength, increase in counter movement and to gain postural control in patients having low extremity weakness. The other technique explored in literature is continuous passive motion (CPM), in which an external motorized device passively moves the knee joint through a preset desired arc of motion. Authors of RCT suggested that patients who received CPM immediately in the recovery room after TKR had significantly gained in the active and passive flexion ROM as compared to patients who received CPM 1<sup>st</sup> day after surgery. However, systematic review indicated that CPM had small, short-term effects on active and passive knee flexion ROM and no evidence support the presence of long-term effects of CPM on active or passive knee extension ROM, pain, swelling, and quadriceps strength.<sup>[8]</sup>

The other rehabilitation technique reviewed by authors is hydrotherapy that showed improved functional outcome such as decrease in pain, stiffness, and functional impairments when received by patients for 6 months after TKA. Two literature reviews discussed the effectiveness of cryotherapy to reduce blood loss, gain in pain reduction, and reduction in swelling and to improve early knee flexion when applied on day 2 postoperatively. In addition to it, two controlled trials demonstrated a positive effect of pulsed electromagnetic field therapy (PEMF) in the 1<sup>st</sup> month after surgery explained that PEMF has an anti-inflammatory effect (through A22 adenosine receptors) that results into reduction in pain and swelling in patients underwent TKA.<sup>[9]</sup>

The article presented by Shah explained a very unique method to increase knee flexion and extension ROM. After ACL reconstruction, total knee arthroplasties, arthrofibrosis of the knee results into decreased flexion and extension ROM due to post-operative stiffness. In addition to it, limited ROM leads to complications such as abnormal gait pattern, limited functional squatting, running, jumping, and sitting that are necessary for ADLs and sport-specific activities. Thus to solve these problems, Shah presented a unique technique that is cost effective, requires minimal equipment, less time consuming, and convenient for the therapist also. The technique is as follows:

### Knee extension

To improve knee extension, instruct the patient to lie in supine position on the plinth. Then make sure that level of plinth should be low enough to attain maximum of 0° knee extension. Then, tie a mobilization belt around the knee by safely keeping a towel at distal surface of shaft of femur or just superior to patella. After that plinth must be raised very slowly until sustained force is applied to attain desired range of knee extension. The author suggested that 1–2 min of duration is sufficient initially and can be progress by 5 min according to patient's tolerance. If one wants to achieve extension ROM greater than 0, then a foam roll can be paced under the patient's ankle.<sup>[4]</sup>

### Knee flexion

To improve knee flexion, instruct the patient to maintain prone lying position by placing pillow beneath stomach, towel around shoulder and ankle for patient's comfort. Then, use two mobilization belts and strap one end around the ankle then pass it over the patient's shoulder and finally attach to lower part of hydraulic plinth. Then, physiotherapist will slowly raise the plinth to gain 10–120° of flexion. Again, the duration will be same as for knee extension and progression in the duration as well as in sustained force will be according to the patient's tolerance level. Once the desired amount of ROM is achieved, then only one mobilization belt is strapped/attached to the table instead of patient's shoulder to achieve ROM more than 120°.<sup>[4]</sup>

In another case study, Douglass found that the use of Graston technique to breakdown soft-tissue adhesions after knee arthrofibrosis and after patellar tendon repair has significantly improved knee ROM and quadriceps activity. Graston technique is soft-tissue mobilization method that is applied with the help of stainless steel instruments. These instruments get adapted according to shape of tissues to release scar tissue, adhesions, and fascial restrictions. Hence, this is the kind of transverse frictional massage that is used to promote a local hyperemia, analgesia, fibroblastic

response, and healing. In this case study, GT was applied in conjunction with traditional physiotherapy care that included patellar mobilization and quads sets on the day of surgery, ROM exercises 7 day postoperatively, CPM 2–6 h 7 days postoperatively, joint mobilization (30 oscillations), interferential current along with ice pack to control edema and pain, and home exercise program.<sup>[7,10]</sup> At the last visit after 5 weeks period, patient gained 28° of passive ROM and 17° of active ROM and there was decreased extensor lag by 19°, and finally, patient was able to ambulate on even surfaces without assistive devices or braces.<sup>[2]</sup>

A systematic review of controlled trials by Joseph *et al.* identified the effectiveness of post-operative interventions that included strengthening exercises, aquatic therapy, balance training, and clinical environment on reducing impairments following TKA. Studies included patients who underwent unilateral TKA, unicompartmental, or TKA with average age ranged from 65 to 73 years. Author explored that progressive strengthening protocol with or without NMES significantly improved quadriceps strength when compared to one RCT study that received only functional training in standard rehabilitation. Studies evidenced that intensive rehabilitation protocol significantly improved 6 min walk, western Ontario and McMaster universities arthritis index, and pain score when assessed at 4<sup>th</sup> and 6<sup>th</sup> month post-TKA.<sup>[11]</sup> Evgeniadis *et al.* reported that 8-week supervised strengthening home program had significantly improved knee flexion and extension ROM as compared to control group who received only inpatient rehabilitation.<sup>[12]</sup>

Valtonen *et al.* reported that subjects who received 12 weeks of a water-based resistance exercises significantly improved knee flexion and extension strength, walking speed, and stair climbing speed as compared to the subjects who did not receive any exercise interventions.<sup>[13]</sup>

Another study by Piva *et al.* reported that 6 weeks of balance training in combination with intensive functional rehabilitation program had significantly improved gait speed by 8%, single leg stance time by 24%.<sup>[14]</sup>

Authors have explored that subjects who received 12–18 months home-based, outpatient (clinical based) rehabilitation program, telerehabilitation program, and multidisciplinary rehabilitation all were having almost similar effect on knee ROM, leg extensor power, gait speed, walk test, and knee extension torque.<sup>[3]</sup>

A review presented by Rudavsky and Cook discussed the physiotherapy strategies that are effective for pain management, strength gain, and prevention of secondary complications in case of patellar tendinopathy. The author suggested that sustained isometric contractions for 45 seconds 2 times/day with four repetitions have a large hypoalgesic effect. In addition to it, if one wants to improve

strength; heavy slow (isotonic) resistance with 4 sets, 6–8 repetitions for 3–5 times/day, walk lunge with body weight, stair walking, split squats, faster stairs, and skipping exercises can significantly improve functional strength and power. For energy storage, combined exercises with concentric, eccentric, and plyometric training at set intensity and frequency for 6 weeks can be recommended for endurance training in case of tendinopathy of knee joint.<sup>[15]</sup>

## DISCUSSION

The literature discuss that post-operative ACL reconstruction, TKA, patellar tendon repair, and various arthroscopic surgeries cause loss of knee ROM, gait impairments, and other musculoskeletal dysfunctions. Hence, to overcome all these primary as well as secondary post-operative complications, research supports the unique method of sustained force to increase knee ROM. The advantage of technique explained by Shah is that it is cost effective, requires basic equipment, less time consuming, and provides sustained and consistent force without causing fatigue to therapist. However, on the other side, limitations of this technique are that sustained force is not considered appropriate for every stage of healing and for every subject and this technique does not address specific joint glide which may alter the outcomes adversely.<sup>[4]</sup> Basic or traditional physical therapy interventions may be ineffective to improve knee ROM after post-surgical knee arthrofibrosis. Addition of GT along with standard physical therapy has significantly improved physiologic and accessory movements of patella-femoral and tibiofemoral joint. Authors discuss that with the help of GT technique, we can deal with post-surgical adhesions, extensor lag, and quadriceps muscle inhibition.<sup>[2]</sup> Literature shows that to obtain better and faster outcomes, early knee mobilization should be apply as soon as possible to prevent stiffness, DVT, and other secondary complications. Moreover, studies recommend that intensive rehabilitation and pre-rehabilitation (pre-operative ROM) program must be incorporated and considered as first treatment to reduce post-operative knee stiffness.<sup>[9,16,17]</sup>

## CONCLUSION

Based on the findings from this review, the standard and optimal physical therapy program should include strengthening, intensive functional exercises, aquatic exercises, electrotherapy interventions (NMES, interferential therapy currents), and advanced techniques. It is recommended that outpatient physical therapy, home-based physiotherapy treatment, occupational treatment, supervised therapy, telerehabilitation, and pre-rehabilitation protocols can be planned according to the stage of healing as well as according to the short- and long-term goals that therapist wants to achieve.

The findings of the current study support that both electrotherapy and exercise interventions play a significant role to overcome the consequences of post-operative knee stiffness. In addition to it, literature enlightens that advanced techniques are much more beneficial and advantageous over traditional and conventional methods of physiotherapy treatment to manage post-operative knee stiffness. On the other side, the literature determines that the exercises performed under physiotherapist supervision are much more effective as compare to home-based treatment.

## Future scope of study

Most of the studies do not have specific standardized physiotherapy and rehabilitation protocols; therefore, controversies remain regarding the choice and effectiveness of different techniques. There is a need for well-designed RCTs to assess the effectiveness of specific techniques according to stage of healing which are recommended on larger sample size.

The need for further research in these areas is apparent. In other word, there is a need to analyze the effectiveness of certain exercise techniques over others, specifically in relation to attaining short-term and long-term goals.

## Declaration of patient consent

Patient's consent not required as there are no patients in this study.

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## Conflicts of interest

There are no conflicts of interest.

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