Physiotherapy management of knee osteoarthritis: recent advances and evidence-based practice

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Abstract:
Knee osteoarthritis is a prevalent whole-joint condition associated with pain, reduced mobility and limitations in daily participation. Contemporary physiotherapy aims not merely to reduce symptoms during a clinic visit, but to develop capacity, confidence and durable self-management. This narrative review summarises evidence-based assessment and rehabilitation, including therapeutic strengthening, aerobic exercise, neuromuscular and functional training, aquatic exercise, education, activity pacing, weight-management support and selected assistive devices. It discusses the importance of screening for atypical symptoms, measuring outcomes that matter to patients, adapting treatment for comorbidity and addressing barriers to adherence. Recent developments in digital physiotherapy and low-load blood-flow-restriction training are examined with attention to limitations in the current evidence. Current guidelines consistently place tailored exercise and education at the centre of non-surgical management, although recommendations for adjunctive interventions vary. Digital delivery can extend access but should preserve individualisation, safety and follow-up. Blood-flow-restriction training may be an option for selected patients who cannot tolerate conventional loading, but evidence certainty and safety requirements mean it should not be treated as routine first-line care. A practical staged pathway is proposed, moving from assessment and shared goals to progressive loading, functional practice, outcome review and long-term maintenance. The review concludes that the most important advances are likely to be reliable, equitable delivery of established treatments, supported by transparent communication, patient-centred outcomes and appropriate integration of newer methods.

Keywords:
Knee osteoarthritis; physiotherapy; therapeutic exercise; strengthening; self-management; telerehabilitation; blood-flow restriction; functional outcomes.

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1. Introduction:

Knee osteoarthritis (KOA) is a common, long-term musculoskeletal condition associated with pain, stiffness, reduced activity tolerance and difficulty performing everyday tasks. It is not simply the result of cartilage "wearing out", nor is it an inevitable consequence of ageing. Osteoarthritis affects the whole joint, including articular cartilage, subchondral bone, synovium, menisci, ligaments, capsule and surrounding muscles. Symptoms arise from a combination of local tissue changes, altered biomechanics, reduced muscle capacity, sleep disruption, mood, expectations and the person's social environment. This broad understanding helps explain why radiographic severity and lived disability do not always correspond closely (Hunter and Bierma-Zeinstra, 2019; Katz et al., 2021).

The global burden is substantial. The World Health Organization estimated that approximately 528 million people were living with osteoarthritis in 2019, with the knee being the most frequently

affected joint. Ageing populations, previous joint injury, excess body weight, occupational loading and unequal access to preventive care contribute to rising demand for treatment (World Health Organization, 2023). A painful knee may limit work, caring responsibilities, shopping, stair climbing, religious or community participation, and recreational activity. The consequences extend beyond the joint: inactivity can worsen cardiovascular risk, diabetes control, muscle weakness and social isolation. Physiotherapy therefore needs to target meaningful activity and participation rather than pain scores alone.

Evidence-based care places education, tailored therapeutic exercise and weight management when appropriate at the centre of treatment. These interventions should be adapted to the person's goals, comorbidities, symptom irritability, resources and preferences. Guidelines from NICE, the American Academy of Orthopaedic Surgeons, the Osteoarthritis Research Society International and the American College of Rheumatology/Arthritis Foundation broadly support exercise-based care while differing in recommendations for selected adjunct treatments (NICE, 2022; AAOS, 2021; Bannuru et al., 2019; Kolasinski et al., 2020). This review examines established physiotherapy practice alongside recent developments in digital rehabilitation, low-load resistance training with blood-flow restriction, outcome monitoring and more individualised care. It aims to help clinicians translate evidence into safe and practical plans without overstating what emerging methods can achieve.

2. Review approach and scope:

This article is a narrative review intended to synthesise clinically relevant evidence rather than report a new systematic review. The material was organised around current clinical practice guidelines, authoritative overviews, systematic reviews, randomised trials and recent reviews available up to October 2026. Priority was given to NICE guidance, AAOS guidance, OARSI and ACR/Arthritis Foundation recommendations, Cochrane evidence and peer-reviewed work on exercise, weight management, digital delivery and emerging strengthening methods. References were selected for their relevance to physiotherapy decisions and clinical translation, not because the collection represents an exhaustive search of every database.

A narrative approach allows discussion of assessment, exercise prescription, adherence, care pathways and service implementation in one clinical account. It has limitations: no formal duplicate screening, risk-of-bias tool or meta-analysis was performed for this article, and the selected literature may not represent every language or health system. Where findings are inconsistent or based on small samples, this is stated explicitly. Clinical decisions should be based on the full patient presentation, local protocols and the most recent applicable guidelines rather than on an isolated study or any single recommendation.

3. Understanding knee osteoarthritis:

The knee is a load-bearing synovial joint that transfers forces during standing, walking, stair use, squatting and rising from a chair. In KOA, cartilage structure may change, bone can remodel, osteophytes may develop and the synovium may become irritated. Meniscal extrusion, ligament laxity, varus or valgus alignment, previous trauma and reduced quadriceps capacity can alter how loads are distributed. These findings vary between individuals. Some people have marked structural changes with few symptoms, whereas others have substantial pain despite modest radiographic change. Imaging should therefore support clinical reasoning when indicated, not replace careful history-taking and physical assessment (Sharma, 2021; Katz et al., 2021).

Pain in KOA is multifactorial. Nociceptive input can come from innervated structures such as subchondral bone, synovium, capsule and periarticular tissues; articular cartilage itself has no pain nerve endings. In some people, altered central pain processing, heightened threat perception, poor sleep or persistent stress can increase symptom intensity. This does not mean the pain is imaginary. It means the pain experience reflects interaction between tissue, nervous system and context. A purely structural explanation may be unhelpful because it can create fear of movement and encourage avoidant behaviour. Physiotherapists should explain that an arthritic joint can remain load-capable and that graded activity is usually a key part of management (Hunter and Bierma-Zeinstra, 2019; Sharma, 2021).

Clinical phenotypes are useful but should not be treated as rigid categories. Some patients mainly present with weakness and deconditioning; others have intermittent effusion, marked stiffness, malalignment, patellofemoral symptoms, high pain sensitivity or major weight-related loading. A person may move between patterns during a flare or after an injury. Tailoring treatment means identifying which impairments and barriers currently matter most, then selecting interventions with a plausible mechanism and a measurable goal. This patient-specific logic is consistent with modern chronic disease care and reduces reliance on a one-size-fits-all exercise sheet.

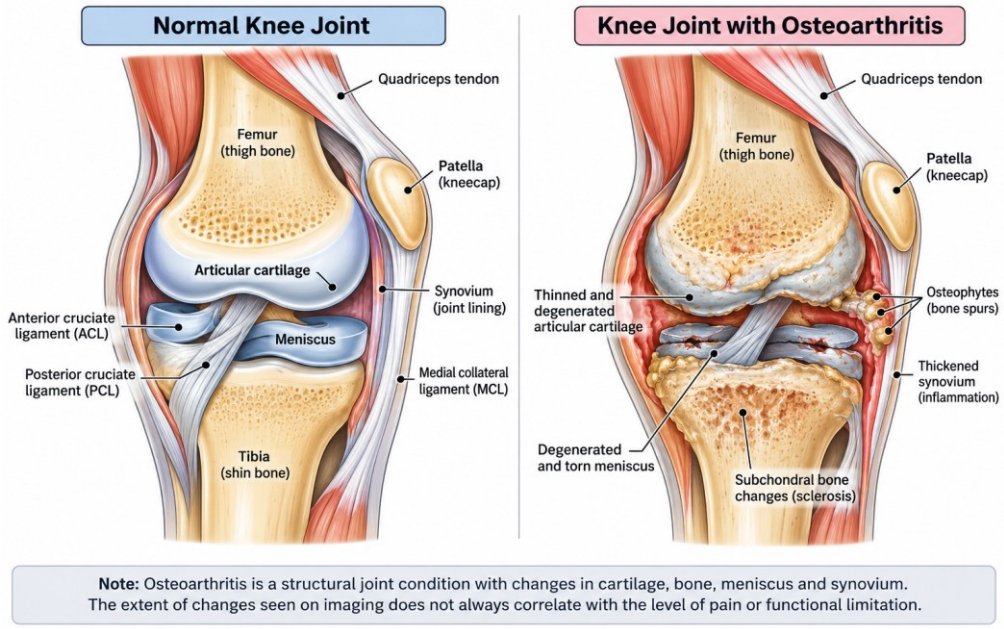


Figure. 1: The knee as a whole-joint organ in osteoarthritis

4. Risk factors and prevention opportunities:

Risk factors include increasing age, prior knee injury, higher body mass, family history, some occupational exposures and lower-limb alignment. Women experience a high burden, particularly in later life, while people in manual work may face repetitive kneeling, deep squatting or heavy lifting. Sporting injury can increase long-term risk, which reinforces the value of injury prevention and appropriate rehabilitation after ligament or meniscal injury. Risk factors cannot all be changed, and patients should not be blamed for developing osteoarthritis. Clinicians can, however, help identify modifiable contributors such as inactivity, low muscle strength, poorly controlled comorbidities and barriers to safe exercise (World Health Organization, 2023; Katz et al., 2021).

Prevention is not limited to preventing the first structural change. It also includes preventing avoidable loss of strength, mobility, confidence and participation after symptoms begin. An exercise plan that is feasible for the person's work schedule and home environment may maintain capacity for years. Early attention to pain flares and fear of movement can reduce cycles of avoidance and deconditioning. Public-health approaches are also important: accessible walking routes, community exercise programmes, safe workplaces and affordable physiotherapy can make movement more achievable. Clinicians should discuss body weight sensitively, using neutral language and asking permission before raising the topic, while making clear that weight is only one of several influences on joint symptoms.

5. Clinical presentation and diagnosis:

Typical symptoms include activity-related knee pain, short-lived stiffness after rest, difficulty walking, rising from a chair or using stairs, and occasional swelling. Crepitus, bony enlargement, restricted movement and reduced quadriceps strength may be present. Symptoms often fluctuate rather than worsen steadily every day. Diagnosis is usually clinical in adults with characteristic symptoms and signs; routine imaging is not always necessary, and the amount of cartilage loss on a

scan does not reliably predict individual pain or disability (NICE, 2022). A physiotherapist should ask about the onset, duration, pattern and distribution of pain, prior trauma or surgery, previous treatments, sleep, activity, falls, goals and the person's understanding of the problem.

Atypical features require further medical assessment rather than routine exercise progression. These include a hot, markedly swollen knee with systemic illness, sudden severe pain, recent significant trauma, inability to bear weight, rapid deterioration, a locked knee, unexplained weight loss, prolonged morning stiffness suggesting inflammatory disease, or calf swelling and breathlessness that could indicate a thromboembolic event. A new acute effusion may need investigation. Red flags do not automatically mean a serious diagnosis, but they change the safety pathway. Physiotherapists should know local referral arrangements and document the reason and urgency for escalation (NICE, 2022; Sharma, 2021).

Radiographs may be appropriate when the presentation is atypical, another diagnosis is suspected, symptoms are progressing unexpectedly or surgical planning is being considered. MRI is not routinely needed to diagnose typical KOA and may reveal age-related meniscal or cartilage abnormalities that are not the source of symptoms. Imaging findings must be interpreted in context. When patients bring scan reports, explain the terms in plain language and connect them to function without implying that a specific image finding guarantees pain or predicts inevitable surgery. The central question is: what can be changed to make the person safer, more active and less limited now?

6. Comprehensive physiotherapy assessment:

Assessment should begin with a patient-centred interview. Ask what the person wants to do but cannot currently do, what they fear, what has helped before and what resources they can use. "Walking comfortably to the local shop" or "climbing stairs to the bedroom" may be more meaningful than a generic goal to improve strength. Explore activity levels, employment, caregiving responsibilities, transport, home hazards, preferred forms of movement, language and health literacy. Ask about cardiovascular disease, diabetes, respiratory conditions, neuropathy, balance impairment and other musculoskeletal pain because these influence exercise selection and monitoring. Medication use should be reviewed with the prescriber when it affects exercise safety, dizziness or pain response.

Physical assessment may include gait observation, knee range of motion, quadriceps and hip muscle capacity, sit-to-stand ability, balance, stair performance and functional movement relevant to the patient's goals. Palpation and joint-line assessment can be useful, but no single test establishes the full clinical picture. Baseline measures should be chosen for their relevance and feasibility. Common options include the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), Knee injury and Osteoarthritis Outcome Score (KOOS), a numerical pain rating scale, the 30-second chair stand, Timed Up and Go, and a walking test. WOMAC and KOOS have established use in knee-related symptom and function measurement (Bellamy et al., 1988; Roos and Lohmander, 2003).

Use the same outcome measure at follow-up whenever possible. A short record of pain, swelling, walking tolerance, exercise completion and confidence can reveal useful patterns even when a long questionnaire is impractical. Ask about the person's response 24 hours after activity, not only during the treatment session. A temporary increase in symptoms can be acceptable, but persistent marked worsening, substantial swelling or loss of function suggests that the dose may need adjusting or another diagnosis may require consideration. Assessment is not a one-time hurdle: it is repeated during care to guide progression, maintenance and referral.

7. Core principles of evidence-based physiotherapy:

The first principle is that exercise is a core treatment rather than a last resort after passive treatments fail. Guidelines recommend tailored therapeutic exercise for people with osteoarthritis, with supervised sessions considered when appropriate. Education can be combined with exercise and behaviour-change support to improve engagement (NICE, 2022; Kolasinski et al., 2020). The second principle is individualisation. A programme should match current capacity, goals, symptom irritability and preferences. The same exercise may be valuable for one person and unrealistic for

another, and the initial dose should be modest enough to support success while still providing a meaningful challenge.

The third principle is progressive overload with flexibility. Muscles and functional capacity adapt when demands are increased gradually and consistently. Progression can involve repetitions, resistance, duration, movement range, speed, complexity or task specificity. The therapist should not progress every variable at once. The fourth principle is shared decision-making: discuss expected benefits, possible short-term discomfort, alternatives and the time needed to build a habit. The fifth is continuity. A brief course of physiotherapy may help establish technique and confidence, but the person's longer-term outcome depends on continuing activity outside the clinic. A maintenance plan must be realistic with or without ongoing supervised visits.

Finally, use interventions according to evidence, not novelty. A modality may provide short-term comfort yet have limited effects on long-term function. Such options can be considered selectively if they help a person participate in active rehabilitation, but they should not displace exercise, education or appropriate weight management. NICE advises against offering acupuncture or dry needling for osteoarthritis and recommends considering manual therapy only alongside therapeutic exercise for hip or knee osteoarthritis (NICE, 2022). These distinctions support transparent conversations and avoid prolonged treatment built around interventions with uncertain added value.

8. Therapeutic exercise: the foundation of care:

Exercise produces modest average improvements in pain and physical function, but the response varies between people. Benefits are not restricted to a single exercise category: strengthening, aerobic activity, neuromuscular training and aquatic exercise can all be considered according to the patient's needs. Reviews suggest that exercise type matters less than finding a tolerable, progressive plan that the person can sustain, though differences in programme design and trial quality affect certainty (Fransen et al., 2015; Goh et al., 2019). Exercise should be presented as a long-term self-management tool rather than a short course that "repairs" cartilage.

A useful exercise plan normally includes several complementary elements: strengthening to improve force production; aerobic activity to support general health and walking endurance; movement practice for tasks such as standing and stairs; flexibility when restricted movement interferes with function; and balance or neuromuscular exercises when stability is a concern. Not every person needs every component in the same proportions. A patient with marked quadriceps weakness may initially devote more time to strength work, while a person whose main problem is low activity tolerance may begin with short intervals of walking or stationary cycling. The combination should follow the assessment rather than a standardised list.

Supervision can improve technique, confidence and adherence, particularly early in treatment or when comorbidities complicate exercise. However, supervised care is not the only route to benefit. A well-explained home programme, community class, aquatic exercise group or digital follow-up may be useful when appropriate. GLA:D is an example of a structured implementation approach combining education with supervised neuromuscular exercise for people with hip or knee osteoarthritis (Skou and Roos, 2017). The general lesson is that programmes need a clear structure, trained delivery, follow-up and outcome monitoring rather than simply distributing written instructions.

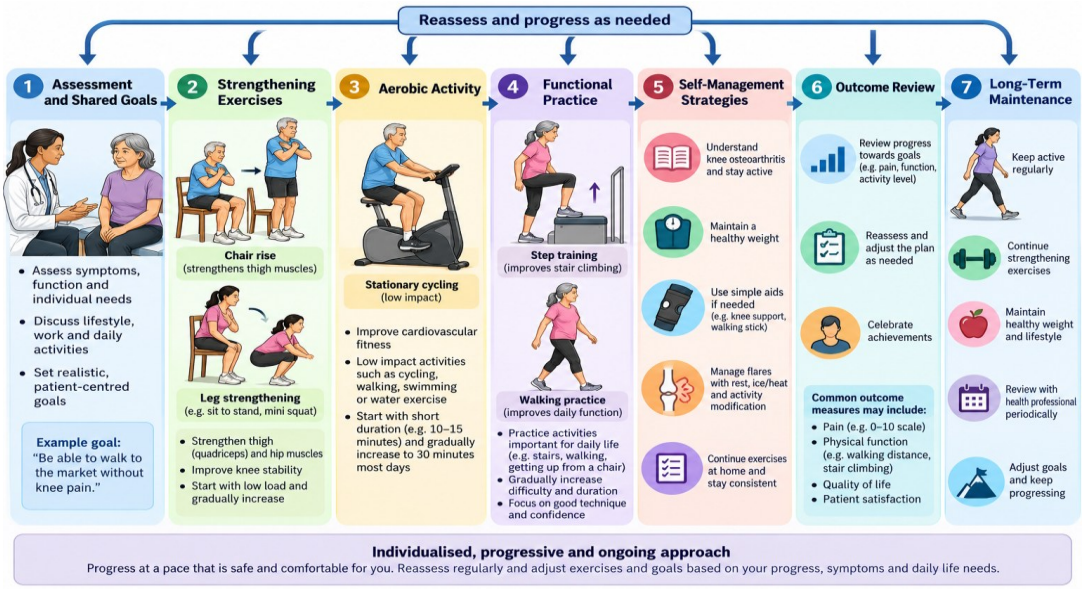


Figure. 2: Individualised physiotherapy pathway for knee osteoarthritis

9. Resistance and strengthening exercise:

Quadriceps weakness is common in KOA and can contribute to difficulty rising from a chair, controlling stairs and sustaining walking. Strengthening should also consider hip abductors and extensors, calf muscles and other groups needed for functional control. Initial exercises may include quadriceps sets, straight-leg raises when tolerated, seated knee extension in a comfortable range, sit-to-stand from a raised chair, calf raises and hip strengthening. As capacity improves, resistance bands, machine-based exercise, step-ups and loaded sit-to-stand can be introduced. Exercise selection should reflect symptom response and available equipment.

A practical starting prescription may use one to three sets of around eight to fifteen repetitions, two or three days per week, with load chosen so the final repetitions feel challenging but controlled. This is a starting framework, not a universal rule: frail adults or people with substantial symptoms may begin with fewer repetitions, less resistance or shorter bouts. Progression is warranted when the patient completes the current task with good technique and acceptable next-day symptoms. In later stages, heavier resistance may be appropriate, but high loads are not essential for everyone to benefit. Juhl et al. reported that exercise features and dose can influence outcomes, although programme heterogeneity means exact optimal dosing remains uncertain (Juhl et al., 2014).

Pain during strengthening should be interpreted alongside the full response. Mild and short-lived discomfort may be acceptable if it settles and does not produce a sustained loss of function. Sharp pain, rapidly increasing swelling, instability or persistent worsening should prompt modification and reassessment. Use slow, controlled movements at first, then introduce more functional speeds when safe. Patients should learn that soreness is not automatically evidence of joint damage, but neither should they be told to ignore symptoms. A simple traffic-light approach can support self-management: green for tolerable symptoms and normal recovery, amber for a dose that needs adjustment, and red for warning signs requiring clinical review.

10. Aerobic exercise and daily physical activity:

Aerobic activity supports cardiovascular health, endurance, mood and general mobility, all of which matter when KOA reduces walking. Options include walking, stationary cycling, low-impact dance, swimming, water walking and other preferred activities. Selection should account for balance, cardiopulmonary status, footwear, weather, access and the person's confidence. A stationary bicycle may be useful for someone who struggles with weight-bearing walking; short bouts of walking may be preferable for someone who wants to return to community mobility. The best option is one that can be repeated safely and adapted to symptoms.

For people who are inactive, begin with a manageable volume rather than immediately pursuing population-level activity targets. Five- to ten-minute bouts can be accumulated and lengthened over time. Increase duration before intensity when endurance is limited, and avoid making a large jump in weekly load after a good day. Later, a gradual plan may work towards public-health targets for aerobic activity as health and tolerance allow. The updated EULAR recommendations on physical activity in people with inflammatory arthritis and osteoarthritis emphasise supporting physical activity as part of routine care, adapted to individual circumstances (Rausch Osthoff et al., 2026).

Functional activity is also exercise. Practising shopping routes, standing breaks, household tasks, gardening or walking with a family member can make rehabilitation relevant and improve the likelihood that gains transfer outside the clinic. Discuss pacing rather than advising complete rest during a flare. Pacing means alternating demanding and easier tasks, taking planned breaks and distributing activity across the day. It is different from avoiding activity indefinitely. A simple activity diary can help distinguish a sustainable pattern from cycles of overdoing activity on a relatively good day followed by several days of inactivity.

11. Neuromuscular training, balance and functional practice:

Neuromuscular training seeks to improve the coordination of the trunk, hip, knee and ankle during movement. It may include weight shifting, controlled step-downs, balance practice, changes of direction, single-leg tasks with support, and repeated sit-to-stand. The level of challenge should be selected according to fall risk and available support. A patient with poor balance may begin beside a stable counter; a more capable person may progress to multidirectional stepping or uneven-surface practice in a controlled setting. Safety must take precedence over adding complexity.

Functional training should mirror the activities that the patient needs to regain. A person who avoids stairs may practise weight transfer, step-ups and controlled lowering from a low step before progressing to a full flight. A person who struggles to rise from low seating can start from a higher chair, use the hands as needed, and gradually reduce assistance or seat height. Repetition allows the therapist to identify compensations and improve confidence. Task practice can be more motivating than isolated muscle exercise alone, but strengthening may still be necessary when force production is a limiting factor.

Evidence does not establish one universally superior form of exercise for all KOA patients. A network meta-analysis found that several exercise approaches may improve pain or function, with uncertainty in comparisons and study protocols (Goh et al., 2019). Physiotherapists should therefore combine clinical reasoning with patient preference, monitor outcomes and avoid overpromising that one branded method is uniquely effective. The goal is sufficient strength, balance and movement confidence to make valued daily activities possible, not perfect movement mechanics on every repetition.

12. Flexibility, range of motion and mobility:

Limited knee extension can interfere with standing and walking, while restricted flexion can make sitting, stairs and transfers difficult. Gentle active range-of-motion exercise, heel slides, supported knee extension and cycling through a tolerable range can help maintain movement. Stretching may be appropriate when hamstring, calf or quadriceps tightness meaningfully limits function, although stretching alone is not a comprehensive KOA treatment. Avoid forceful techniques that provoke substantial pain or swelling, particularly during an irritable episode.

Mobility work should be connected to a functional objective. For example, improving extension may support a more comfortable stance phase, while improving flexion may make bicycle use or chair transfers easier. Measure progress with simple repeatable methods and avoid treating a small range-of-motion change as the only sign of success. A person may walk farther or perform stairs better even if joint range changes little. Conversely, persistent restriction, mechanical locking or a sudden loss of movement should prompt review rather than increasingly forceful stretching.

13. Aquatic exercise and lower-load options:

Aquatic exercise can be useful when land-based movement is painful, body weight makes exercise difficult or the patient prefers a pool environment. Buoyancy reduces the effective weight-bearing demand, and water resistance allows graded strengthening and aerobic activity. Exercises can include walking in water, gentle knee bending and straightening, supported sit-to-stand practice and simple aerobic sequences. Warm water may improve comfort for some patients, but water temperature and pool access should be considered, and aquatic therapy should not be described as cartilage regeneration.

A Cochrane review found small short-term improvements in pain, disability and quality of life from aquatic exercise for knee or hip osteoarthritis, while noting that the evidence and follow-up were limited (Bartels et al., 2016). Aquatic exercise can function as a bridge to land-based activity or as a longer-term option for people who cannot tolerate enough land exercise to maintain fitness. Pool treatment may be unsuitable for people with certain wounds, uncontrolled medical conditions, significant water-related fear or limited access. The transition to land-based tasks should be planned when those tasks remain important to the patient's goals.

14. Exercise dose, progression and managing flares:

There is no single dose that suits every patient. A starting dose should consider baseline fitness, pain severity, swelling, sleep, comorbidities, prior experience and the demands of daily life. Use a clear prescription that states the exercise, repetitions or duration, frequency, effort, rest and progression criteria. Patients benefit from knowing why each exercise was chosen and what to do when symptoms change. Written or digital instructions can improve recall, but should be understandable and matched to the person's equipment and language.

A practical flare plan allows adjustment without abandoning activity. During a temporary increase in pain, reduce resistance, range or total repetitions, use shorter bouts and maintain comfortable movement. If swelling or pain is substantial, reassess the cause and consider temporary substitution with a less provocative activity such as cycling or pool exercise where appropriate. Return to the previous dose gradually as symptoms settle. Sudden severe pain, a hot swollen joint with fever, new inability to bear weight, or major unexplained loss of function is not a routine flare and requires medical review.

Progression can be based on a combination of perceived exertion, movement quality, task performance and symptom recovery over the following day. Avoid rules that require all exercise to be pain-free, since this can reinforce fear; equally, avoid messaging that any amount of pain is acceptable. The clinician and patient should agree on an acceptable range in advance. Exercise logs can document completed sessions and symptom response. When progress stalls, identify the cause before adding more exercises: barriers may include an excessive initial dose, unclear instructions, transport costs, depression, low confidence, caregiving demands or an untreated medical problem.

15. Education, self-management and pain communication:

Education should give patients a coherent and hopeful explanation of KOA. Explain that it is a whole-joint condition, that pain does not always match X-ray severity, and that regular movement is usually beneficial when appropriately graded. Avoid alarming descriptions such as "bone on bone" without context or claims that the joint is inevitably deteriorating with every step. At the same time, do not dismiss symptoms as "just ageing". A respectful explanation recognises pain and limitations while emphasising the options that remain available. NICE recommends accessible information tailored to the individual and supports combining exercise with education or behaviour-change approaches (NICE, 2022).

Self-management skills include goal setting, pacing, flare planning, problem solving, activity scheduling and knowing when to seek help. Motivational interviewing techniques can explore ambivalence without blame: ask permission, listen for the patient's own reasons for change and agree on a small achievable action. Instead of asking a patient to "exercise more", identify a specific behaviour such as walking for six minutes after breakfast on three days this week. Review success,

barriers and confidence at the next visit. Small goals can build mastery and lead to broader activity over time.

Pain neuroscience education may help selected patients understand why pain can persist in a condition with variable structural findings, but it should not replace exercise or be delivered as a lecture about the nervous system. Explain the relevance to the individual, invite questions and check understanding.

Psychological factors such as fear avoidance, low mood, catastrophising and poor sleep can influence disability and are appropriate subjects for compassionate screening. Physiotherapists can provide basic support and refer for more specialised care when distress is persistent, severe or beyond their scope. Integrating physical and psychological approaches avoids a false choice between "physical" and "mental" causes of pain.

16. Weight management and whole-person health:

For people living with higher body weight, weight management can reduce knee loading and may improve pain, mobility and general metabolic health. Conversations must be non-stigmatising and individualised. Ask permission before discussing weight, avoid assumptions about diet or motivation, and acknowledge that weight regulation is influenced by biology, medication, sleep, stress, socioeconomic circumstances and access to food and exercise facilities. Where appropriate, offer or refer to a structured programme that combines nutrition support, behavioural strategies and physical activity rather than giving a brief instruction to lose weight.

The IDEA randomised trial found that diet-induced weight loss combined with exercise produced improvements in several clinical and biomechanical outcomes in overweight and obese adults with knee osteoarthritis, compared with some single-component approaches (Messier et al., 2013). NICE notes that any weight loss may help and that larger sustained losses can yield greater benefit for people who are overweight, while recognising that achieving and maintaining weight reduction can be difficult (NICE, 2022). The appropriate target should be agreed with the patient and based on health, preferences and feasibility, not imposed as a prerequisite for receiving physiotherapy.

Whole-person assessment should also include cardiovascular risk, diabetes, osteoporosis, falls, sleep and physical activity outside formal exercise. A programme that improves knee symptoms but ignores these related needs may miss important opportunities for prevention. For instance, short bouts of aerobic activity may support glucose control and endurance while strengthening supports transfers and balance. Coordinate with primary care, dietitians, occupational therapists, psychologists and other services when needed. Physiotherapy should be integrated with routine health care rather than framed as an isolated joint-focused service.

17. Manual therapy and adjunct interventions:

Manual therapy may include joint mobilisation, soft-tissue techniques or other hands-on approaches intended to improve short-term comfort or movement. NICE advises that manual therapy should only be considered for hip or knee osteoarthritis alongside therapeutic exercise and that evidence does not support its use alone (NICE, 2022). A brief trial may be reasonable when a specific restriction or pain response prevents active participation, provided the clinician sets an explicit functional target and reviews whether the technique adds value. Manual therapy should not become the main treatment simply because passive care feels easier during a painful visit.

Heat or cold may provide temporary symptom relief for some patients, but response is individual and these methods do not replace exercise. If recommending heat, ensure the patient can safely regulate temperature and has intact skin sensation. Cold may be useful for short-term comfort after activity in some individuals, but prolonged direct skin exposure should be avoided. Electrical modalities and therapeutic ultrasound have inconsistent or limited evidence for sustained benefit and should not displace active treatment. The clinician should explain the expected purpose and review the result rather than automatically repeating modalities at every session.

Acupuncture and dry needling are not recommended by NICE for osteoarthritis management, and evidence for other passive adjuncts varies across guidelines (NICE, 2022; Bannuru et al., 2019). Disagreement between guidelines is possible because recommendations consider different evidence

cut-offs, patient groups, values and outcomes. Practitioners should explain uncertainty honestly, use local professional standards and avoid claims that an adjunct regenerates cartilage, corrects the underlying disease or guarantees avoidance of surgery. If the adjunct does not improve a meaningful activity or support adherence to exercise, its place in the plan should be reconsidered.

18. Braces, orthoses, walking aids and footwear:

Assistive devices can help selected patients who have pain, instability, malalignment or reduced walking confidence. A cane held in the hand opposite the more symptomatic knee can reduce knee loading and improve steadiness for some people. The correct height, safe sequencing and practice on stairs should be checked. A walker may be more suitable for someone with substantial balance impairment. These devices are not signs of failure; they are tools to preserve independence and activity while other components of rehabilitation develop.

Tibiofemoral bracing may be considered for selected patients whose knee symptoms significantly affect ambulation, stability or pain and who can tolerate the brace. Patellofemoral bracing may be suitable in selected presentations, though recommendations are more conditional. ACR/Arthritis Foundation guidance strongly recommends tibiofemoral bracing for appropriate patients and conditionally recommends patellofemoral bracing, reflecting variation in benefit and tolerance (Kolasinski et al., 2020). The brace should be fitted appropriately, skin checked and use reviewed for comfort, practicality and functional benefit. A device that is uncomfortable or difficult to wear is unlikely to be effective in daily life.

Footwear advice should be practical rather than prescriptive. Comfortable, stable shoes may improve confidence; however, no single shoe type works for every patient. Lateral wedge insoles and other orthoses have variable evidence and should not be routinely prescribed without a clear rationale. If tried, define a time-limited review with outcomes such as walking comfort or stair performance. The same principle applies to taping: consider it only when an individual response suggests a useful short-term effect, and ensure it complements rather than replaces active treatment.

19. Digital physiotherapy and telerehabilitation:

Digital physiotherapy includes video consultations, app-based exercise programmes, web education, remote monitoring and messaging between visits. It can reduce travel time, extend access for people in rural areas or with mobility restrictions, and support contact between appointments. Digital care may be especially useful for exercise instruction, goal tracking, reminder systems and follow-up after an initial in-person assessment. It is not automatically more accessible: reliable internet, device access, digital literacy, privacy, language and hearing or vision impairment can all create barriers. A hybrid model may combine in-person assessment with remote coaching.

A 2025 systematic review and meta-analysis reported that digital physiotherapy interventions were associated with a small improvement in physical function, with subgroup findings suggesting possible improvements in pain and function from video-conferencing and app- or web-based programmes. The authors also noted heterogeneity and limitations in the underlying trials (Cheung et al., 2025). A 2026 meta-analysis of tele-rehabilitation in middle-aged and older adults found favourable trends in several pain and function outcomes, but evidence was not consistently statistically significant; the review concluded that tele-rehabilitation is best viewed as a complementary option while stronger trials are needed (Parmar and Sharma, 2026).

Remote delivery should preserve the key ingredients of good rehabilitation: individualised exercise, progression, education, safety screening, feedback and outcome measurement. The therapist should assess whether the patient can safely perform a task in the home setting, whether a nearby support person is needed, and whether video quality permits adequate observation. A plan may need alternatives for limited floor space or lack of equipment. Remote contact should not delay urgent assessment of red flags or new significant injury. Digital tools work best as a delivery channel for evidence-based care rather than as a substitute for clinical judgement.

20. Emerging advance: low-load blood-flow-restriction training:

Blood-flow-restriction training uses a cuff around the proximal limb to partially restrict blood flow during low-load resistance exercise. The proposed advantage is that some muscular adaptations may be achieved with loads that are easier to tolerate than conventional heavy resistance. This approach has attracted interest for patients with pain-related weakness who struggle with higher loads. However, it is a specialised method, not a necessary component of routine KOA physiotherapy, and it should only be considered after a careful safety assessment and by clinicians trained in cuff selection, pressure setting and monitoring.

Recent evidence is mixed. A 2025 systematic review and meta-analysis focused on low-load blood-flow-restriction training reported improvements in knee pain, quadriceps strength and chair-stand performance compared with conventional resistance training, but estimates were based on a limited number of trials and should be interpreted cautiously (Lin et al., 2025). A separate 2025 systematic review of trials in knee osteoarthritis found no significant overall advantage over resistance training for several symptom and function outcomes, and rated the evidence as low quality (He et al., 2025). A network meta-analysis also reported favourable comparisons with low-intensity resistance training, although between-study differences and uncertainty remain (Yang et al., 2025).

Practical safeguards are essential because the cuff changes the physiological load of exercise. Screening should consider vascular disease, history of thromboembolism, uncontrolled hypertension, severe varicosities, impaired sensation, skin problems and other medical factors in line with professional guidance and local protocol. Do not improvise occlusion pressures or use a tight elastic band without calibrated equipment. Explain that the evidence is developing and that conventional progressive strengthening remains an appropriate first-line option for most patients. Blood-flow restriction can be discussed as a selective alternative where low-load exercise is insufficient or higher loads are poorly tolerated, not as a replacement for comprehensive rehabilitation.

21. Gait retraining, biomechanics and individualization:

Gait and movement analysis can identify modifiable strategies that contribute to difficulty, such as reduced walking speed, short stance time on the painful side, limited knee flexion, trunk lean or poor step control. These patterns may be adaptive responses to pain rather than faults that must be corrected. A physiotherapist should ask whether a gait feature creates a functional problem and whether changing it improves comfort or safety. Cues, mirror feedback, video feedback or step targets can be used when appropriate, but the aim is not to enforce a single “normal” gait in every person.

For selected patients, small adjustments to walking speed, stride length, step width or use of a walking aid may improve symptoms or confidence. However, sustained gait retraining requires practice and should be tested in real-world conditions. Changes in loading may shift forces to other structures, so follow-up should include symptoms in the knee and elsewhere. Likewise, alignment or foot posture should not be treated as a stand-alone cause of KOA. Biomechanical interventions are most defensible when a clear assessment links the feature to the person’s goals and a trial shows a meaningful response.

Individualisation also means adapting the programme to the dominant symptom pattern without assuming that a specific phenotype predicts a guaranteed response. Patients with patellofemoral-predominant symptoms may benefit from attention to hip and knee strength, movement tasks and selected bracing; patients with tibiofemoral symptoms and instability may need more support during gait. If the picture is complex or unclear, collaboration with a specialist or multidisciplinary team may help. The principle is to combine sound clinical reasoning with measurable response, not to rely on a single biomechanical theory.

22. Medication, injection and surgical coordination:

Physiotherapists do not independently prescribe medication unless authorised under applicable rules, but they should understand how medical management interacts with rehabilitation. Topical or oral non-steroidal anti-inflammatory drugs, paracetamol in selected settings and other prescribed treatments may be used by clinicians according to patient-specific risks and guidelines. Pain relief

can allow greater participation in exercise, but should not be used to mask warning signs or enable an abrupt jump in training volume. Patients should be advised to discuss medication changes, adverse effects and interactions with their prescriber or pharmacist.

Intra-articular corticosteroid injections may provide short-term relief for selected patients, but they are not a substitute for continuing rehabilitation. In a randomised trial, patients who received physical therapy had better pain and functional outcomes at one year than patients who received glucocorticoid injection (Deyle et al., 2020). This trial should not be interpreted as proof that injections are never appropriate; it demonstrates the value of active physical therapy as a treatment in its own right. The timing of exercise after an injection should follow the treating clinician's advice and the patient's response.

Surgical referral may be appropriate when pain and functional limitation remain substantial despite a well-delivered non-surgical programme and when symptoms are consistent with the structural diagnosis. Referral should not be withheld solely because of age, body size or an arbitrary exercise score. In a randomised trial of people eligible for knee replacement, total knee replacement plus non-surgical treatment improved pain and function more than non-surgical treatment alone, while also producing more serious adverse events; the decision therefore requires discussion of expected benefit, risk and patient priorities (Skou et al., 2015). Physiotherapy can support pre-operative conditioning, recovery planning and post-operative rehabilitation when surgery proceeds.

23. Outcome measurement and treatment review:

Outcome measurement should balance patient-reported experience with observable performance. Patient-reported measures reveal pain, stiffness and difficulty in daily life, while performance tests provide information about mobility, balance and functional capacity. Common options include WOMAC, KOOS, numerical pain rating, 30-second chair stand, Timed Up and Go, stair tests and a timed walk. WOMAC is widely used for pain, stiffness and function in osteoarthritis (Bellamy et al., 1988), while KOOS was developed to evaluate symptoms and functional outcomes across knee injury and osteoarthritis contexts (Roos and Lohmander, 2003). Select a small set of measures rather than burdening every patient with multiple long questionnaires.

Set a review interval at the beginning of treatment. At follow-up, examine whether the original goals are closer, whether exercise dose was achievable, whether pain recovery was acceptable, and whether the person's confidence or activity has changed. If there is little progress, do not assume poor motivation. Revisit the diagnosis, dose, adherence barriers, social environment, pain coping, sleep, comorbidities and whether another service is required. A planned discharge should include a maintenance programme, signs that warrant reassessment, and realistic options for returning to care if symptoms change.

A meaningful clinical response may include walking a little farther, needing fewer rests, rising from a chair with less assistance, reducing fear of stairs, or returning to a valued role. These changes can matter even when radiographs do not change. Conversely, a small reduction in pain without improved participation may not meet the patient's main goal. Discuss results openly and avoid portraying any scale as a pass-or-fail test. Where services collect outcomes routinely, aggregate data can support service improvement, but individual context must remain central to decisions.

24. Special populations and adapting care:

Older adults may have frailty, reduced balance, osteoporosis, cardiovascular disease, sensory impairment or several painful joints. Begin with safe transfers and functional strengthening where needed, provide stable support and allow more recovery time. Exercise remains relevant, but dose and monitoring must reflect overall health. For people with diabetes or peripheral neuropathy, foot care, sensation and balance may require attention. People with cardiovascular or respiratory disease may need pacing, intensity monitoring and coordination with medical care. The presence of comorbidity should lead to sensible adaptation, not automatic exclusion from physical activity.

For people with obesity, weight-related discussion should remain respectful, and treatment should not be contingent on achieving a target weight. For people with depression, anxiety or persistent pain-

related fear, simple behavioural strategies and coordinated referral may be needed. For people from rural or underserved communities, travel, cost and access may be more limiting than knowledge. Digital care, group programmes, community facilities and home-based exercise can help, but only when designed to avoid widening access gaps. Ask what is feasible in the individual's real living conditions rather than assuming access to a gym, a pool, a smartphone or a private exercise space.

Employment also affects physiotherapy planning. People who kneel, squat, climb or lift for work may need a graded work plan, task modification, scheduled breaks or occupational-health input. Caregivers may need short, flexible sessions. Cultural beliefs about arthritis and exercise should be explored without judgement. Where literacy is limited, demonstrate exercises, use plain words and ask the patient to teach back the main instructions. A good plan is not merely scientifically valid; it must also be understood, affordable and possible to follow.

25. Psychosocial contributors, sleep and pain coping:

Pain-related disability is shaped by more than the intensity of a painful sensation. Fear that movement will damage the joint can lead a person to avoid stairs, walking and exercise; reduced activity then contributes to weakness and lower tolerance, which can make ordinary tasks harder. This pattern may occur alongside genuine structural pathology, and recognising it does not invalidate the person's symptoms. Physiotherapists should use language that validates pain while supporting gradual re-engagement. Ask what the patient believes is happening in the knee, what they expect from exercise and which activities feel unsafe. The answers help clinicians tailor education and detect misconceptions that may otherwise undermine the plan (Sharma, 2021; Hunter and Bierma-Zeinstra, 2019).

Sleep disturbance, anxiety, depressive symptoms and persistent stress may influence pain sensitivity, recovery and willingness to be active. Brief, respectful screening can identify people who need additional support. Physiotherapists can reinforce sleep routines, pacing and gradual activity, but should not attempt to manage complex psychological conditions outside their competence. Referral to primary care or mental-health services may be appropriate when symptoms are persistent or severe. Where available, cognitive behavioural approaches or pain-coping programmes can complement exercise by helping patients respond to symptom fluctuations, set achievable goals and reduce avoidance. The care plan should communicate that the person is not expected to "think pain away"; coping strategies are tools for living and moving while pain is being managed.

Clinician communication can directly affect confidence. Avoid deterministic descriptions such as "your knee is ruined" or promises that an exercise will rebuild lost cartilage. Instead, explain that osteoarthritis is a long-term condition with several influences and that many people can improve function despite ongoing structural changes. Ask permission to discuss scan findings, use simple diagrams when helpful and invite the patient to explain the plan in their own words. The therapeutic relationship should allow questions and disagreement. When a person is not ready to pursue a particular goal, explore a smaller step that aligns with their priorities rather than framing hesitation as non-compliance.

26. Access, equity and cost-effective service delivery:

Access to physiotherapy is uneven. Rural location, transport costs, long waiting lists, unpaid caregiving, limited leave from work, disability, language barriers and out-of-pocket expenses may prevent attendance. A patient who misses appointments may still be motivated but unable to make the service fit their circumstances. Ask directly about barriers and offer options such as clustered appointments, group education, telephone follow-up, community-based exercise or a home programme with planned review. Remote care can reduce travel but should not become the only route to support for people without reliable digital access or private space.

Group-based education and exercise may use resources efficiently and provide peer encouragement, provided that staff can adapt exercises and maintain safety for different ability levels. Standardised patient information can improve consistency, but the programme should still include individual goal setting and an opportunity to discuss comorbidities. Use interpreters or translated materials where

needed, ensure that exercise instructions are accessible to people with visual or hearing impairment, and avoid assumptions about gym access or equipment. Low-cost home options such as a stable chair, step and resistance band may be sufficient for a useful programme, provided that the environment is safe and the exercises are prescribed appropriately (Mohammed AS, Nadeem, Kumar M, et al., 2026) Quality improvement should monitor not only average outcomes but who reaches care, who completes a programme and who benefits. Results may differ by age, income, disability, ethnicity, language or digital access. If a service reports high average satisfaction but some groups rarely attend follow-up, it should investigate the reason rather than attributing the difference to patient preference alone. Cost-effectiveness includes the resources used by the service and the broader effect of improved mobility on independence, work and caregiving. Making core exercise and education accessible may be a more valuable innovation than adding expensive equipment without evidence of additional benefit.

27. Illustrative clinical profiles and tailored treatment plans:

Profile one: an adult with medial knee pain, marked quadriceps weakness and difficulty rising from a low chair wants to return to walking in the neighbourhood. After screening for red flags and establishing baseline function, the physiotherapist begins with chair rises from an elevated surface, seated knee extension, supported calf raises and short intervals of walking on a level route. The programme is deliberately small so it can be completed between work and family responsibilities. As technique and recovery improve, resistance and walking duration are increased gradually. The goal is not an arbitrary number of exercises; it is to build the strength and endurance required for the patient's desired walk.

Profile two: an older adult has bilateral knee symptoms, obesity, diabetes and fear of falling. The therapist checks medical stability, foot sensation, balance and transfer safety, and chooses supported strengthening, sit-to-stand practice from an appropriate chair, short bouts of stationary cycling or walking, and a plan for safe progression. Weight management is discussed only with permission and linked to the patient's own priorities, with referral to suitable nutrition support if desired. A walking aid may be trialled to improve safety and participation. Remote check-ins could support adherence, but the person's digital access and preference are assessed rather than assumed.

Profile three: a patient with persistent pain, poor sleep and fear that exercise will "wear the cartilage away" has stopped most recreational activity. The therapist first listens to the person's concerns, explains the relationship between symptoms and structural findings in plain language, and agrees on a low-threat activity goal. The initial programme may include comfortable range-of-motion work, isometric or low-load strengthening and short, predictable walks, with a symptom-response plan. Progress is measured by confidence, activity and a patient-defined goal as well as pain. If distress or sleep disruption is substantial, additional care is coordinated with the appropriate clinician rather than relying on exercise instruction alone.

These profiles illustrate that the exercise menu changes, but the reasoning process remains consistent: identify the most important functional limitation, check safety, choose a tolerable starting dose, agree on progression criteria, and reassess the outcome. The same intervention may play different roles across patients. A walking aid may enable activity in one person, while graded exposure to stairs may be more relevant in another. Weight-management support may be important for some and not a priority for others. Personalisation is therefore not simply changing repetitions; it is matching the whole treatment process to the person's health, goals and context.

28. Clinical pathway: a practical staged approach:

At the first encounter, screen for red flags and confirm whether the presentation is compatible with KOA. Clarify the patient's most important functional goal, establish baseline pain and function, assess strength and mobility, and identify major barriers. Provide an explanation that validates pain while correcting misconceptions. Agree on one or two initial actions rather than an overwhelming programme. Depending on presentation, these might be a short walking plan, chair-based strengthening, knee range-of-motion practice, an appropriate walking aid or referral for weight-management support.

During the early phase, prioritise tolerability, technique and habit formation. The therapist should observe the exercise, ensure that equipment and home space are safe, and record the next-day response. Introduce progressive strengthening and aerobic activity in a manageable combination. If pain is high, use lower-load options and functionally relevant movements, but retain the intention to build capacity. If symptoms suggest another problem, or if the patient deteriorates unexpectedly, reassess the diagnosis rather than continuing the same programme unchanged.

During the build-up phase, increase resistance, duration or functional complexity one variable at a time. Add balance, stair or gait practice according to goals. Consider manual therapy only if it helps active work, and consider bracing or walking aids when impairment warrants them. At review, repeat the selected outcome measures and discuss progress against the patient's own goals. In the maintenance phase, transfer responsibility to a sustainable home, community or hybrid plan. Clear discharge advice should specify what to continue, how to respond to flares, and which warning signs require clinical review.

29. Safety, contraindications and referral:

Exercise prescription should follow a basic safety screen, especially when the patient has significant cardiopulmonary disease, poorly controlled blood pressure, severe balance difficulty, recent surgery or a new acute injury. Check for pain that is unexplained, rapidly progressive or inconsistent with typical KOA. A hot, red joint with fever may indicate infection or an inflammatory process and needs urgent medical assessment. Acute inability to bear weight after trauma requires prompt investigation. New calf swelling with breathlessness or chest pain is an emergency. The clinician should follow local protocols and not use exercise testing to delay appropriate escalation.

During sessions, monitor for dizziness, chest discomfort, unusual breathlessness, pallor, sudden weakness or acute joint instability. Stop exercise and assess if concerning symptoms appear. For people taking medicines that may affect balance, blood pressure or exercise response, discuss precautions with the treating clinician. With low-load blood-flow restriction, use a trained practitioner, calibrated equipment and appropriate medical screening; this emerging method should not be introduced casually into a routine exercise class. Record adverse events and modifications to support continuity of care.

Safety includes psychological as well as physical factors. Some patients fear that any discomfort means damage; others may push through worsening symptoms because they believe pain is required for results. Agree on clear symptom thresholds and explain the difference between expected transient soreness and a potentially harmful response. Make it easy for patients to report concerns without feeling blamed. A safety culture is collaborative: it recognises uncertainty, promotes early review and changes the plan when the observed response does not match expectations.

30. Implementation and quality improvement in physiotherapy services:

Evidence-based recommendations have limited impact if patients cannot access the service or if usual practice centres on passive modalities. Implementation requires staff training, referral pathways, patient education resources, realistic appointment schedules and a mechanism for follow-up. Programmes such as GLA:D show how a structured education-and-exercise model can be delivered at scale through trained physiotherapists, although local adaptation is necessary to meet differences in workforce, funding, culture and access (Skou and Roos, 2017). A standard pathway can support consistency without removing individual clinical judgement.

Services can audit whether patients receive core care: baseline assessment, exercise prescription, advice on activity, weight-management discussion when appropriate, documented goals, planned reassessment and a self-management plan at discharge. Audits should also examine access and outcomes across age, sex, socioeconomic status, disability, language and geography. A digital pathway may lower travel barriers but create others for patients without devices or data. Quality improvement should combine quantitative indicators with patient feedback to understand why people do or do not engage.

Shared decision-making can reduce confusion about conflicting treatment messages. A clinician might explain that guidelines agree strongly on exercise but differ on some adjuncts, then discuss the person's preferences and the local options. This transparency is preferable to presenting every recommendation as an absolute. Service leaders should support enough time for education, practical exercise coaching and progression review. Referral targets that reward short visits or passive treatment volume can undermine evidence-based care; quality indicators should focus on function, safety, access and patient-defined goals.

31. Evidence gaps and future directions:

Several important questions remain. Trials differ in exercise selection, load, intensity, supervision, treatment duration, comparator care and follow-up. Participants are often more motivated and less medically complex than patients seen in routine practice. More studies should report adherence, adverse events, socioeconomic factors, patient-defined goals and long-term maintenance, not only short-term pain scores. Research should also clarify who benefits most from particular approaches and how to tailor treatment when knee OA coexists with obesity, diabetes, cardiovascular disease, frailty or persistent pain.

Digital physiotherapy is promising because it can improve convenience and extend support, but future trials should distinguish between technologies itself and the quality of the rehabilitation delivered through it. The current evidence suggests potential benefit with meaningful heterogeneity and limitations in study quality (Cheung et al., 2025; Parmar and Sharma, 2026). Research should examine cost-effectiveness, privacy, digital exclusion, clinician workload and whether improvements persist after app or video support ends. Hybrid pathways may prove more practical than forcing all patients into either remote or in-person care.

Blood-flow-restriction training and other novel methods need adequately powered trials with standardised safety reporting and comparisons against well-designed conventional exercise. It is important to establish whether new methods add clinically meaningful benefit beyond careful load modification and patient-centred coaching. Emerging wearables, remote activity sensors and artificial-intelligence-supported exercise feedback may help monitor movement and adherence, but they can also produce inaccurate recommendations or overwhelming data. Technology should support, not replace, a clinician-patient relationship. The most important innovation may remain reliable delivery of established core treatments to people who currently receive too little of them.

32. Discussion: integrating established practice and newer approaches:

The strongest message across current guidance is the central role of therapeutic exercise, education and weight management when appropriate. These interventions address more than local tissue capacity: they support confidence, metabolic health, independence and long-term participation. A structured programme should be built around meaningful goals and progress through repeated assessment. Exercise can be adapted for pain, age, disability, preference and resource limitations without abandoning the principle of movement-based care (NICE, 2022; AAOS, 2021; Bannuru et al., 2019).

New approaches should be judged by whether they add benefit to these foundations. Digital physiotherapy may improve access, particularly when travel is difficult, but requires attention to digital inclusion. Low-load blood-flow restriction may be useful for selected individuals who cannot tolerate higher resistance, yet evidence remains limited and screening is essential. Bracing, walking aids, aquatic exercise and manual techniques may have a place where a clear impairment and patient goal justify them. None should be presented as a universal solution or as a substitute for progressive activity.

A patient-centred model also avoids reducing success to radiographic change. KOA is a heterogeneous chronic condition, so outcomes include function, self-efficacy, mood, participation and the ability to manage flares as well as pain. Clinicians should respect that not every patient will aim for the same activity level or have equal resources. The best intervention is both evidence-informed and implementable in the person's circumstances. Transparent discussion of uncertainty and shared decision-making strengthen trust and make the plan more likely to be maintained.

33. Conclusion:

Physiotherapy is a central component of non-surgical management for knee osteoarthritis. A comprehensive approach combines clear education, progressive strengthening, aerobic and functional exercise, activity pacing, weight-management support when appropriate, and regular outcome review. Treatment should be based on the person's goals, baseline capacity, comorbidities and preferences, with safety screening and timely referral for atypical symptoms. Passive modalities and devices may be used selectively when they support function, but should not displace active rehabilitation.

Recent developments in digital physiotherapy, hybrid care and low-load blood-flow-restriction training may expand options for selected patients, although evidence certainty and access considerations vary. The priority is not to adopt every new method but to deliver established care consistently, monitor meaningful outcomes and refine the programme in response to each patient. Through shared decision-making, realistic exercise progression and long-term self-management support, physiotherapists can help people with knee osteoarthritis improve function, maintain activity and participate more fully in everyday life.

Table. 1: Example components of an individualised KOA physiotherapy programme

Component	Possible starting approach	Progression option	Clinical focus
Strengthening	1-2 sets of controlled chair rises, knee extension or hip exercises	Increase repetitions, resistance or task demand one variable at a time	Build lower-limb capacity for transfers and stairs
Aerobic activity	Short, manageable bouts of walking or stationary cycling	Lengthen total duration, then add intensity as appropriate	Improve endurance and support general health
Neuromuscular / balance	Supported weight shifts, stepping and stable balance practice	Add direction changes or less hand support if safe	Improve confidence, control and fall-related function
Mobility	Gentle knee flexion/extension and task-specific movement	Expand comfortable range when it improves a valued task	Maintain useful mobility without forceful provocation
Education / self-management	Explain KOA, set a functional goal and agree a flare plan	Review adherence, barriers and independent problem-solving	Support confidence and long-term activity
Optional adjuncts	Consider walking aid, aquatic session, brace or brief manual therapy where indicated	Continue only if it improves a defined functional goal	Facilitate active care; do not replace core treatment

Table. 2: Outcome measures that can support clinical review

Measure	What it can capture	Practical considerations
Pain numerical rating	Patient-reported pain intensity over a defined period or task	Ask the same question in the same way at follow-up
WOMAC	Pain, stiffness and physical function	Useful for symptom/function tracking; can be lengthy
KOOS	Symptoms, pain, activities of daily living, sport/recreation and knee-related quality of life	Choose relevant subscales and consider patient burden

30-second chair stand	Repeated transfer performance and lower-limb functional capacity	Use a consistent chair height and safe technique
Timed Up and Go	Standing, walking, turning and sitting mobility	Consider balance aids and fall risk
Patient-defined goal	Progress in a meaningful activity such as stairs or community walking	Record a baseline and a concrete, observable target

Table. 3: Examples of symptoms that warrant reassessment or referral

Finding	**Action / reason**
Hot, red, markedly swollen knee, especially with fever	Urgent medical assessment for possible infection or inflammatory condition
Acute severe pain after trauma or inability to bear weight	Prompt assessment for fracture or major injury
Rapid deterioration, locked knee or sudden loss of movement	Reassess diagnosis and arrange appropriate medical review
Calf swelling with chest pain or breathlessness	Emergency assessment for possible thromboembolic event
New progressive neurological or systemic symptoms	Clinical escalation according to the presentation and local pathway

34. References:

(1) World Health Organization. Osteoarthritis [Internet]. Geneva: World Health Organization; 2023 Jul 14 [cited 2026 Oct 24]. Available from: https://www.who.int/news-room/fact-sheets/detail/osteoarthritis
(2) Hunter DJ, Bierma-Zeinstra S. Osteoarthritis. Lancet. 2019;393(10182):1745-1759. doi:10.1016/S0140-6736(19)30417-9.
(3) Katz JN, Arant KR, Loeser RF. Diagnosis and treatment of hip and knee osteoarthritis: a review. JAMA. 2021;325(6):568-578. doi:10.1001/jama.2020.22171.
(4) Sharma L. Osteoarthritis of the knee. N Engl J Med. 2021;384(1):51-59. doi:10.1056/NEJMcp1903768.
(5) National Institute for Health and Care Excellence. Osteoarthritis in over 16s: diagnosis and management. NICE guideline NG226. London: NICE; 2022. Available from: https://www.nice.org.uk/guidance/ng226
(6) American Academy of Orthopaedic Surgeons. Management of osteoarthritis of the knee (non-arthroplasty): evidence-based clinical practice guideline. 3rd ed. Rosemont (IL): AAOS; 2021.
(7) Bannuru RR, Osani MC, Vaysbrot EE, Arden NK, Bennell K, Bierma-Zeinstra SMA, et al. OARSI guidelines for the non-surgical management of knee, hip, and polyarticular osteoarthritis. Osteoarthritis Cartilage. 2019;27(11):1578-1589. doi:10.1016/j.joca.2019.06.011.
(8) Kolasinski SL, Neogi T, Hochberg MC, Oatis C, Guyatt G, Block J, et al. 2019 American College of Rheumatology/Arthritis Foundation guideline for the management of osteoarthritis of the hand, hip, and knee. Arthritis Care Res (Hoboken). 2020;72(2):149-162. doi:10.1002/acr.24131.
(9) Fransen M, McConnell S, Harmer AR, van der Esch M, Simic M, Bennell KL. Exercise for osteoarthritis of the knee. Cochrane Database Syst Rev. 2015;1:CD004376. doi:10.1002/14651858.CD004376.pub3.
(10) Juhl C, Christensen R, Roos EM, Zhang W, Lund H. Impact of exercise type and dose on pain and disability in knee osteoarthritis: a systematic review and meta-regression analysis of randomized controlled trials. Arthritis Rheumatol. 2014;66(3):622-636. doi:10.1002/art.38290.

(11) Goh SL, Persson MSM, Stocks J, Hou Y, Lin J, Hall MC, et al. Relative efficacy of different exercises for pain, function, performance and quality of life in knee and hip osteoarthritis: systematic review and network meta-analysis. Sports Med. 2019;49(5):743-761. doi:10.1007/s40279-019-01082-0.
(12) Bartels EM, Juhl CB, Christensen R, Hagen KB, Danneskiold-Samsøe B, Dagfinrud H. Aquatic exercise for the treatment of knee and hip osteoarthritis. Cochrane Database Syst Rev. 2016;3:CD005523. doi:10.1002/14651858.CD005523.pub3.
(13) Messier SP, Mihalko SL, Legault C, Miller GD, Nicklas BJ, DeVita P, et al. Effects of intensive diet and exercise on knee joint loads, inflammation, and clinical outcomes among overweight and obese adults with knee osteoarthritis: the IDEA randomized clinical trial. JAMA. 2013;310(12):1263-1273. doi:10.1001/jama.2013.277669.
(14) Deyle GD, Allen CS, Allison SC, Gill NW, Hando BR, Petersen EJ, et al. Physical therapy versus glucocorticoid injection for osteoarthritis of the knee. N Engl J Med. 2020;382(15):1420-1429. doi:10.1056/NEJMoa1905877.
(15) Skou ST, Roos EM. Good Life with osteoArthritis in Denmark (GLA:D): evidence-based education and supervised neuromuscular exercise delivered by certified physiotherapists nationwide. BMC Musculoskelet Disord. 2017;18:72. doi:10.1186/s12891-017-1439-y.
(16) Skou ST, Roos EM, Laursen MB, Rathleff MS, Arendt-Nielsen L, Simonsen O, et al. A randomized, controlled trial of total knee replacement. N Engl J Med. 2015;373(17):1597-1606. doi:10.1056/NEJMoa1505467.
(17) Rausch Osthoff AK, Niedermann K, Braun J, Adams J, Brodin N, Dagfinrud H, et al. 2018 EULAR recommendations for physical activity in people with inflammatory arthritis and osteoarthritis. Ann Rheum Dis. 2018;77(9):1251-1260. doi:10.1136/annrheumdis-2018-213585.
(18) Cheung THR, Elliott MT, Stephens G, Mansfield M. Effectiveness of digital physiotherapy interventions in patients with knee osteoarthritis: a systematic review and meta-analysis of randomised controlled trials. BMJ Open. 2025;15(12):e102887. doi:10.1136/bmjopen-2025-102887.
(19) Mohammed AS, Nadeem, Kumar M, Singh B, Chawla A. Role of herbal medicines in the treatment of depression: a comprehensive review. Scienxt J Pharm Sci. 2026;4(2): July–December. doi:10.5281/zenodo.22869446.
(20) Parmar Y, Sharma S. Impact of education protocols and physiotherapeutic management in improving pain, symptoms, activities of daily living, and quality of life in patients with knee osteoarthritis: a systematic review and meta-analysis. Knee. 2026;62:104505. doi:10.1016/j.knee.2026.104505.
(21) Lin Q, Yu D, Zhang Y, Chen X, Qin J, Wu F. Impact of low-load blood flow restriction training on knee osteoarthritis pain and muscle strength: a systematic review and meta-analysis of randomized controlled trials. Front Physiol. 2025;16:1524480. doi:10.3389/fphys.2025.1524480.
(22) Yang H, Xiong L, Wang P, Zeng Y, Zhao Z, He C, et al. Comparative efficacy and safety of blood flow restriction training for knee osteoarthritis: a network meta-analysis. Am J Phys Med Rehabil. 2025;104(12):1086-1094. doi:10.1097/PHM.0000000000002824.
(23) Rausch Osthoff AK, Vliet Vlieland TPM, Ferreira RJO, Amarnani R, Battista S, Orlinov D, et al. EULAR recommendations for physical activity in people with inflammatory arthritis and osteoarthritis: 2025 update. Ann Rheum Dis. 2026;85(6):1026-1038. doi:10.1016/j.ard.2026.03.006.
(24) Bellamy N, Buchanan WW, Goldsmith CH, Campbell J, Stitt LW. Validation study of WOMAC: a health status instrument for measuring clinically important patient-relevant outcomes to antirheumatic drug therapy in patients with osteoarthritis of the hip or knee. J Rheumatol. 1988;15(12):1833-1840.
(25) Roos EM, Lohmander LS. The Knee injury and Osteoarthritis Outcome Score (KOOS): from joint injury to osteoarthritis. Health Qual Life Outcomes. 2003;1:64. doi:10.1186/1477-7525-1-64.

(26) He J, Zhang L, Wu Q, Zhang J. Credibility of blood flow restriction training in patients with knee osteoarthritis: a systematic review and meta-analysis. Orthop J Sports Med. 2025;13(2):23259671241300145. doi:10.1177/23259671241300145.