

EFFECTIVENESS OF PHYSIOTHERAPY INTERVENTIONS FOLLOWING PRIMARY UNILATERAL TOTAL KNEE ARTHROPLASTY: A SYSTEMATIC REVIEW OF RANDOMISED CONTROLLED TRIALS

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ABSTRACT

Osteoarthritis (OA) is a degenerative disease that affects the weight bearing joints and prevents individuals from participating in activities of daily living and work. Osteoarthritis of the knee causes significant pain along with deterioration in function and mobility, with a higher prevalence in athletes and the elderly (65 years). Knee replacement in its various forms is the most common surgical treatment for osteoarthritis, and the number of knee replacements performed each year has increased in parallel with the increasing incidence of OA. The goal of this systematic review is to establish whether physiotherapy interventions have specific efficacy in the management of TKA, based on published studies. PEDro, Science Direct, PubMed, EBSCO host and Cochrane Library databases were searched from inception to 2nd March 2022. The study uses clinical or controlled trials in which some form of physiotherapy treatment was used to treat TKA. 10 studies were included in this review. One virtual reality-based rehabilitation was investigated, in 5 studies a combination of various exercises was investigated, in 2 studies cryotherapy, CPM & MI training was investigated respectively & one study was on mid vastus technique & Para patellar approach was investigated. Despite its present popularity and widespread use, the research on the use of Active assisted cycle ergometry, virtual reality-based rehabilitation, and specialised hip-strengthening exercises for total knee arthroplasty has inconsistencies. While the quality of evidence for acupuncture with low-level laser therapy and motor imagery training is

moderate, the degree of evidence for core stability exercises, isometric quadriceps workouts with auditory and visual feedback varies from moderate to high in quality.

Keywords: Acupuncture with low-level laser therapy-ALLT, Behavioural Regulation in Exercise Questionnaire-BREQ2, Continuous passive motion-CPM, Functional Independence Measure-FIM, Hospital Anxiety and Depression Scale- HADS, Motor imagery-MI, Movement Imagery Questionnaire-MIQ-3.

1. Introduction

Osteoarthritis (OA) is a degenerative disease that affects the weight – bearing joints and prevents individuals from participating in activities of daily living and work. Osteoarthritis of the knee causes significant pain along with deterioration in function and mobility, with a higher prevalence in athletes and the elderly (≥ 65 years). (Lim & Thahir, 2021)

Around 13% of women & 10% of men who are 60 years of age or older have symptomatic knee OA. Due to population ageing and the prevalence of obesity or overweight in the general population, the proportions of people with symptomatic knee OA are projected to rise. (Heidari, 2011)

Knee OA affects the 3 compartments of the knee joint (medial, lateral and patellofemoral joints) and usually develops slowly over 10 to 15 years and interferes with activities of daily living. Classically, it was thought that articular cartilage damage was primarily caused by the —wear and tear of ageing & had nothing to do with inflammation. It is acknowledged that knee OA has a complex origin, despite the fact that the disease's mechanism is still poorly understood and under investigation. (Lespasio et al., 2017)

Traditionally, a method that assigns points to radiographic findings thought to be indicative of osteoarthritis has been used to gauge the condition's severity. However, there is a poor correlation between radiographic osteoarthritis and pain and clinical symptoms, especially at the knee. Some of these issues may be related to scoring system issues (such as the exclusion of patellofemoral views), but this does not seem to be the complete picture since research reveals that a variety of different characteristics may be significant predictors of pain in osteoarthritis. (McAlindon et al., 1993)

Studies have shown that osteoarthritis manifests itself differently in women than in men and can disproportionately affect certain parts of the knee. This is particularly evident in the patellofemoral joint, where isolated patellofemoral arthritis is more common in women than in men. (Hame & Alexander, 2013)

Knee replacement surgery in its various forms is the most common type of surgery for osteoarthritis, and the number of knee replacement surgery performed each year has climbed in lockstep with the rising prevalence of the disease. Total knee replacement (TKR) is the most common type of knee replacement, in which the entire knee joint is removed and rebuilt, although around 10% of knee replacement surgeries are partial, in which only the affected portion of the knee joint is replaced. (Liddle et al., 2013)

The HRQoL of those who suffer from disabilities is improved by TKR. However, sociodemographic or clinical traits like gender or obesity, as well as surgical factors, may have an impact on results. (Nunez et al., 2007)

Physical therapy is an important element of total knee arthroplasty treatment since it improves functional results and enables patients to resume to their daily activities. (Moffet et al., 2015) Early ROM restoration and patient mobilisation are the main goals of rehabilitation following TKA. Despite the absence of clear scientific data, CPM has been frequently employed as part of postoperative therapy following TKA with the goal of promoting postoperative healing and increasing knee joint mobility. (Mau-Moeller et al., 2014)

Young age, recovered sensitivity, radiographic evidence of mild to moderate wear of the knee, and the lack of a degenerative meniscal tear are all factors that suggest a favourable prognosis for early recovery of pain and function after joint arthroplasty. Methods of movement representation may be useful in the early stages of TKA recovery, when mobility and physical function are both compromised. MI which is described as a dynamic mental process that involves the internal representation of an action without its actual motor performance, is one of the most common motion representation approaches utilized in rehabilitation. (Ferrer-Pena et al., 2021)

Cold treatment can be applied externally near joints using a variety of materials, including ice, cooled fluids, cooled air, or cooled gas. Local cooling has the advantages of being accessible to everyone and having minimal expenses. The cooling procedure helps to reduce the intra- operatively generated soft tissue damage to all involved anatomical structures during surgical intervention of the knee joint. (Sadoghi et al., 2018)

NMES is a novel technique for reducing quadriceps muscle voluntary activation deficiencies and preventing muscular atrophy early after surgery, perhaps restoring normal quadriceps muscle function more effectively than voluntary exercise alone. (Stevens-Lapsley et al., 2012)

Based on available studies, the goals of this systematic review is to determine whether physiotherapy interventions have specific efficacy in the management of TKA.

The goal of this study was to gather relevant material and develop important conclusions on the efficacy of physiotherapy treatments in patients with unilateral primary total knee arthroplasty. And which interventions are superior to the others. This research will aid in establishing the most effective and efficient physiotherapy methods for the treatment of primary TKA, hence saving time and resources for both the therapist and the patient. This treatment can be employed in the clinic because it is more convenient, safer and simple to carry out.

2.1 Epidemiology

Hafez et al., 2014 suggest that most common type of joint disease is osteoarthritis (OA) of the knee, which is both radiographically evident and symptomatic, according to the study. Females are more likely to be impacted than males (11.45% vs 6.8%). A recent meta-analysis underlined the gender gap in prevalence, showing evidence for a greater risk of both prevalent and incident knee OA in women. According to the meta-analysis, females had more severe knee OA radiographically assessed than males, and gender inequalities rise with age >55 years. The prevalence of OA will climb as the kingdom's population ages, especially if the obesity rate in the 45+ age group remains above 50%.

2.2 Risk factors

Heidari in 2011 stated that old age, female gender, overweight & obesity, knee injury, repetitive joint use, bone density, muscle weakness, and joint laxity are all factors that contribute to the development of joint OA. As measured by BMI, mechanical stresses acting on joints are a key cause of OA and one of the most modifiable risk factors (BMI). Symptomatic sickness and impairment are associated to female sex, lower educational levels, obesity, and a lack of muscular capacity. Knee OA is more common in people who squat often. Nearly 40% of men and 68% of women under the age of 25 said they squatted for an hour every day. In the elderly, squatting for long periods of time is a significant risk factor for tibiofemoral knee OA. 69 percent of knee arthroplasty cases and 27 percent of hip arthroplasty cases might be due to obesity. Obesity was consistently found to be the primary contributing factor to knee OA in a systematic literature review (OR=2.63). It has been established that inflammatory processes are connected to OA. It's possible that inflammation contributes to the onset and progression of OA.

2.3 Etiology

Sapundzhiev et al., 2021 stated underlying cause of OA knees which is divided into 2 categories: primary or idiopathic, which results from a complex of systemic factors (Age, Sex & sex hormones, race & ethnic origin, weight & BMI, Bone mineral density, diet & alimentary factors, Physical activity, Genetic & epigenetic factors) and local factors (Body weight, Physical activity, Traumatism, Deterioration of biomechanics) interacting and secondary which has a known basic etiology (congenital anomalies, inflammatory, neurologic, or metabolic diseases) that can explain the destructive process occurring in the joint or joints.

2.4 Symptoms

Lespasio et al., 2017 proposed that depending on the underlying source of the problem, knee symptoms can differ. The pain around the knee joint is the primary sign of OA Knee. Pain might be chronic, recurring, sharp, or intermittent (off and on). Agonizing pain can range from minor to severe. Reduced range of motion is possible. The patient may have muscle weakness and report hearing popping or grinding noises. Problematic knee symptoms include swelling, locking, and giving way. These impairments, which are primarily pain-related, frequently appear as difficulty walking, climbing stairs, performing domestic tasks, and sitting erect. They also have a detrimental psychological impact, which can all contribute to a lower quality of life.

2.5 Pathophysiology

Yunus et al., 2020 stated that in OA, the articular cartilage surface often shows the initial pathological changes, with fibrillation forming in areas of greatest strain. The growth of chondrocytes, the sole cell type found in cartilage, rises dramatically in response to the lack of matrix. Some chondrocytes undergo phenotypic changes to become hypertrophic chondrocytes, which are phenotypically similar to the cells found in the hypertrophic zones of the growth plate. Significant matrix degradation and loss occurs as OA progresses due to the continuous synthesis of proteases induced by proinflammatory cytokines, which stimulate chondrocytes to produce additional cytokines and proteases in an autocrine and paracrine manner as OA progresses. As a result of chondrocyte death, large areas of the matrix are devoid of cells, resulting in significant matrix damage. As a result of increased collagen production, subchondral sclerosis develops in the bones as OA progresses, and at later stages bone cysts and osteophytes emerge. Except for the lateral tibia and medial patella, the direction of osteophyte growth is sensitive to size and local cartilage constriction. Osteophyte development is aided by biomechanical considerations. Inflammation and hypertrophy of the

synovium are common in people with symptomatic OA. However, although it helps the pain and illness progress, synovitis inflammation does not cause primary OA. Since plain radiographs only show one aspect of the condition, such as cartilage loss that causes the joint space to shrink and bone alterations that cause the creation of cysts, osteophytes, and subchondral sclerosis, plain radiographs grossly underestimate the involvement of joint tissue in OA. The illness has considerably worsened if these alterations become visible on radiographs. In addition to showing indications of synovitis, bone marrow lesions, and degenerative changes in soft-tissue components outside of the cartilage, such as ligaments and the knee menisci, magnetic resonance imaging tests have the ability to detect early disease. In patients with unexplained knee pain and swelling or in patients with established knee arthritis whose symptoms are out of proportion to radiographic findings, the arthroscope can play a critical diagnostic role.

2.6 Anatomical changes in knee osteoarthritis

Sharma et al., 2013 suggested that the articular surface is crucial for weight transfer between joints, and there is enough evidence to suggest that increased load transfer and/or altered load distribution patterns can speed up the development and progression of OA. The anatomical course of OA is defined by structural changes in articular cartilage that contribute to a narrowing of the joint space. Sclerosis and the formation of osteophytes are caused by aberrant bone remodelling processes in the underlying subchondral bone. Biochemical and molecular crosstalk has been introduced across the afflicted region due to the close physical contact between cartilage and subchondral bone in the joint. Synthetic activity can be modulated or increased in response to direct biomechanical warning in knee OA.

2.7 Biomechanical changes in knee osteoarthritis

Heijink et al., 2012 stated misalignment, meniscal tissue loss, cartilage abnormalities, and joint instability all appear to be associated to osteoarthritis in one way or another. Osteoarthritis can be produced by mechanically induced pathophysiological changes in the articular cartilage, subchondral bone, and possibly other joint tissues. Obesity, high impact sports, labour, and neuromuscular dysfunction are just a few of the etiologies that can cause osteoarthritis. Ongoing research efforts will gradually clarify cartilage's response to mechanical loading and oxidative stress, whether as a result of trauma or joint overloading, allowing us to intervene earlier in the osteoarthritis pathophysiological process and thus reduce the burden of osteoarthritis on society.

2.8 Diagnosis

Braun & Gold, 2012 stated that the importance of early OA diagnosis for better clinical decision-making and a better understanding of disease progression and treatment options cannot be overstated. Radiography is still the most accessible method for examining the OA joint, notwithstanding the emergence of additional imaging modalities. The extended-knee radiograph is a bilateral anteroposterior image acquired while the patient is weight-bearing and both knees are fully extended. Researchers have recently used flexed-knee radiographs with various degrees of flexion and x-ray beam angles to improve intra-articular imaging. Radiographs are used to evaluate osteophyte formation and joint space narrowing (JSN); grading schemes such as the Kellgren-Lawrence grading scheme (Figure 1.1) and the Osteoarthritis Research Society International classification score are used to diagnose OA progression.

KL Grade	Grade0	Grade1	Grade2	Grade3	Grade4
Classification	Normal	Doubtful	Mild	Moderate	Severe
Description	No radiographic features of OA	Doubtful joint space narrowing(JSN)	Definite osteophytes Possible JSN	Multiple osteophytes Definite JSN Sclerosis	Large osteophytes Marked JSN Severe sclerosis

Figure 1.1 Kellgren - Lawrence Grading System

The second is MRI, which uses image contrast to highlight distinct tissue types. Common contrast techniques include 2D or multi-slice T1-weighted, proton density (PD), and T2-weighted imaging. Spinecho (SE) and fast-spin echo (FSE) imaging techniques can be used to assess localised cartilage defects. Several semi-quantitative morphologic MRI grading systems have been developed for the evaluation of the knee joint in OA. To assess cartilage lesions, modified versions of the Outerbridge scale are widely employed, particularly in terms of defect depth. Whole-organ examination, on the other hand, has become more useful as it provides for a comprehensive assessment of articular features. The Whole-Organ Magnetic Resonance Imaging Score, the Knee Osteoarthritis Scoring System, and the Boston Leeds Osteoarthritis Knee Score are the three published approaches for evaluating the complete

knee joint. Furthermore, ultrasonography is a low cost imaging technique that can be used to examine numerous tissues involved in OA without the need of contrast agents (CE). Finally, OCT (Optical coherence tomography) captures cross-sectional infrared light echo graphs to construct near-real-time images of articular cartilage. The endoscope must be placed directly on the cartilage during this technique, which is done during arthroscopy. OCT is an arthroscope-integrated technology that produces cross-sectional images of articular cartilage with resolutions comparable to low-power histology.

2.9 Treatment

2.9.1 Interventional Management

Jang et al., 2021 gives interventional management of OA knees. He postulated that Intra-Articular corticosteroid injections are typically conditionally advised over other types of intra-articular injections in the knee joint with OA. The evidence for the effectiveness of glucocorticoid injections is substantially stronger than that of other medications, despite the fact that there are few direct comparisons. Corticoids exert their immunosuppressive and anti-inflammatory actions by directly interfering with nuclear receptors, which in turn disrupts the inflammatory cascade on multiple levels. They are a component of the pain-relieving mechanism and inhibit the activity and development of the molecules interleukin-1, prostaglandins, leukotriene, MMP9, and MMP-11, which are thought to improve joint mobility in knee OA. Clinically, these actions have anti-inflammatory benefits by reducing erythema, heat, edema, and soreness in inflammatory joints and by increasing relative viscosity with an increase in hyaluronic acid (HA) content. In this way, intra-articular corticosteroid injections lessen acute pain episodes and improve joint mobility, especially when there are signs of joint effusion and inflammation during OA redness. A number of instant release corticosteroids, including methylprednisolone acetate, triamcinolone acetate, triamcinolone hexacetonide, betamethasone acetate, betamethasone sodium phosphate, and dexamethasone, have been approved by the current Food and Drug Administration for use intra-articularly.

Abate et al., 2010 suggested that VS (viscosupplementation) therapy with Hyaluronic Acid (HA) appears to be a safe and effective treatment option for OA patients who have failed to react to conventional medications. The FDA (Food and Drug Administration) has approved this treatment for knee OA, but the evidence for the other joints is promising but not conclusive. When NSAIDs (Non-steroidal anti-inflammatory drugs) are contraindicated or poorly tolerated, or when NSAIDs or corticosteroids are ineffective, HA is utilised. VS has a

significant pain-relieving effect within three months, and this effect lasts for a long time (12-18 months). Patients can resume work and social activities more rapidly now that their articular function has improved.

Hong et al., 2021 conducted a systematic review and meta-analysis and they found that PRP (Platelet-Rich Plasma) is more successful at symptom relief when compared to the conservative treatments. In terms of the short-term curative effect, there were no appreciable differences between the triple and single PRP applications.

2.9.2 Cellular Therapy

Brittberg et al., 1994 conducted a study in which 23 patients were participated. Patients age ranged from 14 to 48 years and had full thickness cartilage defect that ranged in size from 1.6 to

6.5 cm². During arthroscopy, healthy chondrocytes were removed from an unaffected portion of the damaged knee and cultivated in the lab for 14 to 21 days. The location of the defect was subsequently filled with the cultivated chondrocytes. A sutured periosteal flap removed from the proximal medial tibia was used to cover the deformity. Clinical assessment in accordance with predetermined criteria, arthroscopic inspection, and a biopsy of the transplanted site were all included in the evaluation. Moreover, the study found that deep cartilage abnormalities in the femorotibial articular surface of the knee joint can be repaired using cultured autologous chondrocytes.

2.9.3 Gene Therapy

Kim et al., 2018 reported the clinical effectiveness of TissueGene-C (TG-C), a cell and gene treatment for human knee OA that consist of non-transfected and transduced chondrocytes transduced using retrovirus to overexpress Transforming growth factor beta 1 (TGF- β 1). They concluded that TG-C was associated with a statistically significant improvement in function and pain in patients with knee OA.

2.9.4 Surgical Management

Arthroscopic Lavage and Debridement :Ronn et al., 2011 stated that knee can be lavaged and debrided using arthroscopic procedures (e.g., shaving of rough cartilage or smoothing of the degenerated meniscus). Theoretically, by removing the debris and inflammatory cytokines that cause synovitis, arthroscopy for OA should ease symptoms. Debridement can remove loose cartilage flaps and meniscal fragments that have torn. However the role of arthroscopy in treating knee OA is controversial.

Osteotomies around the Knee : Smith et al., 2013 carried out a thorough literature review to identify the important steps in the development of osteotomy around the knee and found that Osteotomy around the knee is now an efficient biological treatment for degenerative disease, deformity, knee instability, as well as an adjunct to other complex joint surface and meniscal cartilage surgeries, with appropriate patient selection, accurate pre-operative planning, modern surgical fixation techniques, and quick rehabilitation. Ronn et al., 2011 stated that unicompartmental OA of the knee is now commonly treated with osteotomies. The traditional Coventry osteotomy was a closed-wedge valgization with a fibula osteotomy that was performed close to the tibial tuberosity.

Unicompartmental Knee Arthroplasty :Ronn et al., 2011 stated that when only one of the 3 compartments of the knee i.e. the medial tibiofemoral, lateral tibiofemoral, or patellofemoral compartment—is affected by OA, unicompartmental knee arthroplasty is recommended. The most usual unicompartmental knee arthroplasty involves inserting a polyethylene inlay between two metallic prosthetic devices and removing the contact surfaces of the medial tibiofemoral compartment. (Figure 1.2)



Figure 1.2 Treatment of an isolated medial compartment OA by unicompartmental arthroplasty. It is a less invasive surgical method. In particular, there is no eversion of the patella and no injury to the extensor mechanism, allowing for a significantly quicker recovery and earlier release from the hospital. Additionally, it offers bone stock preservation, improved physiological function, and more typical knee kinematics.

Total Knee Arthroplasty :Ronn et al., 2011 found stated that TKA has been demonstrated to be a highly successful treatment that significantly improves patient functionality and health-related quality of life in advanced knee OA with multiple compartments implicated and failure of conservative treatments. (Figure 1.3)



Figure 2.3 Treatment of advanced knee OA by total knee arthroplasty (example without patella resurfacing)

Lenguerrand et al., 2020 evaluated the long-term clinical effectiveness of a novel group-based outpatient physiotherapy following total knee replacement. 180 patients with osteoarthritis on a waiting list for primary TKR were randomly assigned to either usual treatment alone (n=91) or usual care plus a 6-session group-based outpatient physiotherapy intervention. The Lower Extremity Functional Scale was used to measure patient-reported functional abilities at 12 months after surgery. Knee discomfort, depression, anxiety, and contentment were secondary outcomes. Surveys were filled out before surgery as well as 3, 6, and 12 months later. At 12 months following TKR, they found that adding this group-based outpatient physiotherapy intervention to normal care improved function, even if the size of the difference was less than the minimal clinically relevant difference of 9 points. However, the intervention group had a higher patient satisfaction rate, and after three months, there was some proof of functional gains that were clinically significant.

Avramidis et al., 2011 reports the results of a prospective, randomized controlled trial evaluating the effect of electric muscle stimulation of the vastusmedialis on the speed and effort of walking, quality of life, and knee performance in patients undergoing TKR. 70 patients who had TKR were randomly split into 2 groups. For 6 weeks, patients in group A received both regular physiotherapy and electric muscle stimulation, while those in group B received only physiotherapy. Prior to surgery as well as at 6, 12, and 52 weeks after surgery, all patients underwent clinical evaluations using both subjective and objective clinical assessments. Three individuals stopped using the electrical stimulation because they felt the feeling to be too painful. Infections at the surgery site and no cutaneous responses were noted. In addition to traditional physiotherapy, they discovered that electrical stimulation of the vastusmedialis muscle enhances early rehabilitation and functional recovery following TKR.

Lopez-Liria et al., 2015 compared home-based rehabilitation with the standard hospital rehabilitation in terms of improving knee joint mobility and recovery of muscle strength and function in patients after a total knee replacement. The study comprised 78 prosthetic knee patients who were randomly assigned to either a home-based or hospital-based rehabilitation regimen. Exercises were used as part of the treatment to increase patients' functional ability while regaining strength and joint mobility. The primary outcome was the treatment effectiveness measured by the Western Ontario and McMaster Universities Osteoarthritis Index. The study found that rehabilitation services provided at home or in medical facilities are equally beneficial.

Liao et al., 2020 identified the effects of elastic resistance exercise training after total knee replacement on muscle mass and physical outcomes in older women with knee osteoarthritis. The experimental group, which underwent 12 weeks of postoperative elastic resistance exercise training, was divided into 60 older women who underwent unilateral primary total knee replacement surgery. The control group, which underwent normal care, received no special treatment. The outcome measurements included appendicular lean mass, the Western Ontario

and McMaster Universities Osteoarthritis Index, and physical function performance (such as Timed Up & Go, gait speed, forward reach, single-leg stance, and timed chair rise). The study found that older women with knee osteoarthritis benefited from a 12-week elastic resistance exercise training programme after total knee replacement in terms of their muscle mass, mobility, and functional outcomes as measured by the Western Ontario and McMaster Universities Osteoarthritis Index.

Kohli et al., 2018 conducted a randomised controlled trial to study aims toward establishing new post-operative rehabilitation protocol for faster recovery in knee surgery. And the study concluded that reverse walking should be included as a principle part of early protocols in post op rehabilitation for knee replacement surgeries.

3. METHODOLOGY

The study followed the PRISMA criteria for reporting systematic reviews of randomised controlled trials and utilised systematic review methodologies as specified in the Cochrane handbook of systematic reviews.

Types of Studies

The study included papers that were randomised controlled trials (RCTs) with randomization at the individual or cluster level to eliminate selection bias. The analyses omitted studies that

were only presented as abstracts or those we were unable to obtain as full text copies through interlibrary loans or email contact with authors. Patients having complete knee replacement who were identified retrospectively were likewise excluded from the study.

Types of Interventions

Any exercise or physiotherapy-based intervention was included. Outpatient, community, or home-based interventions began at a pre-determined time after discharge from the hospital; typically, 2–12 weeks. We included studies that compared physiotherapy exercise programmes to the following: regular or standard care; various types of intervention, including home-based; and improved physiotherapy formats with added components.

Search Methods for Identification of Studies

PEDro, Science Direct, PubMed, EBSCO host and Cochrane Library databases were searched from inception to 2 March 2022. Search terms related to: knee arthroplasty; randomised controlled trial; rehabilitation and physiotherapy. The search strategy using Boolean Operators

‘and’ or ‘or’ to combine the search key search terms to collect the best current evidence

Eligibility Criteria

Inclusion criteria

- Articles available in full text

Studies had to be published in English language.

- A key term was required in the study Title or Abstract
- Studies included a randomized controlled design comparing a standard based rehabilitation programme with a patient-modified programme.
- Studies reporting on patients who underwent unilateral TKA were included
- There were no restrictions regarding the type of hospital (community (general), teaching, rural, urban, or federal government hospital) or the number of hospitals from which participants were recruited.
- Interventions including electrical stimulation, acupuncture or electrical modalities such as continuous passive motion were included.

Exclusion criteria

- Studies without comparison groups, case reports and nonsystematic review were excluded
- Study with inadequate information - Only Abstracts available

- Studies with high risk of bias
- Studies including only revision surgeries or bilateral TKA were not considered eligible.
- Studies with low level of evidence- Letters/ Opinion articles/ Editorials.
- Unpublished studies
- Reviews or systematic reviews
- Non- English articles

Study selection

An initial screening of titles and abstracts was conducted based on the inclusion criteria to identify potentially relevant studies. Following that, a final review of the retrieved full text papers was done. The lead investigator reviewed all titles, abstracts, and entire articles before deciding whether or not the study was eligible.

Assessment of risk of bias in included studies

The Cochrane risk of bias scale was used to evaluate potential sources of bias. Random sequence generation, allocation concealment, blinding of outcome assessment, insufficient outcome data, selective reporting, and other sources were used to assess bias. The PEDro scale checklist was used to rate the assessment's methodological aspects, such as randomised sequence, allocation concealment, blinding, and conflicts of interest. The PEDro score was interpreted as follows: a score of greater than 9 indicates exceptional methodological quality, a score of 6 to 8 indicates good methodological quality, a score of 4 to 5 indicates fair methodological quality, and a score of less than 4 indicates poor methodological quality.

4. RESULT AND DISCUSSION

4.1 Result

Search, Screening, and Selection Results

The outcomes of the search strategy and screening process are depicted in Fig. 4.1 as a flowchart. In the beginning, database searching yielded a total of 8326 records. After removing duplicates and screening the remaining 7324 articles (of which 7302 were deemed invalid), 22 papers were examined in full text. A total of ten articles were chosen as being eligible for inclusion in this review.

Description of included Studies

Five studies were single blinded randomised controlled trials, three studies were randomised controlled trials, one study was double blinded randomised controlled trials, and one study

was the first, large longitudinal randomised controlled trials that were reviewed based on the eligibility criteria. (Table 4.1.)

General Characteristics of Participants

There were 642 participants who contributed to the studies reported in this review. Total number of participants in the control groups were 320 and in the intervention groups were 322, the gender of the included subjects was predominantly female. Mean age was 60 years. Table 4.2 summarizes each study's numbers including reported losses to follow up.

Table 4.1 Pico Information of the Studies Included in the Review

S N o.	Author/ Year	Sample size & charact eristics	Participants in each group	Interve ntion / Task for N1	Interve ntion / Task for N2	Time of interve ntion	Conclu sion
		Age					
1	Gianola et al./ 2020	B/w 45 & 80 years old	<p>N1 (VR- based rehabilitation or experimental group) = 44 (54.5% men)</p> <p>N2 (Traditional rehabilitation or control group) = 41 (31.7% men)</p> <p>Total 37 men and 48 women</p>	<p>Passive knee motion on a Kinetic knee continuo us passive motion system & function al exercise s.For first 3 sessions : Knee extensio n, Ball compres sion with knee flexed, hip</p>	<p>N2 group perfor med similar exercis es without VR support system plus passive knee motion</p>	10 days	<p>In terms of pain alleviati on, medicat ion assumpt ions, and other function al outcom es, virtual reality- based rehabilit ation is not superior to traditio nal rehabilit ation, but it</p>

				abduction on side lying, active flexion-extension of knee on the bed, hip flexion with knee extended, gluteal bridge exercise, active knee extension, active triple flexion, supine target proprioception (eg, number draw). After 1st 3 sessions : hip flexion with knee extended, in sitting position active knee flexion & extension, in standing			does appear to increase global proprioception in TKA patients.
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				(active bilateral squat), in standing position (hip flexion & knee extension, active hip abduction, proprioception), standing on balance board, balance b/w lower extremity limbs, reaching target by lower extremity limbs.			
2	Warner et al./2020	50- 80 years, mean age 62.93±9.146	N1 (experimental group) = 22 N2 (control group) = 22 Male &female frequency is 15 and 29.	Core stability exercises, abdominal bracing, bridging with abdominal bracing, curl ups, heel slide with abdominal bracing, leg lift	Ankle pumps, SLR, short arc quad, hip abduction in side lying, squats & walking	6 weeks	In complete knee replacement patients, core stability exercises were more beneficial than normal PT activities.

				with abdominal bracing, side support with knee flexion & extension, table top leg press, & dead bug along with routine PT exercise.								
3	Kondo et al./ 2020	More than 60 years, mean age of N1 group (75.8) and N2 group (75.5)	<table border="1"> <tr> <td>N1 (Intervention group) = 34</td> </tr> <tr> <td>N2 (control group) = 35</td> </tr> <tr> <td>82.4% women in N1 group while 82.9 % women in N2 group</td> </tr> <tr> <td>N1 (Lost to follow-up) = 3</td> </tr> <tr> <td>N2 (Lost to follow up) = 4</td> </tr> </table>	N1 (Intervention group) = 34	N2 (control group) = 35	82.4% women in N1 group while 82.9 % women in N2 group	N1 (Lost to follow-up) = 3	N2 (Lost to follow up) = 4	Isometric quadriceps exercise with auditory and visual feedback rehabilitation program	Standardized rehabilitation program (bed side exercises, knee ROM exercises, strengthening exercises including traditional quadriceps, gait training , progression of ROM	3 weeks	In the early stages of postoperative TKA, isometric quadriceps workouts with audio and visual feedback provided early knee pain alleviation, likely leading to better improvements
N1 (Intervention group) = 34												
N2 (control group) = 35												
82.4% women in N1 group while 82.9 % women in N2 group												
N1 (Lost to follow-up) = 3												
N2 (Lost to follow up) = 4												

					& strengthening & manual stretching as necessary.		in physical performance and patient perception of physical function.
4	Sanzo et al./ 2021	50- 80 years	<p>N1 (intervention group) = 28 [13 males and 15 females]</p> <p>N2 (control group) = 27 [10 males and 17 females]</p> <p>N1 (did not receive allocated intervention)= 1</p> <p>N2 (did not receive allocated intervention) = 2</p> <p>N1 (Lost to follow-up) = 1, N2 (Lost to follow up)= 0</p> <p>N1 (Analysed) = 26 and N2 (Analysed) = 25</p>	Same as N2 group with addition of Viscus© (Active assisted cycle ergometry) use.	Standard post-operative exercise protocol	6-12 weeks	The addition of an Active assisted cycle ergometry regimen to total knee arthroplasty rehabilitation may improve post-operative clinical results.
5	Huang et al./2021	More than or equals to 60 years, mean age of N1 group is 73.10 while N2 is 73.20	<p>N1 (experimental group) = 41</p> <p>N2 (control group) = 41</p> <p>N1 (Lost to follow-up) = 2</p> <p>N2 (Lost to follow up) = 1</p> <p>N1 (Analysed) = 39 [13 male and 15 female]</p>	Acupuncture with low-level laser therapy, remote acupuncture points (Neiguan , Sanyinji	Participants in this group received sham ALLLT at identical acupuncture locations but	upto day 3 postoperatively	ALLLT can help patients with total knee replacements regain physical function , as evidenced by

			N2 (Analysed) = 40 [15 male and 25 female]	ao, Taixi, Kunlun, Fengshi, Futu)	without the use of the laser beam. True or sham ALLT was provided on both hands at Neiguan, and on the sick side at Sanyinjiao, Taixi, Kunlun, Fengshi, and Futu.		knee joint flexion and stiffness .
6	Iwakiri et al./ 2020	Mean age of N1 group is 75.0 and N2 group is 75.6 years	<p>N1 (ROM day 1 group) = 55 [45 females and 10 males]</p> <p>N2 (ROM day 7 group) = 54 [44 females and 10 males]</p> <p>N1 (Analysed)= 55</p> <p>N2 (Analysed)= 54</p>	Physiotherapist assisted passive & active hospital-based rehabilitation program that consisted of walking with walker starting at day 1 after TKA.Knee flexion and	Walking with T-shaped cane & climbing & descending stairs starting at day 7 after TK.Knee flexion & extension on the affected side 7 days	3 months	Beginning ROM exercises early in the postoperative period is beneficial in minimizing postoperative discomfort after TKA.

				extension on affected side 1 day after TKA.	after TKA.		
7	Schache et al./ 2019	Mean age of N1 group is 70 years and N2 group is 69 years	<p>N1 (experimental group) = 54 [72% female], Week 0</p> <p>N2 (control group) = 51 [58% female], Week 0</p> <p>N1 (Lost to follow-up) = 1, Week 0</p> <p>N2 (Lost to follow up) = 0, Week 0</p> <p>N1 (Lost to follow-up) = 5, Week 6</p> <p>N1 (experimental group) = 48, Week 26</p> <p>N2 (control group) = 48, Week 26</p>	Fourty five minute exercise therapy sessions with progressive hip abductor strangle ning, manual therapy	Fourty five minute exercise therapy sessions and manual therapy	6-8 weeks	Whether specific hip-strengthening exercises were incorporated or general functional exercises were continued instead as part of a postoperative rehabilitation programme for participants after TKA, similar improvements in muscle strength, functional performance and patient

							reported outcomes were observed.
8	Paravlic et al./2019	B/w 50 and 85 years. Mean age of N1 group is 62.2 and N2 group is 60.0 years	<p>N1 (Motor Imagery group) = 17 [7 men and 6 women]</p> <p>N2 (control group) = 17 [7 men and 6 women]</p> <p>N1 (received allocation intervention)= 15</p> <p>N2 (received allocation intervention)= 17</p> <p>N1 (Lost to follow-up) = 2</p> <p>N2 (Lost to follow up) = 4</p> <p>N1 (Per protocol analysed) = 13</p> <p>N2 (Per protocol analysed) = 13</p>	MI group received motor imagery training for 15 minutes per day for 5 days per week and routine physical therapy	Control group performed routine physical therapy alone for 4 weeks	4 weeks	When MI training was used as a supplement to regular physical therapy, it resulted in improvements in both specific and general adjustments to patients' physical skills.
9	AP et al./2019	Mean age of MPP (N1 group) is 60.07 and MV (N2 group) is 60.23.	<p>N1 (Medial patellar approach group) = 53</p> <p>N2 (Midvastus group) = 52</p> <p>N1 (Lost to follow-up) = 8</p> <p>N2 (Lost to follow up) = 12</p> <p>N1 (Analysed) = 45 [33 female , 12 male]</p> <p>N2 (Analysed) = 40 [31 female, 9 male]</p>	Early function phase from day 1 to second week , progressive function phase from third week to sixth week & advanced function phase from seventh week to 12th week comprised structural rehabilitation program. Mobility, stretching, strengthening, closed chain exercises, balance		12 weeks	The mid vastus technique was reported to have better physical summary scores of quality of life & joint specific results following structured

				& functional training, , aerobic conditioning were all parts of progressive & advanced function phase, followed by discharge planning, but parts of phases 2 & 3 were termed home based rehabilitation.		rehabilitation therapy than the medial parapatellar method.	
10	Chen et al./2020	b/w 18 and 90 years	N1 (Intervention group) = 30 [7 male and 23 female] N2 (control group) = 30 [5 male and 25 female]	Continuous passive motion machine & cryotherapy intermittently within 1 hour on the day of surgery.	CPM & cryotherapy not used on the day of surgery but routine nursing procedures were performed. On POD1 patient began CPM, application of cryotherapy was not programmed .	Within 1 hour after surgery to the day of discharge	Immediate programmed cryotherapy & CPM may aid in the recovery of ROM following CAS-TKA. For patients undergoing CAS-TKA, it should be included in the daily nursing plan.

General Characteristics of Participants

There were 642 participants who contributed to the studies reported in this review. Total number of participants in the control groups were 320 and in the intervention groups were

322, the gender of the included subjects was predominantly female. Mean age was 60 years.

Table 4.2 summarizes each study's numbers including reported losses to follow up.

Table 4.2 Study Numbers

Sno.	Author	Eligible for Inclusion	Excluded	Number Allocated			Excluded post allocation	Lost to follow up	Included in final analysis	
					Experimental group	Control group			Experimental group	Control group
1	Gianola et al., 2020	88	3	44	41	0	11	35	39	
2	Warner et al., 2020	44	0	22	22	0	0	0	0	
3	Kondo et al., 2020	78	9	34	35	0	7	31	31	
4	Sanzo et al., 2021	75	20	28	27	3	1	26	25	
5	Huang et al., 2021	109	27	41	41	0	3	39	40	
6	Iwakiri et al., 2020	120	11	55	54	0	0	55	54	
7	Schache et al., 2019	315	210	54	51	0	9	48	48	
8	Paravlic et al., 2019	363	306	17	17	2	6	13	13	
9	AP et al., 2019	150	45	53	52	0	20	45	40	

10	Chen et al., 2020	68	8	30	30	0	0	30	30
Totals		1410	639	378	370	5	57	322	320

Exercise Therapy Interventions

Interventions examined in the studies were passive knee motion on a kinetic knee continuous passive motion system, Knee extension, Ball compression with knee flexed, hip abduction on side lying, active flexion- extension of knee on the bed, hip flexion with knee extended, gluteal bridge exercise, active knee extension, active triple flexion, supine target proprioception (eg, number draw), hip flexion with knee extended, in sitting position active knee flexion & extension, in standing (active bilateral squat), in standing position (hip flexion & knee extension, active hip abduction, proprioception), standing on balance board, balance b/w lower extremity limbs, reaching target by lower extremity limbs, Core stability exercises, abdominal bracing, bridging with abdominal bracing, curl ups, heel slide with abdominal bracing, leg lift with abdominal bracing, side support with knee flexion & extension, table top leg press, & dead bug , active assisted cycle ergometry, Acupuncture with low-level laser therapy, progressive hip abductor strengthening, manual therapy, motor imagery training, closed chain exercises, balance and functional training, aerobic conditioning.

Outcomes

The primary and secondary outcome measures were varied amongst the included studies. In terms of timing and frequency of the included outcome measures, 4 of the 10 studies took a pre- operative measure to determine baseline. The maximum follow-up time for an outcome measure varied significantly between studies with the longest reported follow up of an outcome measure being 1–2 year post operatively. Details of each outcome measure included in the studies reviewed are detailed in Table 4.3.

Table 4.3 Outcome Measures of Studies Reviewed

S N O.	AU TH OR	PRIMARY OUTCOM E	MEASURE MENT OF PRIMARY OUTCOM E	SECONDA RY OUTCOME	MEASUREM ENT OF SECONDA RY OUTCOME	FREQU ENCY OF OUTCO MES	ADV ERS E EVE NTS
1	Gian olaet	Pain Score	100mm on a VAS	knee disability	WOMAC	At baseline	Nil repor

	al., 2020			HRQoL	EQ-5D	(3–4 days after TKA) and then at discharge (around 10 days after surgery).	ted
				GPE	GPE Score		
				FIM	FIM Questionnaire		
				Frequency of medication assumption			
				Isometric strength of quadriceps and hamstrings muscles	Dynamometer		
				Knee active ROM	Goniometer		
				Proprioception	Stabilometric platform of the VRRS (Virtual Reality Rehabilitation System)		
2	Warner et al., 2020	Lower extremity function	Lower extremity functional scale			Pre and post baseline & after 6 weeks	Nil reported
3	Kon do et al., 2020	knee pain	0- to 100-mm VAS	Isometric knee extension strength	Hand-held dynamometer	Knee pain intensity, knee extension strength, passive ROM in knee flexion, and psychological status	Nil reported
		"plasma C-reactive protein (CRP) levels on postoperative days 7 & 14, as well as the use of postoperative	Electronic medical records	Passive ROM in knee flexion	Standard long-arm goniometer.		
				Physical performance	TUG, the 10-m gait speed, 6MWD		
			Functional status	Disease-specific questionnaire & WOMAC			

		e pain medications.		Psychological status.	HADS and PCS	and were evaluated before and 1 to 3 weeks after TKA. The TUG and 10 m-gait time were measured before, 2, and 3 weeks after TKA. The 6MWD and WOMAC were investigated before and 3 weeks after TKA.	
4	Sanzo et al., 2021	Knee pain	VAS			Rest pre-operatively & 6–12 weeks post-operatively	Nil reported
		Knee function	Lower extremity functional scale				
		Knee swelling	Girth measurement				
		Knee flexion & extension ROM	Goniometer				
		Motivation	BREQ2				
		Resisted isometric knee flexion & extension strength	La-fayette Manual Muscle Tester				

5	Huang et al., 2021	Angular magnitude of active flexion of the knee joint	Goniometer	Joint stiffness	WOMAC	Before surgery—the baseline—and on day 1, day 2, and day 3 after surgery	Nil reported
6	Iwakiri et al., 2020	(VAS) at rest	100mm on a VAS	Laboratory data [C-reactive protein, creatinine kinase, hemoglobin level, D-dimer		"VAS [Preoperatively, every 3h from 3 to 24 h from time zero immediately after surgery, every 8h from 24 to 72h, and on postoperative days 7 and 14].Laboratory data [preoperatively and on postoperative days 1,4,7 & 14],D-dimer [preoperatively and	Nil reported
				Estimated blood loss	Nadler formula		
				ROM of knee			
				Thigh swelling	The ratio of the post-operative thigh circumference divided by preoperative thigh circumference was calculated for comparing the thigh swelling between two groups.		
				WOMAC index			

				Adverse complications, including wound complications, surgical site infection, peroneal nerve palsy & DVT.		on postoperative days 7 and 21], ROM of knee [preoperatively and on postoperative days 7, 14, 21, 28 and 3 months, and 1-2 year), thigh swelling,[preoperatively and on postoperative days 7, 14, and 21], WOMAC Index (preoperatively and 3 months and 1-2 year postoperatively].	
7	Schahe et al., 2019	KOOS	KOOS Self-reported questionnaire	Stair climb test	Time taken to climb 4 steps in seconds	For all primary and secondary outcomes ,between-group comparisons at 0 week, 6 weeks & at 26	Nil reported
		Isometric hip abductor muscle strength	Handheld dynamometer	6- minute walk test TUG	Measured in meters Measured in seconds		

				40- m- fast paced walk test	Measured in seconds	weeks were reported as mean difference with 95% confidence intervals.			
				30- second chair stand test	Measured as number of stands				
				Step taps	Measured as number of taps				
				Isometric quadriceps muscle strength	Measured in Newtons and normalised to body mass index				
				Passive knee ROM	Measured in degrees				
				Lower extremity function	LEFS				
				Short form-12 version					
8	Paravlic et al., 2019	Maximal isometric knee extension strength.	Custom-build dynamometer	Gait measurements	2D OptoGait system	1 day before surgery (PRE) & 1 month post surgery (POST)	Nil reported		
				Chair sit - to stand	Chair sit-to-stand movement test				
				Self-reported physical function	LEFS				
				Motor imagery ability	MIQ-3				
9	AP et al., 2019	Quality of life using SF- 36	SF- 36v2	Knee mobility	Standard goniometer	At baseline, on discharge (POST 1) and after 3 months	Nil reported		
				Isometric knee musculature testing	Dynamometer				
				6-min walk distance	Measured in meters				

10	Che n et al., 2020	NRS (numeric rating scale)	0-10 points	SF- MPQ		POD 1 & POD 4 or until the patients were discharge d	Nil repor ted
				ROM	Universal goniometer		
				Swelling status of extremity	Tape		

4.2 Discussion

The primary purpose of this systematic analysis is to see how effective physiotherapy interventions are after primary unilateral total knee replacement.

Strengthening Interventions

Warner et al., 2020 compared the benefits of conventional physical therapy activities with and without core stability exercises in total knee replacements patients. The control group included ankle pumps, straight leg lifts in supine, short arc quad, hip abduction in side laying, squats, and walking. The experimental group includes curl ups, bridging with abdominal bracing, heel slide with abdominal bracing, leg lift with abdominal bracing, side support with knee flexion, side support with knee extension, table top leg press, and dead bug, as well as standard physical therapy activities. The lower extremity functional scale showed a significant difference, and he concluded that core stability exercises were more useful than conventional PT activities.

Kondo et al., 2020 assessed the Short-Term Effects of Isometric Quadriceps Muscle Exercise with Auditory and Visual Feedback on Pain, Physical Function, and Performance Following Total Knee Arthroplasty. Isometric quadriceps exercise with auditory and visual feedback rehabilitation programme was given to the intervention group, whereas the control group received routine therapy. The intervention group had significantly lower VAS scores than the control group at 1, 2, and 3 weeks after TKA. There was no difference in CRP between the two groups on postoperative days 7 and 14. Three weeks after TKA, the intervention group's mean TUG was significantly higher than the control group's. When compared to the control group, the intervention group showed a substantial improvement in 10-m gait speed three weeks following TKA. When compared to the control group 3 weeks after TKA, the intervention group showed a significant improvement in the mean WOMAC total score, pain, and function, and the study concluded that in the early stages of postoperative TKA, isometric quadriceps workouts with audio and visual feedback provided early knee pain

relief, likely leading to better physical performance and patient perception of physical function.

Sanzo et al., 2021 examined the effect of the use of an active assisted cycle ergometer as an adjunct to post-operative treatment following total knee arthroplasty, patients were randomly assigned to either the standard of care or the active assisted cycle ergometer (AACE) group. The AACE has a smooth mechanism that allows for easy movement with minimal effort, aided by a flywheel, while helping to improve range of motion. Although there was no statistically significant difference between the standard of care and the AACE group in terms of knee pain on the visual analogue scale, improved Lower Extremity Functional Scale scores, and knee extension ROM and strength, there was a trend for a greater reduction in knee pain on the visual analogue scale, improved Lower Extremity Functional Scale scores, and knee extension ROM and strength. The experimental group had a higher percentage of motivated individuals. There were no significant changes in the assessments of swelling and blood biomarkers. The post-operative qualitative response of the AACE group was also positive. As a result, using an AACE regimen as part of total knee arthroplasty rehabilitation may improve clinical outcomes.

Iwakiri et al., 2020 examined different postoperative ROM exercise initiation timings after TKA and compare the results in terms of postoperative pain, swelling, and ROM improvement to determine the optimal time of ROM exercise initiation after TKA in which all patients underwent the same physiotherapist-assisted passive and active rehabilitation programme that only differed in the ROM exercise initiation time on postoperative day 1 or day 7. From 18 to 72 hours after surgery, the group that began ROM exercise on postoperative day 1 had considerably lower VAS scores. There was no difference in ROM, laboratory data, thigh girth, WOMAC, or the occurrence of problems between the two groups at any postoperative time point. As a result, initiating ROM exercises early in the postoperative period is beneficial in minimising postoperative discomfort following TKA.

Schache et al., 2019 conducted a randomized controlled trial to see if introducing focused hip abductor strengthening activities into total knee arthroplasty therapy is beneficial. The experimental group followed a standard rehabilitation programme with the addition of hip abductor strengthening. The control group did the same therapy as the experimental group, plus 15 minutes of general functional activities. Neither the experimental nor the control intervention produced substantially higher increases in hip strength, KOOS, or any of the secondary end measures at 6 or 26 weeks. Similar improvements in muscle strength,

functional performance, and patient-reported outcomes were observed whether specific hip-strengthening exercises were incorporated or general functional exercises were continued instead as part of a postoperative rehabilitation programme for participants after total knee arthroplasty.

Paravlic et al., 2019 investigated whether an Motor Imagery practice focused on maximal isometric knee extension strength induces additional specific and general adaptations on neuromuscular and functional measures when compared to conventional therapy alone in patients submitted to total knee arthroplasty. Patients were randomly assigned to either a MI practise group or control group that performed routine physical therapy alone for 4 weeks. The findings revealed that MI based solely on strength tasks reduced the deterioration of maximal isometric knee extension strength and that the proposed training regime has positive transfer effects on several other functional outcomes, including gait speed under single and dual task conditions, and lower limb repetitive strength one month after surgery. As a consequence, when MI training was utilised as a supplement to traditional physical therapy, patient's physical skills improved in both specific and general ways.

AP et al., 2019 analysed the impact of a structured TKR rehabilitation programme on quality of life and joint-specific outcomes in two surgical techniques. The patients were separated into two groups: those who underwent a medial parapatellar approach and those who received a mid vastus approach. Both groups underwent a three-phase organised rehabilitation plan for 12 weeks. The mid-vastus technique outperformed the traditional medial parapatellar method in terms of quality of life and joint specific outcome scores. Following systematic rehabilitation therapy, the mid vastus technique was observed to have better physical summary scores of quality of life and joint specific results than the medial parapatellar procedure.

Virtual reality based rehabilitation

Gianola et al., 2020 assessed the efficacy of an early rehabilitation performed by the VR-based rehabilitation versus the traditional rehabilitation provided by physical therapists after primary total knee arthroplasty. The intervention group received passive knee motion on a Kinetec knee cpm system & functional exercises. The controlled group received similar exercises without VR support system plus passive knee motion. No significant difference in decrease in VAS pain scores was found between the experimental and the control group. Knee impairment, as measured by the WOMAC, was similar in both groups ($P=.62$, t test), while the only items linked to joint rigidity in the control group were statistically

substantially different ($P=.04$, t test). All other outcomes, including HRQoL as measured by the EQ 5D ($P=.15$, t test), FIM scale ($P=.07$, t test), GPE ($P=.28$, t test), quadriceps and hamstring isometric strength as measured by a dynamometer ($P=.95$, t test), and knee active ROM ($P=.58$, t test), showed no differences between the two groups. Nonetheless, the experimental group's proprioception task score was considerably higher ($P=.002$, t test). The frequency of medication use did not differ between the two groups. Virtual reality-based rehabilitation, according to the author, is not superior to traditional rehabilitation, although it does appear to improve global proprioception in TKA patients.

Laser & Acupuncture

Huang et al., 2021 investigated the ALLLT's impact on physical function outcomes in individuals undergoing TKR were studied. In the experimental group, ALLLT was applied to the Neiguan, Sanyinjiao, Taixi, Kunlun, Fengshi, and Futu acupuncture sites, whereas in the control group, sham ALLLT was applied to the same acupuncture locations. Generalised estimating equations revealed a significant difference between the two groups in joint flexion. The experimental group showed better joint flexion and reduced stiffness on days 2 and 3 than the control group. As evidenced by knee joint flexion and stiffness, they concluded that ALLLT can aid in the recovery of physical function in total knee replacement patients.

Cryotherapy and CPM

Chen et al., 2020 analysed the computer-assisted total knee arthroplasty, the effects of immediate planned cryotherapy and ongoing passive motion. The intervention group employed programmed cryotherapy and CPM within 1 hour after returning to the ward on the day of the procedure, but the control group did not. They came to the conclusion that immediate programmed cryotherapy and CPM might help with ROM recovery after CAS-TKA. It should be part of the daily nursing plan for patients who are having CAS-TKA.

Conclusion

Despite its present popularity and widespread use, the research on the use of Active assisted cycle ergometry, virtual reality-based rehabilitation, and specialised hip-strengthening exercises for total knee arthroplasty has inconsistencies. While the quality of evidence for acupuncture with low-level laser therapy and motor imagery training is moderate, there are a lack of high quality randomised controlled trials that show the effectiveness of these treatments, due in part to the heterogeneity of techniques described in the literature. More study is needed to prove the benefit of acupuncture combined with low-level laser therapy, core stability exercises, isometric quadriceps workouts with auditory and visual feedback, and motor imagery training in total knee arthroplasty maintenance beyond the placebo effect.

Furthermore, when compared to control/sham/other therapies for changes in pain and functional outcomes, the degree of evidence for core stability exercises, isometric quadriceps workouts with auditory and visual feedback varies from moderate to high in quality. In the near term, it appears that core stability exercises and isometric quadriceps workouts with auditory and visual feedback are more helpful than other treatments for lowering discomfort and boosting function. More research is needed to determine the long-term efficacy of core stability exercises and isometric quadriceps workouts with audio and visual feedback. Due to concerns with content and structural validity, more research into the quality of patient-reported outcome measuring instruments is also necessary.

Limitations

To summarize, bias, small sample sizes, ambiguous randomization and concealment procedures, inappropriate blinding, imbalanced baseline characteristics, lack of standardised methodologies, unreliable outcome measures, high attrition rates, unknown long-term treatment effects, lack of effective sham methods non-standardized definition of variables, variation in application and number of techniques are all limitations found in the articles. Keyword selection, limits posed by the quality of the research under discussion, risk-of-bias, the inclusive search, and any other methodological factors are all restrictions to consider on the part of the writers responsible for synthesis of this review.

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