Clinical Practice Guideline for Physical Therapist Management of Total Knee Arthroplasty: Revision 2025

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Introduction

This clinical practice guideline (CPG) is based on a systematic review of published studies with regard to the physical therapist management of patients undergoing total knee arthroplasty (TKA). In addition to providing practice recommendations, this guideline also highlights limitations in the literature, areas that require future research, intentional vagueness, and quality improvement activities. This guideline is intended to be used by all qualified and appropriately trained physical therapists involved in the management of patients undergoing TKA. It is also intended to serve as an information resource for decision makers and developers of practice guidelines and recommendations.

Overview

Goals and Rationale

Current evidence-based medicine standards demand that clinicians use the best available evidence in their clinical decision making, incorporate clinical expertise, and consider the patient's values. To assist clinicians, this guideline contains a systematic review of the available literature regarding the management of patients undergoing TKA. The systematic review detailed herein was conducted on studies published between 1995 and 2024 and demonstrates where there is good evidence, where evidence is lacking, and the topics that future research must target to improve the management of patients undergoing TKA.

Intended Users

This guideline is intended to be used by physical therapists for the management of patients who will undergo or have undergone TKA. Orthopaedic surgeons, adult primary care clinicians, geriatricians, hospital-based adult medicine specialists, physiatrists, occupational therapists, nurse practitioners, physician assistants, emergency clinicians, and other health care professionals who routinely see this type of patient in various practice settings may also benefit from this guideline. Some of those professionals also have their own CPGs, such as the American Academy of Orthopaedic Surgeons' (AAOS) "Evidence-Based Clinical Practice Guideline on the Surgical Management of Osteoarthritis of the Knee."[1] This APTA guideline is not intended for use as a benefits determination document.

Patient Population

This guideline addresses the management of adult patients with knee osteoarthritis undergoing primary TKA. It is not intended to address management of revision or partial knee arthroplasty, pediatric patients, or patients undergoing TKA for reasons other than osteoarthritis. In addition, this guideline is not intended to address nonoperative management of patients with osteoarthritis.

Burden of Disease

Knee osteoarthritis (OA) is a leading cause of musculoskeletal disability in the United States and worldwide. Global prevalence of osteoarthritis is 7.6%, and incidence is rising, especially in adults with early onset of OA before age 55. The societal burden of osteoarthritis is high, with Years Lived with Disability due to OA doubling from 1990-2019.[2]

Knee OA often leads to TKA, also known as total knee replacement, which is one of the most commonly performed orthopedic surgeries in the lower extremity. In 2019, 480,958 TKAs were performed on patients with Medicare in the United States; current estimates for total annual TKAs in the United States are nearly 800,000.[3] Since 2000, the annual volume of TKAs increased by 156%, and projections indicate a continued growth rate of 4.44% per year over the next few decades, reaching nearly three million surgeries per year by 2060. [4]

Surgical techniques for TKA continue to change over time, which also affects rehabilitation settings and protocols. Robotic-assisted TKA utilization was extremely rare prior to 2010 but was used in 8.5% of TKAs in 2020. Prevalence is projected to increase to 70% by 2030. Use of this technique is also associated with shorter hospital lengths of stay and more frequent discharge directly to home with no inpatient admission.[5]

Risk Factors

Both treatable or modifiable risk factors and nonmodifiable risk factors will impact outcomes after TKA. An understanding and appreciation of the risk factors helps inform care and determine prognosis. The guideline development group (GDG; also "work group") (Appendix) identified aspects of the relationship between risk factors and outcomes in this patient population. Due to the volume of information regarding risk factors for TKA and certain outcomes after TKA, this information will be made available in a separate forthcoming publication.

Potential Benefits, Risks, Harms, and Costs

The potential benefits, risks, harms, and costs are provided for each recommendation within this document.

Future Research

Consideration for future research is provided for each recommendation within this document.

Methods

The methods used to create this CPG were intended to minimize bias and enhance transparency in the selection, appraisal, and analysis of the available evidence. These processes are vital to the development of reliable, transparent, and accurate clinical recommendations for management of patients undergoing TKA. Methods from the APTA Clinical Practice Guideline Process Manual[6] and AAOS Clinical Practice Guideline Methodology[7] were used in the development of this CPG. Since this last edition, AAOS has updated their study appraisal methodology to ensure concordance with the Cochrane handbook and the ROBINs, QUADAS, and QUIPs tools as applicable (full methodology can be found on the AAOS website). Additionally, to align with GRADE methodology, all observational studies are now assigned a base appraisal of low-quality evidence.

GDG Team

APTA sought out the expertise of the AAOS Evidence-Based Medicine Unit as paid consultants to assist in the creation of this CPG. The GDG consisted of volunteer members: physical therapist clinicians, educators, researchers and an administrator (MB, AB, LC, PD, CH, JT, DS) an orthopedic surgeon (PM), an occupational therapist (KL), and a total joint replacement program coordinator (SC). APTA put out a call for GDG applicants in July of 2023. APTA staff selected a balanced team and then requested organizational representatives from AAOS, American Occupational Therapy Association and National Association of Orthopaedic Nurses, to complete the workgroup. All GDG members, APTA staff, and methodologists were free of financial conflicts of interest relevant to the topic under study. The GDG member with intellectual conflicts, due to authorship on articles included for review, abstained from authoring or voting on recommendations related to their evidence.

Process

This CPG was prepared by the APTA GDG with the assistance of APTA staff and the AAOS Clinical Quality and Value Department (staff evidence-based medicine methodologists). To

develop this guideline, the GDG held an introductory meeting on November 5, 2023, to establish the scope of the CPG. The GDG defined the scope by creating PICO(T) questions (population, intervention, comparison, outcome, and time) that directed the literature search. The medical librarian from AAOS created and executed the searches. *Supplementary Appendix 1* contains the search strategies used. AAOS chose the included studies (*Figure 1; Supplementary Appendix 2*), and performed quality assessments, The GDG reviewed the aggregate evidence, created or modified a previous recommendation, adjusted the strength of the recommendations depending on the evidence to decision framework, and provided rationale in the context of physical therapist practice. Additional background on the people and processes involved in the creation of this guideline are provided in *Supplementary Appendix 1*.

Best-Evidence Synthesis

The guideline includes only the best available evidence for any given outcome addressing a recommendation. Accordingly, the highest-quality evidence for any given outcome is included first, if it was available. In the absence of 2 or more occurrences of an outcome based on the highest-quality evidence, outcomes based on the next level of quality were considered until at least 2 or more occurrences of an outcome had been acquired. For example, if there were 2 “moderate”-quality occurrences of an outcome that addressed a recommendation, the recommendation does not include “low”-quality occurrences of evidence for this outcome. A summary of excluded articles can be viewed in *Supplementary Appendix 1*, and the data findings for each recommendation can be viewed in *Supplementary Appendix 2.*

Literature Searches

The medical librarian conducted a comprehensive search of MEDLINE, Embase, and the Cochrane Central Register of Controlled Trials based on key terms and concepts from the PICO(T) questions. Retrospective noncomparative case series, medical records review, meeting abstracts, meta-analyses, systematic reviews, historical articles, editorials, letters, and commentaries were excluded. Bibliographies of relevant systematic reviews were hand searched for additional references. All databases were last searched on January 2, 2025, and searches were limited to publication dates from 1995 to 2025 and publications in the English language.

Defining the Strength of the Recommendations

Judging the strength of evidence is one step in determining the strength of a CPG recommendation. The operational definitions for the quality of evidence are listed in Tables 2 and 3. The evidence to decision framework is described in Table 4, and Table 5 defines recommendation strength and links each strength to its visual representation and language of obligation.

Voting on the Recommendations

GDG members agreed upon the strength of each recommendation. When changes were made to the strength of a recommendation based on the evidence to decision framework (Table 4), the GDG voted in person or electronically and provided an explanation in the rationale.

Role of the Funding Source

The American Physical Therapy Association, which funded the volunteer GDG, provided coordination and played no role in the design, conduct, and reporting of the recommendations.

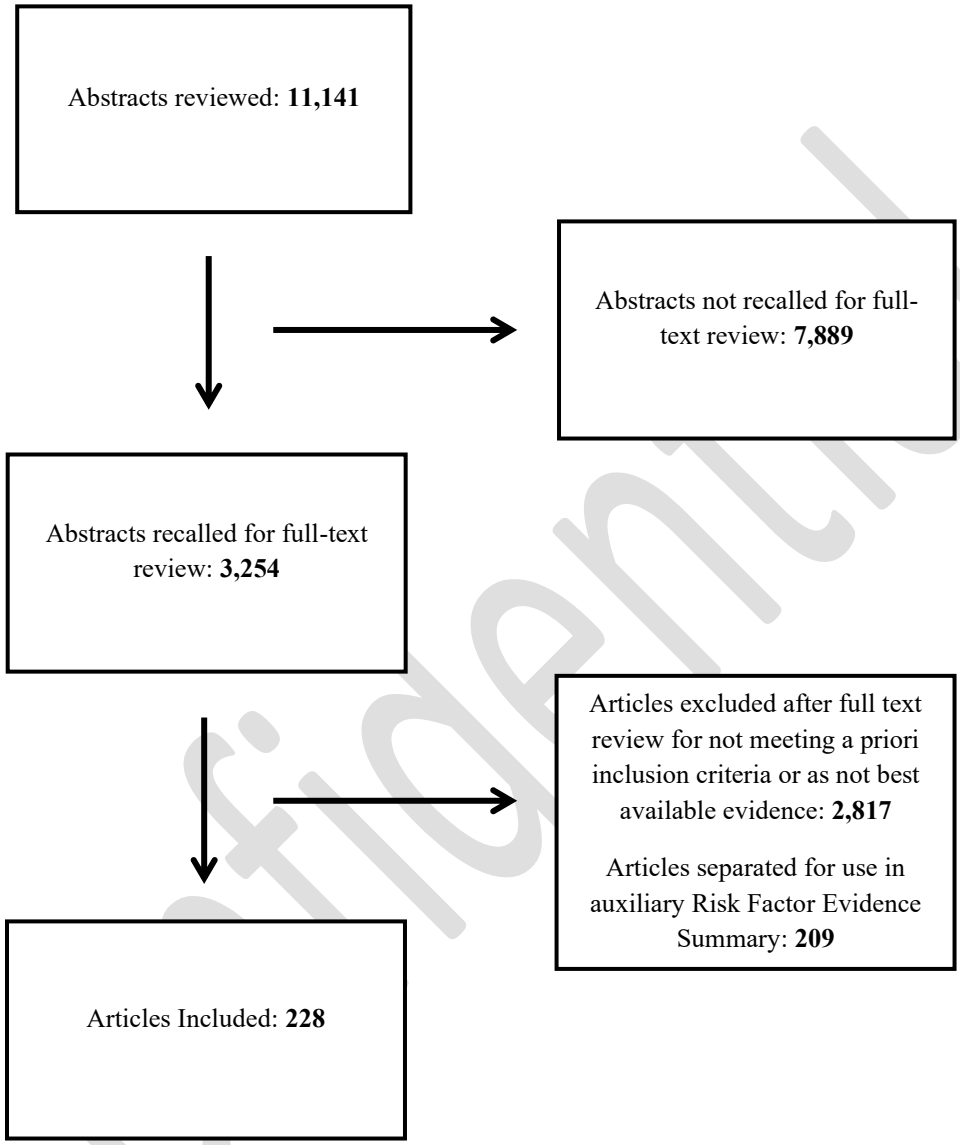
Peer Review and Public Commentary

Following the formation of a final draft, the CPG review draft was subjected to a 3-week peer review for additional input from external content experts and other interest holders. More

than xx comments (Supplementary Appendix 4) were collected via an electronic structured review form. All peer reviewers were required to disclose any potential conflicts of interest, which were recorded and, as necessary, addressed.

The draft was also subjected to a 2-week public comment period. Commenters consisted of xxx. More than xx public comments were received. Revisions to the draft were made in response to relevant comments.

Figure 1
Study attrition flowchart.



353 **Table 1**
354 Summary of Recommendations for Total Knee Arthroplasty (TKA)
355

Interventions	Rating	Practice Recommendation
Preoperative Physical Therapy	♦♦♦◊	Physical therapists should design and implement preoperative exercise programs for patients undergoing total knee arthroplasty (TKA) to improve pre- and postoperative outcomes, including strength, flexibility, and endurance. Preoperative education may also incorporate neuroscience-based strategies to help manage pain and reduce procedure-related anxiety.
Range of Motion Interventions – Continuous passive movement (CPM) machine	♦♦♦♦	Physical therapists should not use CPMs for patients who have undergone primary, uncomplicated total knee arthroplasty (TKA).
Range of Motion Interventions – Bracing, Splinting	♦♦♦◊	Physical Therapists should NOT use bracing or splinting in the early postoperative period to increase knee range of motion for patients who have undergone primary, uncomplicated total knee arthroplasty (TKA).
Range of Motion Interventions –Passive, Active-Assisted, and Range Of Motion (ROM) Exercises	♦♦♦◊	Physical therapists should design and implement treatment interventions for patients undergoing total knee arthroplasty (TKA) that include passive, active-assistive, and active range of motion (ROM) exercises to optimize recovery and improve functional outcomes of the affected knee.
Range of Motion Interventions –Manual Therapy and Devices	♦♦◊◊	Physical therapists may use manual therapy with exercise and/or devices to augment active-assisted exercise to improve range of motion (ROM) in the early postoperative period.
Non-pharmacological Pain Interventions – Cryotherapy	♦♦♦◊	Physical therapists should teach and encourage use of cryotherapy for early postoperative pain management for patients who have undergone total knee arthroplasty (TKA).
Non-pharmacological Pain Interventions – TENS, Kinesiotaping, Manual Therapy, Psychologically-informed Techniques	♦♦◊◊	Physical therapists may use TENS (acute and subacute phases), kinesiotaping (acute phase), manual therapy (time-frame not specified), and/or psychologically-informed techniques (time-frame not specified) to decrease pain after total knee arthroplasty (TKA).
Swelling and Edema Management – Cryotherapy, Positioning	♦♦♦◊	To minimize risk of immediate postoperative swelling/edema, physical therapists and/or other team members should prescribe cryotherapy treatment and teach positioning techniques of the surgical limb in the initial recovery period after total knee arthroplasty (TKA).
Swelling and Edema Management – Kinesiotaping	♦♦◊◊	Physical therapists may consider kinesiotaping after uncomplicated total knee arthroplasty (TKA) to reduce postoperative swelling and edema; however, evidence is mixed regarding its benefit.
Swelling and Edema Management – Manual Lymphatic Drainage (MLD), Compression, CPM	♦◊◊◊	In the absence of sufficient quality evidence, it is the opinion of this workgroup that physical therapists should not use manual lymphatic draining (MLD), compression dressings, or continuous passive motion (CPM) to reduce postoperative swelling and edema following total knee arthroplasty (TKA) as these interventions have not been proven effective.
Physical Activity Interventions	♦♦♦◊	Physical therapists should encourage early physical activity and develop a plan to progressively increase physical activity based upon safety,

		functional tolerance, physiological response, and collaborative goal setting with patients who have undergone total knee arthroplasty (TKA).
Movement Pattern Retraining	♦♦♦♦	Physical therapists should include motor function training in their interventions for patients who have undergone total knee arthroplasty (TKA). Interventions can include dynamic balance training, computer or app-assisted gait retraining, and movement training with feedback.
Neuromuscular Electrical Stimulation (NMES) Interventions	♦♦♦◊	Physical therapists should use NMES for patients who have undergone total knee arthroplasty (TKA) to improve quadriceps muscle strength, gait performance, performance-based outcomes, and patient-reported outcomes but its impact on patient reported outcomes is less well defined.
Strength Training Interventions	♦♦♦♦	Physical therapists should design, implement, and teach patients who have undergone total knee arthroplasty (TKA), progressive strength training and exercise programs beginning in the early post-acute period to improve function, strength, and ROM.
Physical Therapy Delivery Methods – Supervised Management	♦♦♦◊	Supervised physical therapist management should be provided for patients who have undergone total knee arthroplasty (TKA). The optimal setting should be determined by patient safety, mobility, and environmental and personal factors
Physical Therapy Delivery Methods – Group and Individual Sessions	♦♦◊◊	Physical therapists may use group-based or individual-based physical therapy sessions for patients who have undergone total knee arthroplasty (TKA).
Physical Therapy Delivery Methods – Digital Health	♦♦♦◊	Physical therapists and patients should consider use of digital health tools after total knee arthroplasty (TKA), either in addition to in-clinic care or as an alternative to in-clinic care.
Accelerated Postoperative Rehabilitation Protocol	♦♦♦◊	Physical therapist management should start within 24 hours of surgery and prior to discharge for patients who have undergone total knee arthroplasty (TKA)
Postoperative Care Settings	♦♦◊◊	When possible, post-operative physical therapy after total knee arthroplasty (TKA) may take place in an outpatient setting rather than in inpatient rehabilitation or at home.
Postoperative Care Coordination Protocol	♦◊◊◊	In the absence of sufficient information, it is the opinion of this workgroup that physical therapists should collaborate in pre- and post-operative care coordination to optimize outcomes in patients undergoing total knee arthroplasty (TKA).

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357 **Table 2.**

358 Rating Quality of Evidence, Individual Studies

Study Quality	Design and Risks of Bias (RoB)
High Quality	Randomized design with 0-1 RoB
Moderate Quality	Randomized design with 2-3 RoB or Observational study with <4 RoB and large magnitude of effect, observable dose-response gradient, or adjustments for all plausible residual confounding factors
Low Quality	Randomized design with 4-5 RoB or Observational study with <4 RoB

Very Low Quality	Randomized design with > 6 RoB or Observational study with ≥4 RoB

Table 3.

Rating Quality of Evidence, Overall

Evidence Quality Designation	Definition
High Quality	Evidence from two or more "High" quality studies with consistent findings recommending for or against the intervention.
Moderate Quality	Evidence from two or more "Moderate" quality studies with consistent findings or evidence from a single "High" quality study recommending for or against the intervention.
Low Quality	Evidence from two or more "Low" quality studies with consistent findings or evidence from a single "Moderate" quality study recommending for or against the intervention.
Insufficient Evidence	Evidence from one "Low" quality study, or no supporting evidence

Table 4.

Evidence to Decision Framework

Evidence to Decision Framework Categories
1. Certainty of evidence
2. Is there uncertainty over how people value the main outcomes?
3. Are the desirable effects large?
4. Are the undesirable effects small?
5. Are the desirable effects large relative to the undesirable effects?
6. Are resources required to implement the recommendation small?
7. Are the incremental costs small relative to the net benefits?
8. Is the recommendation likely to be acceptable to key stakeholders?

9. Is the option feasible to implement?

Table 5.

Strength of Recommendation and Language of Obligation

Recommendation Strength	Visual	Definition	Language of Obligation
Strong	♦♦♦♦	High quality evidence, or using the EtD framework, moderate quality evidence was upgraded.	Benefit: Must or Should Risk, Harm or Cost: Must not or Should not
Moderate	♦♦♦	Moderate quality evidence, or using the EtD framework, high quality evidence was downgraded or low quality evidence was upgraded.	Benefit: Should Risk, Harm or Cost: Should not
Weak	♦♦	Low quality evidence, or using the EtD framework, moderate quality evidence was downgraded or a consensus recommendation was upgraded.	Benefit: May Risk, Harm or Cost: May not
Consensus	♦	In the absence of sufficient evidence, the guideline work group made a statement based on clinical opinion.	Benefit: May or Should Risk, Harm or Cost: May not or Should not

Recommendations

Preoperative Physical Therapy

In patients with osteoarthritis of the knee, where TKA has been decided, does preoperative PT affect postoperative outcomes?

Physical therapists should design and implement preoperative exercise programs for patients undergoing total knee arthroplasty (TKA) to improve pre- and postoperative outcomes, including strength, flexibility, and endurance. Preoperative education may also incorporate neuroscience-based strategies to help manage pain and reduce procedure-related anxiety.

Evidence Quality: High
Recommendation Strength: Moderate ♦♦♦◊ (Downgraded due to limited data on educational components and generally small to moderate effect sizes)

Action Statement Profile
Aggregate Evidence Quality

- 12 high-quality studies[8–19]
- 32 moderate-quality studies[20–51]

Rationale:
Preoperative rehabilitation has been shown to improve early postoperative outcomes (0–1.5 months), including increased strength, improved function, and reduced pain. However, these early benefits tend to diminish over time, with limited evidence supporting sustained long-term effects. Importantly, no studies have demonstrated that preoperative exercise is inferior to alternative interventions or no intervention.

While the evidence strongly supports incorporating preoperative exercise, there is insufficient evidence to identify a specific exercise modality, clinical setting, or level of supervision (e.g., in-person vs. home-based) as superior. Therefore, the choice of intervention should consider the advantages and disadvantages of available options, as well as patient preferences.

One high-quality study (Huysmans, 2021) showed that integrating cognitive behavioral therapy (CBT) and pain neuroscience education (PNE) with joint mobilization may help reduce procedure-related anxiety and pain.[19]
Overall, preoperative interventions appear to be safe, with no reported increase in postoperative complications or adverse events.

Potential Benefits, Risks, Harms, and Costs of Implementing This Recommendation

Potential Benefits:

- Improved postoperative strength, flexibility, endurance, functional outcomes, and reduced pain and anxiety, particularly in the early phases of rehabilitation.

Risks, Harms, and Costs:

- Few studies directly compare physical therapy to no intervention, limiting the ability to assess economic value of prehabilitation.
- Prehabilitation is often covered under bundled-payment programs, which reimburse hospitals a fixed amount for the entire episode of care rather than individual services.

Benefit-Harm Assessment:

- Preoperative physical therapy interventions appear to be safe, with no increase in postoperative complications or adverse events.

Feasibility

- The implementation of pre-operative physical therapy is feasible and does not require specialized equipment or training beyond standard physical therapy practice.

Role of Patient and Client Preferences

- Patient preferences should be considered, particularly concerning potential out-of-pocket costs and insurance limits on the number of covered rehabilitation visits.

Exclusions

- None identified.

Future Research

- To better understand the economic value of preoperative physical therapy for patients with knee osteoarthritis undergoing total knee arthroplasty (TKA), more detailed research and refined payment models are needed.

Range of Motion Interventions

In patients with osteoarthritis of the knee selected for TKA, which postoperative range of motion (ROM) interventions are associated with improved outcomes?

ROM Recommendation A: Physical therapists should not use CPMs for patients who have undergone primary, uncomplicated total knee arthroplasty (TKA).

Evidence Quality: High;
Strength of Recommendation: Strong ♦♦♦♦
Action Statement Profile: Aggregate evidence quality: 4 high quality[52–55] studies and 12 moderate quality studies[56–67].

ROM Recommendation B: Physical therapists should NOT use bracing or splinting in the early postoperative period to increase knee range of motion for patients who have undergone primary, uncomplicated total knee arthroplasty (TKA).

Evidence Quality: Moderate;
Strength of recommendation: Moderate ♦♦♦◊
Action Statement Profile: Aggregate evidence quality: One high quality study[68] and 4 moderate quality studies[69–72]

ROM Recommendation C: Physical therapists should design and implement treatment interventions for patients undergoing total knee arthroplasty (TKA) that include passive, active-assistive, and active range of motion (ROM) exercises to optimize recovery and improve functional outcomes of the affected knee.

Evidence Quality: Moderate;
Strength of Recommendation: Moderate ♦♦♦◊
Action Statement Profile: Aggregate evidence quality: 2 moderate-quality studies[73,74] and 2 low-quality studies[75,76]

ROM Recommendation D: Physical therapists may use manual therapy with exercise and/or devices to augment active-assisted exercise to improve range of motion (ROM) in the early postoperative period.

Evidence Quality: Moderate;
Strength of Recommendation: Weak (downgraded) ♦♦◊◊

Action Statement Profile Manual Therapy:
Aggregate evidence quality: 1 high quality study[77]

Action Statement Profile Device-Assisted ROM:
Aggregate evidence quality: 2 high quality studies[52,78] and 2 moderate quality studies[61,79]

Rationale: The collective evidence for continuous passive motion (CPM) remains consistent with the 2020 TKA CPG, showing no meaningful clinical benefit. Therefore, the use of CPM is not justified given its cost, resource demands, and potential to disrupt postoperative care. Four high-quality studies (Beaupre, 2001; Denis, 2006, Davies 2003, Mau-Moeller 2014) demonstrated no significant short-term or long-term benefits of CPM devices.[52–55] Eight moderate-quality studies (Chiarello, 1997; Worland, 1998; Can, 2003; Lenssen, 2008; Schulz, 2018; Stasi, 2020; Jacksteit, 2021) yielded mixed results that did not support routine use of CPM after TKA.[58,59,61,63,65–67]

Available evidence from multiple studies indicates that bracing and splinting do not result in clinically meaningful improvements in knee ROM following primary TKA. Given the lack of demonstrated benefit and the potential for additional cost and burden to the patient, routine use of these interventions for this purpose is not recommended. Two moderate quality studies (Horton, 2002; Kaseb, 2022) compared bracing patients in knee extension to no brace for two and eight days postoperatively and observed no differences in ROM; however, one study (Kaseb, 2022) indicated improved patient-reported pain and function at one month in the braced group.[69,70] Two moderate-quality studies (Ma 2008; Yang 2015) and one high quality study (Li, 2017) compared splinting the patient in flexion vs. full extension in the immediate postoperative period with no differences in knee ROM.[68,71,72] One study (Yang, 2015) found improved knee flexion at 6 weeks, but no difference at 6 months, while the other 2 studies reported no differences in ROM between groups at 6 weeks.[72]

Evidence suggests that no single ROM exercise method is superior following TKA. Two moderate quality studies (Xu, 2020; Chow, 2010) demonstrated a variety of passive, active-assistive, and active exercises improved knee ROM.[73,74] Chow compared active, passive and PNF interventions to improve knee flexion. All three groups demonstrated similar improvements in knee flexion ROM with no significant differences between groups.[74]

In a high-quality study (Karaborklu Argut, 2021) manual therapy combined with exercise was compared to exercise alone, with both approaches resulting in improvements in pain, function, and patient satisfaction. However, there was no significant difference in ROM observed between groups at two months. [77]

Several devices, including cycle ergometers, active motion machines, and slide boards have also been assessed for their impact on knee ROM. In a high-quality study (Beaupre, 2001), standard care was compared to the addition of either a slide board or continuous passive motion (CPM).[52] All groups showed improvement in knee flexion ROM and function at three- and six-months postoperatively, but there were no significant differences between them. Similarly, a moderate quality study (Sanzo, 2021) found no improvements in knee ROM, strength, or patient-reported function from the use of a cycle ergometer over standard exercise.[79] A high-quality study (Sattler, 2019) compared a pedal-based exercise

program to standard postoperative exercises and in the immediate postoperative period finding improved performance on functional tests and patient reported outcomes at 2 days, but no difference between groups at 2 weeks and 4 months postoperatively.[78] Another moderate quality study (Jacksteit, 2021) compared a low-resistance active motion device applied unilaterally and bilaterally to CPM, the group receiving bilateral active exercise demonstrated the greatest increase in knee flexion ROM.[61] Although no studies demonstrated that these devices are more effective than standard care interventions, they may still be considered as options to improve knee ROM.

Potential Benefits, Risks, Harms, and Costs of Implementing This Recommendation

Potential Benefits:

- Bracing into extension may have short term effects on pain and function
- Active, Passive, and Active-Assisted exercise improve knee ROM and functional outcomes
- Manual therapy and assistive devices can improve knee ROM and function, reduce early postoperative stiffness, and enhance patient engagement in rehabilitation.

Risks, Harms, and Costs:

Continuous Passive Motion (CPM)

- May increase patient discomfort
- Can reduce opportunities for active rehabilitation participation
- May prolong bedrest and delay functional recovery

Bracing and/or Splinting

- May prolong bedrest and limit natural movement patterns, restricting early mobility and gait training
- Presents logistical challenges in coordinating donning/doffing protocols among care team members
- May reduce patient adherence due to discomfort or confusion, leading to premature removal
- Requires administrative coordination with DME vendors to ensure timely provision and insurance coverage

Manual Therapy

- Effectiveness may vary depending on therapist skill and technique, although no reported harm

Basic ROM Exercises

- Associated with minimal cost and no reported harm

Overall Cost Considerations

- The use of CPM, bracing, and/or splinting would likely incur both direct and indirect expenses (e.g., equipment, maintenance, personnel), without evidence of significant or sustained long-term clinical benefit.

Benefit-Harm Assessment: The preponderance of evidence suggests that CPM offers no consistent long-term improvements in function, ROM, or quality of life following uncomplicated TKA. Given the

associated risks, inconvenience, and anticipated costs, the potential harms and resource burden outweigh the modest and transient benefits in most clinical scenarios. The lack of demonstrated clinical benefit, combined with the potential for delayed mobility and increased cost, suggests the harms and burdens of bracing or splinting outweigh any potential short-term advantages in the early postoperative period. There is a preponderance of benefit for implementing ROM exercises post-TKA. While benefits in ROM may not exceed those of standard care, manual and device-assisted approaches may support patient comfort and engagement. Given the low risk, these interventions may be considered when aligned with patient needs and available resources.

Feasibility

Implementation of CPM requires specialized equipment, setup, and supervision, which may limit its feasibility in resource-limited settings. The need for equipment transport, staff time, and patient adherence adds logistical complexity. These factors, along with the lack of long-term benefit, make CPM a less practical intervention compared to more accessible, active rehabilitation interventions.

Bracing and splinting require additional equipment and monitoring, increasing complexity and resource use in the postoperative setting without evidence of added clinical value. The implementation of ROM exercises is feasible in clinical or home settings with minimal resources. Manual therapy interventions may depend upon therapist technical skill, knowledge, and patient acceptance. The use of external devices to augment assisted ROM may be less practical in resource-limited environments.

Role of Patient and Client Preferences

Physical therapists should inform patients about the lack of evidence for CPM. Clinicians should consider patient preferences and individual goals, especially given the lack of definitive benefits with CPM use.

Patients may prefer to avoid restrictive devices that limit early mobility and comfort, particularly in the absence of proven benefit. Shared decision-making should prioritize interventions that align with patient goals and recovery expectations.

Various exercise options are available to improve knee ROM, and selection should be based on patient tolerance and preferences. Options for interventions should be discussed with patients with selections through a shared decision-making model.

Exclusions

Patients with severe stiffness, arthrofibrosis or revision TKA may require individualized rehabilitation strategies.

Future Research

Some subpopulations may benefit from CPM and/or targeting bracing or splinting. This could be explored with studies large enough to allow subgroup analyses or by narrowing inclusion criteria.

Examples may be those with TKA revisions or those with particularly poor preoperative ROM. Cost-effectiveness and patient-centered outcomes should be prioritized in future investigations.

Non-pharmacological Pain Interventions

In patients with osteoarthritis of the knee selected for TKA, are non-pharmacological pain interventions associated with improved patient-reported outcomes?

Pain Recommendation A: Physical therapists should teach and encourage use of cryotherapy for early postoperative pain management for patients who have undergone total knee arthroplasty (TKA).

Evidence Quality: Moderate
Recommendation Strength: Moderate ♦♦♦◊

Action Statement Profile
Aggregate evidence quality: 18 moderate quality studies[80–97]

Pain Recommendation B: Physical therapists may use TENS (acute and subacute phases), kinesiotaping (acute phase), manual therapy (time frame not specified), and/or psychologically-informed techniques (time frame not specified) to decrease pain after total knee arthroplasty (TKA).

Evidence Quality: Moderate
Recommendation Strength: Weak ♦♦◊◊ Downgraded due to low certainty of evidence

Action Statement Profile
Aggregate evidence quality:

- Cryotherapy- 18 moderate quality studies (5 using computer-assisted cryotherapy)[80–97]
- TENS - 1 high quality study[98] and 1 moderate quality study[99]
- Kinesiotaping - 2 moderate quality studies[81,100]
- Manual therapy - 1 high quality study[77]
- Psychologically-informed techniques – 1 high quality study[101] and 4 moderate quality studies[102–105]

Rationale

Cryotherapy: Eighteen moderate-quality studies examined the use of cryotherapy after TKA.

Five studies examined the use of computer-assisted cryotherapy.[80,82,83,86,87] One compared to a control found improvements in pain and a reduction in opioid use (Brouwers, 2022).[80] Two studies found greater improvements in pain compared to a cold pack but total treatment time differed (Coviello, 2022; Karaduman, 2019).[82,83] A similar study comparing computer-assisted cryotherapy for two hours two

times per day compared to cold packs for 20 minutes three times per day found no difference between interventions. Another study that compared two different temperatures of cryotherapy found no difference in pain but less opioid use in the group receiving 10-12° C vs 21°C (Thijs, 2019).[87] Conflicting evidence was found regarding cryotherapy vs a cold pack (Karaduman, 2019; Sadoghi, 2018).[83,86]

One study comparing cold packs used every 2 hours for 12-15 minutes to kinesiotape found that cold packs were better for edema but no better for pain (Yuksei, 2022).[81]

One study found that use of the Cryocompression Game Ready device 6x/day for 20 minutes at 5°C was no better than use of crushed ice bags (Marinova, 2023). [84]

One study comparing cold packs applied to the knee versus cold packs over the palm found no difference in pain with knee flexion (Nishigimi, 2019).[85]

TENS: This recommendation has been downgraded due to small effect sizes in the supporting evidence. One high and one moderate-quality studies (Rakel, 2014; Kim, 2021) were reviewed. Both studies showed that using TENS in the acute and subacute phases after surgery (up to 6 weeks postoperatively) could improve VAS pain ratings after walking.[98,99] Acupuncture-like TENS was better at decreasing pain at rest than standard TENS in the first 2 weeks following surgery.[99] (Kim, 2021) There was no difference in pain scores when TENS was applied daily for a short duration (45 seconds) (Rakel, 2014).[98]

Kinesiotaping: This recommendation was downgraded due to lack of certainty of the supporting evidence. Two moderate-quality studies were reviewed (Jarecki 2021, Yuksel 2022).[81,100] Both studies showed that patients who had kinesiotaping in the first week following surgery had decreased pain when compared to patients who did not have taping. There was no difference in pain at 3 months when patients who had taping in the first week after surgery were compared to patients who did not have taping.(Yuksel 2022)[81]

Manual therapy: This recommendation was downgraded due to the small sample size of the supporting study. One high quality study was reviewed (Karaborklu Argut, 2021).[77] This study showed significantly improved postoperative pain ratings when patients received a multi-modal treatment that included manual therapy when compared to a group whose treatment did not include manual therapy.

Psychologically informed techniques: One high quality study (Cai, 2018) and two moderate quality studies (Chen, 2021; Sun, 2020) examined the use of cognitive behavioral therapy following TKA.[101,103,105] Other interventions investigated include: pain neuroscience education – one moderate quality study (Baas, 2024); Videoinsight art video – one moderate quality study (Russo, 2017); and Biopsychosocial Model-based rehabilitation – one low-quality study (Bhatia, 2020).[102,104,106] In the one high quality study of cognitive-behavioral therapy, kinesiophobia, perceptions of pain, and quality of life were improved following cognitive behavioral therapy at the 1- and 6-month outcome measurements compared to standard therapy. An inclusion criterion for this study was a high level of kinesiophobia defined as a score greater than 37 on the Tampa Scale for Kinesiophobia, which may limit its generalizability to the overall TKA population.[101] In the moderate quality studies, outcomes that were

improved after psychologically informed techniques as compared to other interventions included attention to pain, pain catastrophizing, anxiety, depression, and pain with activity.[103,105]

Benefits of following this recommendation:

Cryotherapy, TENS, kinesiotaping, and manual therapy may contribute to small decreases in postoperative pain when used in a multi-modal physical therapy plan of care. Psychologically informed techniques may help to improve kinesiophobia, pain catastrophizing, and quality of life for persons with high levels of kinesiophobia.

Risks, Harms, & Cost

None of the included studies reported significant adverse events compared to control or other modalities. Risks appear to be low when treatments are applied by a trained physical therapist.

Costs for implementing these treatments vary: cryocompression braces and computer-assisted therapy units are expensive, while TENS units and tape are inexpensive and widely available. Manual therapy interventions can be applied during routine physical therapy treatment sessions. Cognitive-behavioral therapy and other psychologically informed techniques may cost more than standard physical therapy because these may require interprofessional collaboration or advanced training for the physical therapist.

Feasibility

Cryotherapy, TENS, kinesiotaping, and manual therapy have been used extensively and are feasible interventions. The application of manual therapy, kinesiotaping, and cognitive-behavioral therapy may require physical therapists to undergo additional training in order to apply these treatments during routine physical therapy sessions. Cognitive behavioral therapy may involve collaboration with other professions.

Role of Patient Preferences

Patients' preferences for pain-relieving modalities should be considered before applying cryotherapy, TENS, kinestiotape, or manual therapy.

Physical therapists should confer with patients who demonstrate high levels of kinesiophobia regarding the option for psychologically informed treatment strategies in their rehabilitation.

Exclusions

- Clinicians should not utilize cryotherapy or TENS for patients who present with contraindications to these modalities.
- Taping should not be used for patients with adhesive allergies or a history of tape reactions.
- Manual therapy should not be utilized for patients with contraindications or by untrained therapists.
- Persons with low levels of kinesiophobia (<37 on the Tampa Scale for Kinesiophobia) are unlikely to benefit from cognitive-behavioral strategies.

Future Research

Further high-quality research is needed to discover optimal treatment parameters and timing for cryotherapy, TENS, kinesiotaping, and manual therapy. Future research is needed to identify best practice for taping application techniques and to determine the effects of taping when it is applied greater than 1 week postoperatively. Additional research is needed to compare the use of kinesiotape to other pain-relieving interventions.

Future research on manual therapy should aim to identify optimal dosing and specific techniques that maximize postoperative pain relief.

Further high-quality research is needed to discover optimal treatment parameters for psychologically informed interventions and to identify sub-groups of patients who are most likely to benefit from these interventions.

Swelling/Edema Management Strategies

In patients with osteoarthritis of the knee selected for TKA, which swelling/edema management strategies improve patient outcomes, postoperatively?

Swelling/Edema Recommendation A: To minimize risk of immediate postoperative swelling/edema, physical therapists and/or other team members should prescribe cryotherapy treatment and teach positioning techniques of the surgical limb in the initial recovery period after total knee arthroplasty (TKA).

Evidence Quality: High;
Recommendation Strength: Moderate. (downgraded due to certainty of evidence) ♦♦♦◊

Action Statement Profile
Aggregate evidence quality: 2 high quality studies[68,107] and 12 moderate quality studies[80,81,83,84,86–88,91,93–96]

Cryotherapy: 12 moderate[80,81,83,84,86–88,91,93–96]

Limb Positioning: 2 high quality studies[68,107] and 3 moderate quality studies[72,108,109]

Swelling/Edema Recommendation B: Physical therapists may consider kinesiotaping after uncomplicated total knee arthroplasty (TKA) to reduce postoperative swelling and edema; however, evidence is mixed regarding its benefit.

Evidence Quality: Moderate
Recommendation Strength: Weak ♦♦◊◊ (Downgraded due to heterogeneity of evidence)

Aggregate evidence quality: 3 moderate quality studies[81,100,110]

Swelling/Edema Recommendation C: In the absence of sufficient quality evidence, it is the opinion of this workgroup that physical therapists should not use manual lymphatic draining (MLD), compression dressings, or continuous passive motion (CPM) to reduce postoperative swelling and edema following total knee arthroplasty (TKA) as these interventions have not been proven effective.

Evidence Quality: Low
Recommendation Strength: Consensus ♦◊◊◊ (Downgraded due to heterogeneity of evidence)

Action Statement Profile
Aggregate evidence quality:

Compression: 1 moderate quality study[111]

Manual Lymph Drainage: 2 conflicting, moderate quality studies[110,112]

Continuous Passive Motion: 1 moderate quality study[113]

Rationale

Cryotherapy: Physical therapists should consider prescribing cryotherapy treatment for postoperative management of edema and swelling following TKA. Current literature does not identify one specific modality of cryotherapy as superior to others in reducing swelling. Therefore, the advantages and disadvantages of each option should be carefully evaluated when selecting a treatment method (12 moderate-quality studies: Su, 2012; Demoulin, 2012; Pan, 2015; Schinsky, 2016; Rui, 2017; Ruffilli, 2017; Sadoghi, 2018; Karaduman, 2019; Thijs, 2019; Brouwers, 2022; Yuksel, 2022; Marinova, 2023). Variability in study protocols limits recommendations regarding the optimal timing, duration, frequency, or method of application. Additionally, there is insufficient evidence to specify when to initiate cryotherapy post-surgery or how long it should be continued.

Limb positioning: early postoperative limb positioning with the knee in flexion (typically 30° to 90°) has been shown to reduce knee swelling and both total and hidden blood loss, while also improving early range of motion (ROM). These benefits are generally observed within the first 72 hours postoperatively, and the intervention has not been associated with increased complications. Supporting evidence includes: (2 high-quality studies[68,107] (Li, 2017; Wu, 2019), 3 moderate-quality studies[72,108,109] (Li, 2012; Panni, 2014; Yang, 2015) Due to variability in study interventions, the work group is unable to recommend an optimal duration, frequency, or degree of knee flexion.

Kinesiotaping: The evidence surrounding kinesiotaping remains inconclusive. Two moderate-quality studies (Jarecki, 2021; Yuksel, 2022) reported no significant benefit of kinesiotaping for reducing postoperative swelling, while one moderate-quality study (Guney-Deniz, 2023) demonstrated short-term improvements in edema.[81,100,110] Given this variability, the overall effectiveness of kinesiotaping in managing postoperative swelling remains uncertain. Clinicians may consider its use on a case-by-case basis following uncomplicated TKAs but should do so with an understanding of the current limitations in the evidence.

Manual lymphatic draining (MLD): The benefits of MLD for postoperative management of edema and swelling after TKA remain unclear, with inconsistent evidence from both moderate and low-quality studies. One moderate-quality study reported improvement in edema on postoperative day 4, but no sustained benefit (Guney-Deniz, 2023), while another moderate-quality study found no significant effect on swelling (Ebert, 2013).[110,112] A low-quality study concluded that MLD is not effective for swelling reduction (Wagner, 2024).[114] Furthermore, when analyzing evidence located as part of this CPG (Appendix 2), we found no significant evidence supporting the use of MLD to reduce postoperative swelling.

Compression: Compression dressings applied during the first 24 hours after TKA do not appear to reduce swelling (moderate-quality study (Brock, 2017). [111]

Continuous passive Motion (CPM): The use of a CPM device does not appear to reduce postoperative edema. One moderate-quality study (Alkire, 2010) reported no statistically significant difference in edema outcomes between the group receiving CPM and the control group.[113] Based on this finding, and

in the absence of consistent or compelling evidence, there is currently insufficient evidence to support the use of CPM for edema control.

Potential Benefits, Risks, Harms, and Costs of Implementing This Recommendation

Benefits are as follows:

- Cryotherapy may result in short-term postoperative improvements in pain, knee flexion, opioid use, and postoperative swelling compared to no cryotherapy; possible modest improvement in early mobilization and walking distance.
- Postoperative positioning of the knee in flexion helps reduce early postoperative swelling and edema and is associated with reduced blood loss and improved knee ROM in the early phase of recovery following TKA.
- The benefit-harm balance for kinesiotaping, MLD, compression dressings and CPM in managing postoperative swelling and edema after TKA is uncertain due to inconsistent or limited evidence of effectiveness. Given the low risk of harm but lack of clear clinical benefit, the recommendation is weak and emphasizes careful consideration before routine use.

Risks, harms, and/or costs are as follows:

None of the included studies reported significant adverse events compared to control or other modalities. Risks appear to be low for all treatment options when implemented by trained physical therapists.

- When using cryotherapy, while rare, complications like skin irritation, cold-induced injury (e.g., frostbite), and delayed wound healing may occur; these risks can be mitigated through appropriate screening, monitoring and patient education.
- Knee flexion positioning may increase the risk of postoperative knee extension loss and should be implemented with caution. Current evidence does not show an increased risk of fixed flexion deformities; however, generalizability is limited by delayed mobilization protocols and prolonged inpatient stays in existing studies.
- Costs for implementing these treatment strategies can vary depending on the intervention and device selected. High-cost cryotherapy devices (e.g., computer-assisted or continuous flow systems) may improve patient experience but could be cost-prohibitive in low-resource or outpatient settings. Low-cost alternatives (e.g., ice packs) are more accessible but may offer less consistent cooling. Limb positioning devices and kinesiotape, and are generally low cost and widely available.
- Costs associated with MLD, compression materials and CPM may not be justified without clear benefit. There is an opportunity cost, as resources spent on these treatments could be allocated to more effective interventions.

Benefit-harm assessment:

N/A

Feasibility

Cryotherapy and postoperative limb positioning are practical, low-cost interventions suitable for both inpatient and outpatient settings. Basic methods (e.g., ice or gel packs) are widely accessible, require minimal equipment, and are simple to apply. Advanced systems (e.g., cryocuffs, continuous cold flow,

computer-assisted devices) involve higher costs and equipment needs but may improve ease of use and patient satisfaction. Minimal staff training is required, and protocols can be tailored to patient needs and facility resources. Overall, both cryotherapy and limb positioning are feasible and scalable interventions for routine postoperative care after TKA.

Kinesiotaping, MLD and compression dressings are generally feasible to implement in clinical settings, requiring modest equipment and staff training. MLD requires skilled therapists, which may limit availability in some settings. Kinesiotaping and compression dressings are widely accessible but require appropriate application techniques. Implementation of CPM requires specialized equipment, setup and supervision, which may limit its feasibility in resource-limited settings. The need for equipment transport, staff time, and patient adherence adds logistical complexity. Given the uncertain benefit, routine implementation may not be a cost-effective use of resources.

Role of Patient and Client Preferences

Patients' preferences should be considered when selecting interventions for the management of postoperative swelling and edema. When utilizing cryotherapy, limb positioning, and kinesiotaping, preferences may be influenced by factors such as cost, insurance coverage, access to equipment, storage needs, physical ability, prior experience, and comfort.
Similarly, clinicians may consider patient preferences when using MLD, compression dressings, or CPM, as these interventions may not improve swelling, edema, or functional outcomes postoperatively. Patients should be informed that evidence is conflicting or lacking—some may value these treatments for comfort or past experience, while others may choose to avoid them due to unclear benefit.

Exclusions

- Patients with cold sensitivity, impaired sensation, impaired circulation or skin concerns may require adjusted protocols.
- Taping should not be used for patients with adhesive allergies or a history of tape reactions.
- This recommendation applies to typical postoperative edema management following TKA. Patients with severe stiffness, arthrofibrosis, or prior interventions (e.g., manipulation under anesthesia) represent atypical cases and may require individualized approaches to cryotherapy and limb positioning.

Future Research

High-quality randomized controlled trials with longer follow-up are needed to improve guidance on cryotherapy and limb positioning after TKA. Key research priorities include:

- Defining optimal timing, frequency, and duration of cryotherapy for maximal benefit.
- Comparing cost-effectiveness across cryotherapy modalities, from basic ice packs to advanced devices.
- Identifying patient subgroups (e.g., high BMI, comorbidities, preoperative swelling) who may benefit most.
- Evaluating effects on early mobilization, functional recovery, opioid use, and healthcare outcomes such as readmissions and length of stay.

- Conducting larger trials comparing degrees of knee flexion, duration, and frequency of positioning to clarify effectiveness in reducing swelling and edema.
- Inclusion of economic analysis and patient-centered outcomes will be essential to establish the value and generalizability of these interventions in contemporary TKA care pathways

High-quality randomized controlled trials are needed to clarify the effectiveness of kinesiotaping, MLD, compression dressings and CPM in reducing postoperative edema and swelling after TKA. Future studies should:

- Determine optimal treatment protocols, including timing, frequency, and duration.
- Identify patient subgroups who may benefit more based on factors such as baseline edema or comorbidities).
- Evaluate patient-centered outcomes including comfort, satisfaction, and functional recovery.
- Incorporate long-term follow up and standardized outcome measures
- Include economic analyses to understand cost-effectiveness.
- Explore potential synergistic effects when combined with other modalities like cryotherapy or therapeutic positioning.

Physical Activity Interventions

In patients with osteoarthritis of the knee selected for TKA, which postoperative physical activities are associated with improved outcomes?

Physical therapists should encourage early physical activity and develop a plan to progressively increase physical activity based upon safety, functional tolerance, physiological response, and collaborative goal setting with patients who have undergone total knee arthroplasty (TKA).

Evidence Quality: Moderate
Recommendation Strength: Moderate ♦♦♦◊

Action Statement Profile
Aggregate evidence quality: 1 high quality study[115] and 9 moderate quality studies[116–124]

Rationale

One high quality (Christiansen, 2024) and one moderate quality (Christiansen, 2020) article examined the outcomes of a physical activity (PA) intervention targeting a progressive increase in PA [steps per day and moderate to vigorous physical activity (MVPA)] using activity trackers and collaborative goal setting with patients.[115,116]

Christiansen et al.,[115] included U.S. Veterans who were 2-4 weeks post-TKA. The intervention group received a telehealth-based PA behavior change intervention focused on education, self-monitoring, feedback barrier and facilitator identification, problem solving, action planning, and encouragement. The control arm received the same number of sessions, but emphasis was placed on health education. The PA behavior change intervention group had more daily steps compared to control at the end of intervention. There were no long-term differences in PA at 6 months; however, a majority of participants walked greater than what has been shown to be protective against functional limitation development in people with knee OA (6000 steps per day).[125]

Christiansen et al., found that patients who received a physical therapist administered PA intervention accumulated more steps per day and spent more minutes per week in MVPA at six months compared to a control intervention.[116] After outpatient physical therapy discharge, patients received monthly phone calls for 6 months to update steps goals and promote sustainability of the PA intervention.

One moderate quality article (Pelligrini, 2023)[3] found no differences at 12 weeks between patients that received an enhanced PA intervention consisting of goal setting, problem-solving, and use of motivational interviewing techniques to promote 150 minutes/week of moderate intensity aerobic activity.[117] A second moderate quality article (Losina, 2018)[4] found that patients who received a PA intervention based on motivational interviewing principles along with financial incentives to increase PA increased their steps per day by 1808 as well as increased weekly PA by 39 minutes.[118]

In addition to PA interventions, moderate quality evidence indicates that activities such as stationary cycling (DeJong, 2020)[5,6], aquatic exercise (Giaquinto, 2010; McAvoy, 2009; Valtonen, 2011)[7-9], and Tai Chi (Li, 2019)[10] are safe in the early postoperative period and demonstrate positive effects on quality of life, physical function, walking ability, knee ROM, and strength.[119–123] Finally, one year after TKA, moderate quality evidence (Hepperger, 2017)[11] supports participating in hiking to improve stair climbing performance and self-reported function.[124]

Benefits & Harms:

Potential benefits are as follows:

- Increased PA levels
- Decreased risk of mortality and development of comorbidities
- Improved activity and participation levels
- Improved quality of life

Potential Harms are as follows:

- No increased risks were identified when progression of PA was monitored for safety, functional tolerance, and physiological response.
- Potential increased risk for soreness/pain

Cost:

- Additional cost may be associated with the health care provider's time to deliver a physical activity intervention as well as potential costs associated with activity tracking

Feasibility

- Feasibility may be limited by resources related to cost as well as the intervention may need to be delivered over a longer period of time to increase sustainability.

Exclusions

None were identified

Role of Patient Preferences: PA goal setting should be based upon a collaborative process with the individual patient. Incorporation of activities such as stationary cycling, aquatic exercise, and Tai Chi should be based on preferences.

Future Research: Future research should determine optimal methods to improve PA levels after TKA and methods to increase sustainment of increasing PA. Furthermore, future studies should examine the effects of PA (e.g. cycling) on both short and long-term outcomes after TKA including safety.

Movement Pattern Retraining Interventions

In patients with osteoarthritis of the knee selected for TKA, which postoperative movement pattern retraining interventions are associated with improved patient outcomes?

Physical therapists should include motor function training in their interventions for patients who have undergone total knee arthroplasty (TKA). Interventions can include dynamic balance training, computer or app-assisted gait retraining, and movement training with feedback.

Evidence Quality: High

Recommendation Strength: Strong. ♦♦♦♦

Action Statement Profile
Aggregate evidence quality: 9 high quality studies[126–134] and 12 moderate quality studies[135–146]

2024 CPG Rationale

Nine high-quality and 12 moderate-quality studies investigated the effects of various types of movement pattern retraining on balance, walking, and physical function after TKA. Interventions varied from in-clinic to home-based. Many studies did not use any specialized equipment, but some used apps, virtual reality, and other technologies. A lot of studies included some type of balance and/or sensorimotor training using uneven surfaces, agility exercises, varying bases of support, and similar approaches. Many studies also incorporated weightbearing functional tasks including sit-to-stand transfers and stair negotiation into their exercise programs.

The included studies vary with respect to whether real-time feedback regarding movement patterns was provided to participants, but six of the included studies (3 high-quality and 3 moderate-quality) appear to have incorporated real-time feedback and therefore may most closely meet the definition of movement pattern retraining.[129,131,134,139,141,143] Two high-quality studies (Christiansen, 2015 and Bade, 2024) investigated movement pattern training versus usual physical therapy post-TKA but found conflicting results.[129,134] Christiansen et al. Found that five times sit-to-stand time and peak knee extension moments during gait favored the intervention group at six months, while Bade et al. mostly found equivocal outcomes between groups. In a study that only included women, Lee and colleagues (2020) compared dynamic balance retraining with vs. without real-time visual feedback and found that the group that received visual feedback had better physical function, gait, and balance post-intervention (four weeks).[139] Three studies provided real-time feedback using technologies. Two moderate-quality studies (Choi, 2019 and Hadamus, 2021) found conflicting short-term results when using gamification as an intervention, but this may be because the Choi study also involved constraint-induced movement therapy.[141,143] One high-quality study (Debbi, 2019) used an external shoe orthotic device to provide feedback on gait biomechanics and found improved function, walking ability, and pain at one year compared to use of a sham device.[131]

Among the included high-quality studies, the majority (Brunn-Olsen, 2013; Christiansen, 2015; Debbi, 2019; Liao, 2015; Moffett, 2004) found outcomes favoring movement pattern or functional retraining with respect to gait, balance, and physical function.[126,128–131] One high-quality study (Roig-Casas, 2018) found mixed results for balance, with some balance outcomes favoring a platform-based balance program vs. standard rehabilitation but other balance outcomes being similar between groups.[133] Three high-quality studies (Bade, 2024; Piva, 2010; Pournajaf, 2022) did not find many significant between-group differences; however, one of those studies (Piva, 2010) was a feasibility study that was not powered to detect significant between-group differences, and another (Pournajaf, 2022) compared two different approaches to balance training so both groups received the training in some manner.[127,132,134]

The included moderate-quality studies mostly favored movement pattern or balance retraining interventions (An, 2023; An, 2024; Choi, 2019; Lee, 2020; Lee, 2021; Moutzouri, 2018; Palanisamy, 2024), with most only examining outcomes immediately post-intervention at 4-8 weeks post-baseline and only one (Palanisamy, 2018) examining outcomes at 6 months or longer.[138–140,142–145] Among the four moderate-quality studies that did not find significant between-group differences (Frost, 2002; Hadamus, 2021; Karaduz, 2024; Nakamura, 2020), some had considerable methodological concerns including very high participant attrition (Frost, 2022) and improper randomization scheme (Nakamura, 2020).[136,137,141,146]

Potential benefits, risks, and harms of implementing this recommendation.

Benefits are as follows:

- Improvement in balance.
- Improvement in walking function.
- Improvement in physical function, especially performance-based measures.
- Improvement in activities and participation (eg, getting in and out of car, shopping, household duties).

Risk, harm, and/or cost are as follows:

- No expected risk or harms are associated with this recommendation.
- Team members should be aware of potential complications after TKA that may affect exercise including incision healing, thromboembolism, and joint stiffness/arthrofibrosis. Some of the more advanced training programs that include app-based training, or weight-bearing biofeedback may be cost- and resource-prohibitive for some clinical settings.

Benefit-harm assessment: A preponderance of evidence supports including motor function training. The individualization of progression to match the patient's goals, abilities, and physiological response should include documentation of objective baseline data, the patient's goals, and plan of care

(interventions, dosage, frequency, and duration). This includes the use of appropriate outcomes to demonstrate patient response to the specific approach.

Feasibility

Feasibility of movement pattern training depends somewhat upon whether the physical therapist and patient intend to use some type of specialized device or digital health tool. Existing research has shown promise for some devices that may not be readily available or financially feasible, but several studies have also shown benefits for intervention programs that are easily and safely implemented within most outpatient clinic or home-based settings.

Role of Patient Preferences

Patient preferences should be considered regarding whether movement pattern retraining interventions should incorporate the use of devices or technologies.

Future research

The long-term impact of normalizing movement patterns or improving balance after TKA remains unclear. Future research should determine whether improving movement symmetry reduces long-term sequelae on the surgical and nonsurgical limbs and whether improving balance after TKA reduces fall prevalence and long-term morbidity. As technology improves, the use of biofeedback-based movement interventions may become more applicable for this patient population. Future research is warranted to determine the feasibility of such systems and long-term impact.

Exclusions. None were identified.

Neuromuscular Electrical Stimulation (NMES) Interventions

In patients with osteoarthritis of the knee selected for TKA, does postoperative use of neuromuscular electronic stimulation around the knee/quadriceps area improve postoperative outcomes?

Physical therapists should use NMES for patients who have undergone total knee arthroplasty (TKA) to improve quadriceps muscle strength, gait performance, performance-based outcomes, and patient-reported outcomes, but its impact on patient-reported outcomes is less well defined.

Evidence Quality: Moderate
Recommendation Strength: Moderate ♦♦♦◊

Action Statement Profile
Aggregate evidence quality: 6 moderate quality studies[147–152] and 2 low quality study[153,154]

Rationale

Six moderate-quality studies (Avramidis, 2011; Avramidis, 2003; Stevens-Lapsley, 2012; Yoshida, 2017; Petterson, 2009; Sax, 2022) evaluated the effectiveness of neuromuscular electrical stimulation (NMES) versus no NMES in patients following total knee arthroplasty (TKA).[147–152] Two studies (Stevens-Lapsley, 2012; Yoshida, 2017) demonstrated that NMES improved quadriceps and hamstring maximum voluntary isometric contraction from 2 to 52 weeks post-TKA.[149,150] Four studies (Avramidis, 2011; Avramidis, 2003; Stevens-Lapsley, 2012; Yoshida, 2017) reported greater improvements in walking ability, stair-climbing performance, and patient-reported outcomes with NMES compared to no NMES use during the same period.[147–150] Postoperative range of motion (ROM) did not differ significantly between NMES and no NMES groups from 2 to 52 weeks after TKA (Stevens-Lapsley, 2012; Yoshida, 2017; Petterson, 2009).[149–151] Initiating NMES as early as postoperative day 2, applying it more frequently (5–7 times daily), and maximizing cumulative intensity were associated with improved outcomes (Avramidis, 2011; Avramidis, 2003; Stevens-Lapsley, 2012; Yoshida, 2017).[147–150]

One moderate-quality study (Sax, 2022) comparing NMES to sham NMES found that at 12 weeks, the NMES group reported reduced knee pain and stiffness and improved function.[152] Another moderate-quality study (Avramidis, 2011) showed that patients receiving NMES experienced statistically significant improvements in patient-reported outcomes, perceived physical health status, and walking speed.[148] Conversely, two other moderate-quality studies (Petterson, 2009; Avramidis, 2003) did not identify significant differences in patient-reported outcomes or perceived physical health status.[147,151]

Potential benefits, risks, and harms of implementing this recommendation.

Benefits are as follows:

- Improvement in quadriceps and hamstrings maximum voluntary isometric contractions from 2 to 52 weeks after TKA.
- Improvement in walking, stair-climbing performance

Risk, harm, and/or cost are as follows:

- The financial cost of using NMES and its availability to patients may be prohibitive for patients.
- Pain/discomfort with use.

Benefit-Harm Assessment:

There is a preponderance of benefit for the use of NMES following TKA, particularly for patients with quadriceps muscle activation deficits. However, considerations such as cost, access, and patient tolerance must be weighed against these benefits.

Feasibility:

Cost, access to NMES units and patient tolerance may limit adoption. Patients after TKA who are most likely to benefit are those with quadriceps muscle activation deficits, often measured in terms of a quadriceps extensor lag or quadriceps activation battery. NMES should be applied regularly for at least a minimum of 3 weeks.

Role of Patient preferences:

Patients should be educated on the benefits of NMES and determine its use in a shared decision-making model.

Future research. Although current evidence supports the use of NMES after TKA, additional research might continue to refine NMES benefits by understanding patient factors supportive of NMES use, optimal dosage, stimulation parameters, application with and without concurrent muscle contraction, mechanisms explaining NMES efficacy, adjuncts to NMES (eg, nutritional supplementation), and when to discontinue NMES.

Exclusions. None were identified.

Strength Training Interventions

In patients with osteoarthritis of the knee selected for TKA, does postoperative strength training significantly improve postoperative outcomes?

Physical therapists should design, implement and teach patients who have undergone total knee arthroplasty (TKA) progressive strength training and exercise programs beginning in the early post-acute period to improve function, strength, and ROM.

Evidence Quality: High

Strength of Recommendation: Strong ♦♦♦♦

Action Statement Profile

Aggregate evidence quality: 7 high quality studies[9,155–160] and 1 moderate quality studies[138,146,161–175]

Rationale. Seven high quality studies (Bade, 2017; Cetinkaya, 2022; Do, 2020; Evgeniadis, 2008; Liao, 2020; Suh, 2017; Yousefian, 2017;) and 17 moderate quality studies (An, 2023; Backer, 2021; Bily, 2016; Cheng, 2024; Husby, 2018; Karaduz, 2024; Karaplnar, 2024; Kondo, 2022; Maeda, 2024; Park, 2012; Piva, 2019; Schache, 2019; Tanaka, 2017, Teissier, 2020; Thonga, 2021; Warner, 2020) support the benefit of postoperative progressive, resistance exercise programs on muscle strength, functional performance, and balance.[9,138,146,155,156,158–174] The type, intensity, timing, and delivery model of the exercise program vary in the studies though all demonstrated benefit.

Specified progressive resistance exercise programs shown to provide significant benefit include the combined use of closed and open-chain exercises (An, 2023; Thonga, 2021), combined use of eccentric and concentric resistance exercises (Suh, 2017; Tessier, 2020), use of isotonic and isokinetic resistance exercise (Cheng, 2014), and use of exercise bands (Cetinkaya, 2022; Liao, 2020).[138,156,158,159,163,172,173] Introducing progressive exercises early in the inpatient, post-acute phase of recovery was also shown to safely provide benefit (An, 2023; Kondo, 2022; Karalpmar, 2024).[138,165,166] Use of auditory and visual feedback with typical postoperative isometric quad exercises showed greater improvements in TUG scores, gait speed, and function (Kondo, 2022).[166] Karalpmar and colleagues (2024) found benefit for both a high intensity exercise program and a low-intensity exercise program when delivered in the inpatient setting.[165] Both groups demonstrated improvement in pain scores while the high-intensity group demonstrated improved stiffness and function. Similarly, Bade (2017) showed benefit for both high-intensity and low-intensity resistance training though not significant difference between the two.[155] The authors noted that the effectiveness of high-intensity resistance training may be limited by arthrogenic inhibition of the quadriceps (muscle activation deficits) in the early postoperative period (Bade, 2017).

Several articles tested the addition of specific exercises (Bily, 2016; Husby, 2018; Karaduz, 2024; Schache, 2019) into a typical postoperative exercise regimen.[146,162,164,170] Schache (2019) added in specific hip abductor exercises which did not significantly improve function, strength, or patient satisfaction over general functional strengthening exercises.[170] Conversely, Do (2020) found that the

inclusion of hip muscle strengthening versus quad and AROM training can significantly improve physical function and gait.[157] Bily (2016) looked at isokinetic less press exercise and found that it was less time consuming than conventional physical therapy but did not have significant differences in quad strength, pain or functional outcomes for participants.[162] Maximal strength training did seem to show significant difference in strength of targeted muscle groups but not in overall functional gains (Husby, 2018).[164] Finally, Karaduz (2024) found that including core stabilization exercises and balance training were beneficial for balance, function, and ROM.[146]

Further evidence is needed to assess the benefit of physical therapy in later-stage recovery (greater than 2 months postoperatively. Piva (2019) showed functional improvement from the physical therapy intervention when compared to community exercise groups or no intervention, but there was not perceived improvement by patient self-report.[169]

Potential benefits, risks, and harms of implementing this recommendation.

Benefits are as follows:

- Improvement in muscle strength.
- Improvement in functional activities
- Improvement in gait speed
- Improvement in balance.
- Improvement in knee extension.

Risk, harm, and/or cost are as follows:

- Early postoperative high intensity resistance training after TKA does not have harms or risks when the therapist follows appropriate progression criteria (eg, avoiding excessive swelling, pain, or prolonged soreness following intervention) and educates the patient accordingly.
- In the absence of appropriate criteria, overly aggressive progression can exacerbate pain and swelling.
- Team members should be aware of potential complications after TKA that may affect exercise including incision healing, thromboembolism, and joint stiffness/arthrofibrosis.

Benefit-harm assessment: There is a preponderance of benefit for this recommendation.

Feasibility

Feasibility of a postoperative exercise program will vary based on the setting, supplies, and timing of therapist interaction with the patient. However, due to the preponderance of data showing benefit from various kinds of exercise, a program can be chosen and tailored by the therapist to meet the needs of individual patients within the constraints of the work setting with the resources available.

Role of Patient Preferences

Exercise programs can be adjusted based on patient preferences and tolerance. Improvements in strength, function, and gait can be gained through different methods.

Exclusions. None were identified.

Future research. Future studies should evaluate the impact of muscle activation deficits on the effectiveness of early progressive resistance exercise in terms of muscle strength gains and functional outcomes. Additional work should focus on the optimal timing of resistance training, potentially targeting later postoperative recovery when muscle activation deficits have resolved.

Physical Therapy Delivery Methods

In patients with osteoarthritis of the knee selected for TKA, what delivery methods of postoperative physical therapy are associated with improved outcomes?

Delivery Methods Recommendation A: Supervised physical therapist management should be provided for patients who have undergone total knee arthroplasty (TKA). The optimal setting should be determined by patient safety, mobility, and environmental and personal factors

Evidence Quality: Moderate

Recommendation Strength: Moderate ♦♦♦◊

1 high quality study[176]

20 moderate quality studies[40,73,101,116,155,177–191]

Delivery Methods Recommendation B: Physical therapists may use group-based or individual-based physical therapy sessions for patients who have undergone total knee arthroplasty (TKA).

Evidence Quality: Moderate

Recommendation Strength: Weak ♦♦◊◊ *(Downgraded due to heterogeneity in study results and issues with study design)*

1 high quality study[192] (Fransen, 2017)

4 moderate quality studies[169,193–195] (Artz, 2017; Krumov, 2022; Lenguerrand, 2020; Piva, 2019)

Delivery Methods Recommendation C: Physical therapists and patients should consider use of digital health tools after total knee arthroplasty (TKA), either in addition to in-clinic care or as an alternative to in-clinic care.

Evidence Quality: High

Recommendation Strength: Moderate ♦♦♦◊ *(Downgraded due to wide variation in interventions being compared and heterogeneity in outcomes measured.)*

3 high quality studies[115,196,197]

25 moderate quality studies[26,104,135,141,161,198–217]

Action Statement Profile

Aggregate evidence quality:

6 high quality studies and 48 moderate quality studies as delineated above

Rationale

Supervision of postoperative PT: In the original 2020 CPG, the two available high and moderate quality trials found that supervised exercise was superior to unsupervised. Recent moderate-quality studies examining supervised vs. unsupervised exercise post-TKA (Hamilton, 2020; Xu, 2021) have mostly found equivocal outcomes, although standard outpatient rehabilitation was associated with stronger functional outcomes at three months postoperatively compared to home-based rehabilitation.[73,182] Since the 2020 CPG, two moderate-quality studies (Christiansen MB, 2020; Haghpanah, 2024) compared home-based to outpatient physical therapy.[116,181] One found that direct-to-outpatient physical therapy was more effective at restoring strength, reducing pain, and improving performance on functional tests at one month postoperatively. The other found equivalent outcomes at five months postoperatively.

Group vs. individual PT: Two moderate-quality studies have been added to the literature since the original 2020 CPG. One study (Lenguerrand, 2020) found that group-based exercise plus usual care is superior to usual care alone in improving function one year postoperatively.[195] Another study (Krumov, 2022) found that group-based physical therapy was superior than 1:1 physical therapy at three and six months postoperatively, but there were concerns about the lack of adherence data, the specific content of the interventions, and considerable differences in treatments received between groups.[194]

Digital health tools: Digital health encompasses the use of digital tools, including telehealth/telerehabilitation, smartphone applications, wearable sensors, remote patient monitoring, and other emerging technologies. Since the initial CPG was published, three high-quality studies (Chang, 2023; Christiansen, 2024; Yoon, 2020) compared various remotely-delivered or technology-based interventions to usual care or usual rehabilitation.[115,196,197] They found that video-based exercise and education was superior in improving lower extremity strength and function compared to usual care (Chang, 2023), that telehealth-delivered self-management education resulted in short-term gains in step count (Christiansen, 2024), and that the addition of virtual reality to standard rehabilitation may improve lower extremity stability (Yoon, 2020). Additional moderate-quality trials (Backer, 2021; Bell, 2020; Correia, 2019; Duong, 2023; Gianola, 2020; Hadamus, 2021; Hardt, 2018; Nuevo, 2024; Pronk, 2020; Prvu Bettger, 2020; Sahin, 2022; Shim, 2023; Torpil, 2022; Tripuraneni, 2021; Zhao, 2023) have compared a variety of physical therapist-delivered telerehabilitation interventions, remote therapeutic monitoring approaches, and smartphone apps to various control and usual care conditions.[135,141,161,198,200–202,206,208,209,211,212,214–217] Most commonly, they have found similar outcomes

between telerehabilitation and in-person approaches. Often, the addition of smartphone apps or remote monitoring technology in addition to standard rehabilitation results in short-term improvements compared to standard rehabilitation without apps or remote monitoring. One moderate-quality study showed lasting benefits to an app, fitness tracker with activity goals, and online health coaching for at least one year post-TKA (Duong, 2023); otherwise, there is limited evidence available to make a conclusion regarding the long-term impacts of these approaches.[201]

Potential Benefits, Risks, Harms, and Costs of Implementing This Recommendation

Benefits:

- Approaches that include supervised physical therapist management that is individualized to each patient based on their unique needs may produce better outcomes than group-based approaches or those offering less supervision from a physical therapist.
- Group-based therapy may be less costly than individually-based therapy.
- Remote therapeutic monitoring and/or telerehabilitation approaches may allow for frequent physical therapist supervision without concern for transportation barriers.

Risks, harms, and/or costs:

- There were no reported risks or harms associated with providing supervised physical therapist care. Group therapy may fail to provide enough progression of interventions for more advanced patients or provide adequate engagement for patients with significant impairments. Therefore, group-based physical therapist management after TKA will require careful selection of patients, and patients' progress should be monitored throughout their course of care.
- Telerehabilitation and other technology-based approaches to treatment may save the patient money in transportation and parking, and may either be either cost-saving (due to needing less physical clinic space) or cost-producing (due to needing specialized technology) depending upon the specific technologies used.

Benefit-harm assessment:

There is a preponderance of benefit that supervised physical therapist management (in group-based or individual-based sessions) should be provided after TKA to address impairments and functional limitations.

Feasibility

Feasibility of implementing telerehabilitation, remote therapeutic monitoring, or other technology-based delivery modes may vary based on clinical setting and available technology. Feasibility of providing 1:1 vs. group-based care may vary based on clinical setting, space and time considerations, and/or insurance and payment restrictions.

Role of Patient and Client Preferences

Physical therapists should confer with each patient or client their preferences regarding postoperative care settings and supervision, desire for 1:1 or group-based environments, and preferences for digital health tools. Out-of-pocket costs, transportation, and other potential barriers and facilitators to accessing care should be discussed.

Exclusions

Exclusions for telerehabilitation as an alternative to in-person physical therapy include when a patient indicates a preference for purely in-person care, when the clinician is not trained in using digital health tools, or when the patient's presentation precludes the safe delivery of telerehabilitation services.

Future Research

While truly withholding physical therapy after TKA may not be ethical, studies that compare supervised physical therapy with a true nonactive control or self-directed exercise without physical therapist input are needed. Studies are also needed that compare individual vs. group-based approaches where the content and dosage of the interventions are substantially similar between groups being compared. Future prognostic studies should also work to identify patient characteristics associated with successful self-management of functional recovery after TKA vs. characteristics associated with requiring more intensive or frequent supervision from a physical therapist postoperatively to achieve desired functional outcomes. With the recent explosion in telerehabilitation, remote monitoring, and various smartphone apps used in rehabilitation, future research is needed to understand the impact of these technologies on patient care and how they are best used to support functional recovery after TKA.

Accelerated Postoperative Rehabilitation Protocols

In patients with osteoarthritis of the knee selected for TKA, is an accelerated postoperative rehabilitation protocol associated with improved outcomes, as compared to traditional postoperative rehabilitation?

Physical therapist management should start within 24 hours of surgery and prior to discharge for patients who have undergone total knee arthroplasty (TKA)

Evidence Quality: Moderate

Strength of Recommendation: Moderate ♦♦♦◊

Action Statement Profile

Aggregate Evidence Quality: 3 moderate-quality[218–220] and 9 low-quality studies[221–229]

Rationale

Four moderate quality studies examined postoperative timing for receiving physical therapist management after TKA in an accelerated or "fast track" program and support the use of starting inpatient physical therapy earlier rather than later in hospital settings.[218–220] In each of these studies, physical therapy was initiated within 24 hours of surgery and compared to a group that began therapy on or after postoperative day 1. Those that began physical therapy within 24 hours had less pain and improved range of motion. In one study, the accelerated group demonstrated improved function and fewer adverse events at four weeks and at three months.[219] Several low-quality studies compared a rapid recovery type of program with traditional care and found improved performance with walking distance at four weeks and score on a timed up and go test at seven days.[221,222,225]. In the multiple moderate and low quality studies, length of hospital stay favored an accelerated protocol over a standard protocol[218–222,227–229] Two low quality studies examined adverse events in accelerated postoperative rehab versus a standard protocol. They found lower incidence of deep vein thrombosis, pulmonary embolism, and pulmonary infection in the accelerated groups but higher incidence of hematomas and nausea.[227,228]

Potential Benefits, Risks, Harms, and Costs of Implementing This Recommendation

Benefits are as follows:

- Shortened/no inpatient hospital stay
- Reduced pain
- Improved physical function

Risks, harms, and/or costs are as follows:

No expected harms are expected with implementing this recommendation. The retrospective study reported no difference in 90-day readmission rate between the early-ambulation group and the later-ambulation group.

Benefit-harm assessment: There is a preponderance of evidence that supports early mobilization after uncomplicated TKA.

Feasibility

The implementation of early mobilization within 24 hours of surgery and prior to discharge is feasible and does not require any additional resources or training.

Role of Patient and Client Preferences

Patient support at home is a consideration for an accelerated program, as participation in such a program is likely to impact inpatient length of stay or facilitate direct discharge to home postoperatively.

Exclusions

None were identified.

Future Research

As evolving management emphasizes shorter lengths of hospital stays, including discharge within 24 hours after surgery and surgery on an outpatient basis for some patients, additional high-quality research is needed to investigate the optimal timing and settings of TKA rehabilitation for patients in these management models.

Postoperative Care Settings

In patients with osteoarthritis of the knee selected for TKA, which postoperative care settings and/or setting transitions are associated with improved postoperative outcomes?

When possible, post-operative physical therapy after total knee arthroplasty (TKA) may take place in an outpatient setting rather than in inpatient rehabilitation or at home.

Evidence Quality: Low

Recommendation Strength: Weak ♦♦◊◊

Action Statement Profile

Aggregate Evidence Quality: five low quality studies[116,226,228,230,231]

Rationale

There are five low quality studies (Christensen, 2020; Rak, 2022; Chan, 2018; Picart, 2021, McLawhorn, 2017) that suggest patients should receive postoperative care in an outpatient setting, rather than home health or inpatient rehabilitation. One study (Christensen, 2020) showed that patients who went directly to outpatient physical therapy following surgery had better function at one month postoperatively than patients who had two weeks of home health physical therapy before going to outpatient physical therapy.[116] Function at two years postoperatively was better in patients who were discharged directly to outpatient physical therapy than patients who underwent inpatient rehabilitation (Chan, 2018).[230] There are conflicting findings for function at six months: one study reported that outpatient physical therapy was favored over inpatient rehabilitation in terms of pain, function, and quality of life (Chan, 2018), whereas Rak et al (2022) found that patients who had rehabilitation in an inpatient setting had higher function than those who went directly to outpatient physical therapy after TKA.[226,230] A fourth study (Picart, 2021) reported no difference in outcomes when patients were discharged to outpatient physical therapy versus inpatient rehabilitation.[228] Differences in these reported outcomes were statistically significant but of little clinical difference. There were no differences between treatment settings when adverse events such as need for manipulation, DVT/PE, infection, or need for revision were compared.

Potential Benefits, Risks, Harms, and Costs of Implementing This Recommendation

Benefits are as follows: There is a decreased risk of hospital-acquired infection when patients attend physical therapy in an outpatient setting. Some patients may feel more comfortable being discharged directly to home instead of staying at an inpatient facility; similarly, directly moving to outpatient physical therapy may allow patients increased interaction with the community. Patients managed in outpatient physical therapy may also experience improved pain and functional outcomes.

Cost: It is likely more cost-effective to manage patients in an outpatient setting compared to home health and/or inpatient rehabilitation.

Risks, harms, and/or costs are as follows:

There was no difference in adverse events in the studies reported. However, it is possible that receiving care in an outpatient setting could result in increased risk of health complications for patients who are not good candidates, particularly those who have limited social support. The most important considerations would be concern for cardiopulmonary or thromboembolic events which would require intervention and/or readmission, postoperative wound problems, increased need for reoperation, and or/falls. Patients may also have increased rates of return to the emergency department or hospital re-admission.

Benefit-harm assessment:

There is evidence showing that patients may experience improved function and pain scores when physical therapy services are provided on an outpatient basis. Outpatient physical therapy is more cost effective than inpatient or home-health physical therapy. The studies supporting this recommendation did not report adverse events for patients undergoing physical therapy in an outpatient setting, but health complications and other adverse events, such as falls, are possible. The evidence supporting this recommendation is of low quality and is conflicting, making this recommendation weak.

Feasibility: Patients must have adequate support to safely live at home and must have transportation to outpatient physical therapy.

Role of Patient and Client Preferences

Patient preferences should be considered within reason regarding best postoperative rehabilitation setting.

Exclusions

The patient's home safety, social support, and medical stability should be considered during preoperative and postoperative planning.

Future Research

Future research is needed to determine which patients are best candidates for outpatient rehabilitation. Also, it is imperative to better understand which patients are most at risk for readmission/hospitalization and emergency room visits. Higher quality studies comparing long-term outcomes in individuals who had postoperative physical therapy in different settings should be conducted to strengthen this recommendation.

Postoperative Care Coordination Protocols

For patients with osteoarthritis of the knee selected for TKA, which postoperative care coordination protocols are associated with improved outcomes?

In the absence of sufficient information, it is the opinion of this workgroup that physical therapists should collaborate in pre and post operative care coordination to optimize outcomes in patients undergoing total knee arthroplasty (TKA).

Quality of Evidence: Insufficient

Strength of Recommendation: Consensus ♦ ◊ ◊ ◊

List of included articles: No studies were identified that directly evaluate the effectiveness of care coordination protocols implemented or driven primarily by a physical therapist. For this reason, the workgroup elected to include information from studies addressing care coordination protocols available to patients before or after total knee replacement procedures.

Rationale:

Ho et al (2022) found that an Integrated Education Program (IEP) led to improved patient outcomes at both 3 days and 3 months postoperatively compared to a control group.[232] The IEP involved multiple interventions delivered across the continuum of care, from preoperative education through postoperative follow-up. Notably, the intervention included general "prehabilitation education" provided by a nurse and incorporated a physical therapist as part of a multidisciplinary group education session—highlighting the value of physical therapy involvement in preoperative patient preparation.

Singh et al. (2022) evaluated a formal same-day discharge program that included a preoperative one-on-one physical therapy visit and found no significant improvement in patient outcomes compared to a standard same-day discharge protocol.[233] However, the study retrospectively compared outcomes among patients who successfully achieved same-day discharge and did not assess the impact of care coordination protocols on those requiring a longer hospital stay. Furthermore, the control group also received care involving "standardized protocols for all aspects of perioperative care and postoperative rehabilitation," highlighting the consistent role of physical therapy in both groups.

Smith et al. (2010) demonstrated the importance of the role of physical therapy in discharge planning from the acute care setting.[234] Patients were more likely to be readmitted when the therapist's recommendations were not implemented or when recommended follow-up services were not provided. Falvey et al (2016) identified strategies to expand physical therapy involvement in care coordination to reduce risk of readmission.[235]

Many studies have demonstrated that the Activity Measure for Post-Acute Care (AM-PAC) "6-Clicks" Basic Mobility assessment—commonly used during acute care physical therapy evaluations—has strong

predictive value for discharge disposition from acute care settings.[236–240] This predictive utility has been validated across a wide range of patient populations (Jette, 2014; Warren, 2021), including individuals undergoing TKA (Menendez, 2016; Hadad, 2022; Tuohy, 2024). These findings support the value of incorporating physical therapy into interdisciplinary discharge planning early in the postoperative period. Additionally, two of these studies explored the use of discharge disposition tools administered preoperatively, finding that their predictions aligned with AM-PAC assessments—suggesting that both preoperative and postoperative variables play a key role in determining appropriate discharge destinations (Hadad, 2022; Tuohy, 2024).[236,240] Taken together, these findings suggest that objective screening tools, used either pre- or postoperatively, could be considered to help guide discharge planning and support physical therapists in making recommendations.

A study by Wylde et al (2022) showed the Support and Treatment After Arthroplasty (STAR) care pathway—an interdisciplinary intervention that includes physical therapy —was effective in improving pain outcomes in for patients experiencing chronic pain three months after total knee replacement.[241]

Benefits & Harms:

Benefits:

Physical therapists can provide the care team with valuable information to ensure the most appropriate discharge setting. Involving physical therapists in discharge planning can prepare the patient for a safe and independent transition to the home environment.

Risk, harm: There are no anticipated risks or harms associated with implementing a care coordination protocol.

Cost: Depending on the specific care coordination protocol, costs may vary significantly. Therefore, healthcare organizations should carefully consider both the costs and potential benefits of each approach to determine which strategy is most effective and sustainable within their particular setting.

Feasibility: The studies that demonstrated successful postoperative care required time, financial investment, and multiple health professionals. There is no single best practice due to variability. Instead, personalized, consistent follow- up care (Kubat, 2024; Wylde 2022 [take out if final decision is to include this in the pain PICO instead]) and standardized protocols (Minick, 2023; Capin, 2023) can be considered. Both approaches are feasible but require administrative support for resources, time, and personnel.

Role of Patient Preferences: Patient preferences for discharge disposition and postoperative rehabilitation settings must be considered during shared decision-making regarding postoperative care coordination programs.

Future Research: There is a need for more high-quality research and cost-effectiveness analyses that directly examine the effects of a physical therapy lead or developed care coordination protocols, implemented either pre or postoperatively, on patient outcomes and other indicators such as LOS, cost of care, patient satisfaction, complications.

Exclusions:

None were identified.

Dissemination Plans

The primary purpose of this CPG is to provide interested readers with full documentation of the best available evidence for various procedures associated with TKA. Publication of this guideline will be announced by press release and published in PTJ (Physical Therapy), the journal of the American Physical Therapy Association.

Education and awareness about this CPG will be disseminated via online resources, such as webinars and continuing education courses, at professional annual meetings, and via social media.

Revision and Reaffirmation Plans

This CPG represents a cross-sectional view of current treatment and may become outdated as new evidence becomes available. It will be reviewed in 5 years and will be updated in accordance with new evidence, changing practice, rapidly emerging treatment options, and new technology; reaffirmed; or withdrawn.

Author Contributions

Concept/idea/research design:

Data collection:

Project management:

Providing participants: n/a

Consultation (including review of manuscript before submitting):

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Disclaimer

This guideline is not intended to be a fixed protocol, as some patients may require more or less treatment or different means of diagnosis. Clinical patients may not necessarily be the same as those found in a

clinical trial. Patient care and treatment always should be based on a clinician's independent medical judgment, given the individual patient's clinical circumstances.

Disclosures

In accordance with APTA policy, all individuals whose names appear as authors of or contributors to this CPG filed a disclosure statement as part of the submission process. All panel members provided full disclosure of potential conflicts of interest prior to voting on the recommendations contained within this CPG. Any potential conflicts of interest have been recorded and addressed. Non-voting GDG members Jeanine Kolman, PT, DPT, and Anita Bemis-Dougherty, PT, DPT, MAS were employed by the American Physical Therapy Association during the development and review of this CPG.

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Appendix.

Development Group Roster

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-GDG member list removed for peer review period.

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