

Knee joint replacements

Knee replacement surgery has improved dramatically over the period of a few decades because of improved techniques, improved materials and improved understanding of knee physiology and function.^[1]

The different types of knee replacement

There are, broadly speaking, three types of knee replacement:

Unicompartmental knee replacement

- This involves replacement of the medial or lateral tibiofemoral compartment only with components as below.
- It has largely replaced osteotomy.
- It is usually used for osteoarthritis (OA).
- It is not suitable for patients with rheumatoid arthritis (RA).

Unconstrained bicompartmental knee replacement

- The most common form of total knee replacement.
- The femoral component is metal (and anatomically similar to the bone it replaces, with a groove for the patella).
- The tibial component is a flat metal platform with a plastic (polyethylene) cushion and a stem extending into the tibia.
- The patella component (button) is a dome-shaped piece of polyethylene anchored to a flat metal plate.

Constrained bicompartmental knee replacement

- These are used much less often when considerable bone loss is involved – for example, with bone tumours.

- It is not possible to preserve the more physiological joint action with preservation of supporting ligaments, etc and the joint works like a fixed hinge.
- It is much more prone to loosening.

There are over 150 knee replacement designs on the market. Choice of prosthesis depends on many factors (including age, weight, level of activity, health, cost of prosthesis and experience of the surgeon).

The aim of knee replacement is to replace the deficient joint surfaces (condyles of the femur and top surface of the tibia) with low-friction artificial surfaces (including occasionally the patellofemoral joint if affected). The best function and outcome are, in general, achieved by restoring mechanical alignment and soft tissue balance. These, with newer designs, mean taking advantage of support from posterior cruciate ligament and collateral ligaments. Components are designed so that metal (titanium or cobalt/chromium-based alloys) articulates with plastic (ultra high-density polyethylene). A complete prosthesis now weighs only about 500 to 600 g.

Unicompartmental vs total knee replacement in medial compartment osteoarthritis^[2]

One study of 528 patients with medial compartment osteoarthritis were randomised to unicompartmental or total knee replacement and followed up five years later, the two groups showed similar outcomes in respect of:

- Pain and function as measured by the Oxford knee score.
- Likelihood of requiring further surgical intervention.
- Incidence of complications.

On the basis of these findings, and taking into account the lower costs and better cost-effectiveness with partial knee replacement, the authors recommend that this should be considered the first-choice treatment for patients with late-stage isolated medial compartment osteoarthritis.

Aetiology of knee joint replacement

Osteoarthritis (OA)

The most common reason for knee joint replacement is [osteoarthritis \(OA\)](#). This may be:

- Primary OA. Some 40% of 40-year-olds will have radiographic evidence of OA, of which half will have symptoms. There is a genetic risk for this, with siblings of patients having joint replacement being up to five times more likely to need similar surgery.
- Secondary OA. This is secondary to mechanical derangement (for example, meniscal or cruciate ligament injuries), infection, instability, and fracture into the joint.

Other causes of cartilage destruction

- [Rheumatoid arthritis \(RA\)](#).
- [Haemophilia](#).
- [Seronegative arthritis](#).
- Avascular necrosis. This can be idiopathic or steroid-induced.
- [Gout](#) and other crystal deposition diseases.
- Rare causes, which include bone dysplasias and [bone cancers](#) (eg, osteosarcoma). The bone destruction involved usually requires the use of more unusual 'fixed-hinge' or constrained knee joint prostheses.
- Obesity.^[3]

Assessment for knee replacement

History

The basic indications are pain and loss of function. However, the assessment of these is complex and it is difficult to define a clear consensus between surgeons.^[4] Selection for surgery should take into account severity of symptoms, the combination or integrated effect of these symptoms and the patient's motivation to proceed.

NICE recommends considering referral for people with knee osteoarthritis for joint replacement if:^[5]

- Their joint symptoms (eg, pain, stiffness, reduced function or progressive joint deformity) are substantially impacting their quality of life, and
- Non-surgical management (eg, therapeutic exercise, weight loss, pain relief) is ineffective or unsuitable.
- Use clinical assessment when deciding to refer someone for joint replacement, instead of systems that numerically score severity of disease.
- Do not necessarily exclude people with osteoarthritis from referral for joint replacement because of age, sex or gender, smoking, comorbidities, overweight or obesity.

However, factors to be considered include:

- Age. Surgeons are less likely to operate on young patients.
- Pain. This is predominantly on weight-bearing initially and then becomes more constant. It may be generalised or localised to one compartment (usually the medial compartment). Pain can be graded either from 1 to 10, or as mild, moderate or severe. Severe daily pain with rest pain on several days per week and daily pain on transferring would help persuade surgeons to operate.
- Functional impairment considerations:
 - How are activities of daily living affected?
 - Are walking devices or aids used?
 - What is the maximum walking distance?
 - Can the patient climb stairs?
 - Can the patient dress and self-manage?
 - What other activities requiring knee bending are impaired?
- Sleep. Sleep may be disrupted by pain. This can lead to depression and mood disturbance.
- Sexual and social functioning.
- Comorbidity. OA and RA are perceived as having a good outcome from surgery.^[6]

- Patient motivation.
- Employment and maintenance of independent living.

Scoring systems have been used in research in an attempt to quantify disability and measure outcomes. These include measures of general health status and specific knee scoring systems (eg, via the Knee Society). [7] [8]

Examination

Examination should incorporate:

- General health and assessment of any medical conditions (for example, hypertension, heart disease, diabetes, etc).
- Knee examination:
 - Inspection. Look for scars, skin sepsis and soft tissue defects around the knee. Skin defects or scarring may affect healing.
 - Palpation. Check pulses and ensure there is no peripheral arterial disease. Arrange for further investigation if peripheral arterial disease is suspected.
 - Look for wasting of the quadriceps and check there is good extensor function.
 - Measure the range of joint movement and any fixed flexion deformity (ideally using a goniometer) and record findings. The best predictor of range of movement after operation is the range before operation.

Investigations

- X-ray (posteroanterior (PA), anteroposterior (AP), lateral, skyline view of the patella, 45° PA or Rosenberg view). These should correlate with the clinical findings. Radiographic destruction of joint space, together with symptoms, are required findings by most surgeons. Cysts, subchondral sclerosis and osteophytes are also seen in OA. [9] .
- MRI scan. This may be done particularly to assess cruciate ligaments and the patellofemoral compartment further.

- Indium white cell scanning and other techniques are rarely needed before operation. In complicated revision arthroplasty, where infection needs differentiating from aseptic loosening, various techniques can be used.^[10]
- Bone densitometry. This is indicated where there are risk factors for [osteoporosis](#).
- Arthroscopy. This has often been performed on younger patients to evaluate symptoms, injury, etc.

Measures to delay or avoid knee replacement

Conservative measures to be considered before surgery include:

- Adequate [pain management](#).
- Weight loss.
- Physiotherapy to help with muscle strengthening, gait, patient education, joint mobility, and walking aids.
- Occupational therapy to aid with activities of daily living: bath aids, toilet aids, grab rails, etc.
- Walking aids (shoe adjustments, bracing of joints, etc).
- Exercise, including muscle strengthening procedures.^[11]

Contra-indications to knee joint replacement

Absolute contra-indications include:

- Knee sepsis.
- Any untreated source of infection.
- Poor knee extensor function.
- Significant [arterial disease](#).
- Genu recurvatum knee deformity (secondary to muscular weakness).
- Presence of a good knee arthrodesis.

Other conditions which cause significant difficulty and are considered relative contra-indications include:

- Any condition increasing anaesthetic risk and good recovery significantly.
- Skin disorders around the line of incision.
- Past history of [osteomyelitis](#).
- [Obesity](#).
- Neurological disorders affecting musculature or joint.

Details of the operation

It may be useful for the GP to have details about the operation where they have a bearing on postoperative progress and possible complications. Such detail is seldom routinely provided but could include:

- Method of anaesthetic. Often epidurals are used.
- Tourniquet time.
- Operative approach. This is usually anterior through a medial parapatellar approach (may be lateral or subvastus). Mini-incision techniques may be used. Guidance from NICE has been produced. [\[12\]](#)
- Whether good mechanical alignment was achieved with good patellofemoral alignment.
- Whether knee ligaments were significantly contracted and, if so, whether knee ligament release was necessary.
- Whether patellofemoral surgery was required (release, reefing or even resurfacing with polyethylene).
- Detail of the prosthesis and whether cemented or uncemented.

Treatment and management of patients after knee replacement

- In hospital, postoperatively, early knee movement within the first 24 hours is encouraged with:
 - Good analgesia. Often patient-controlled methods. Epidural methods are also commonly used.
 - Physiotherapy. A continuous passive motion machine may be used. Exercises are taught. Most patients walk on the second postoperative day.
 - Cryotherapy, which may be used to reduce swelling.
- Early discharge is encouraged at between five days and two weeks, depending on progress; however, but only if:
 - Wound healing is satisfactory.
 - Mobility is satisfactory.
 - Knee flexion of 90° is achieved.
 - No complications have been identified.
- Orthopaedic follow-up is usually at about six weeks in outpatients.

- Review in general practice is likely to be for:
 - Analgesia.
 - Wound care.
 - Reassurance.
 - Identification of complications.
 - Review of thromboembolism prophylaxis. This is often continued at home.
 - Review for return to normal activities: ^[13]
 - Driving: if the left knee has been replaced and the vehicle is automatic, then driving can be resumed as soon as one week after surgery. If the right knee has been replaced, 4-6 weeks off driving is to be expected.
 - Return to work. This depends on the type of work, but may take up to eight weeks.
 - Travelling. Measures to prevent thromboembolic complications are recommended. Airport metal detectors may be triggered and a medical emergency identification bracelet or similar can be useful.
 - Other activities: swimming is recommended, usually from the time the sutures are removed, and the wound has healed fully (about six weeks). Dancing, golf (with spikeless shoes and cart), and cycling (level ground) are also acceptable. Activities which stress the joint should be avoided (for example, tennis, squash, jumping, ski-ing, and jogging).

Complications of knee joint replacement

- Thromboembolic complications, including [deep vein thrombosis](#) and [pulmonary embolus](#).
- Infection.

- Patellofemoral instability and other complications.
- Vascular complications.
- Neurological complications. Peroneal nerve palsy is the most common neurological problem, occurring most often when correcting fixed valgus and flexion deformities. 50% recover spontaneously.
- Aseptic loosening.
- Fractures. Periprosthetic fractures, especially of the femur (supracondylar) can (rarely) occur.
- Arthrofibrosis or restrictive scarring can impair knee movement.

The future of knee joint replacement

New developments include:

- Use of uncemented designs allowing bone to grow into a porous prosthesis and give 'biologic' fixation.
- New joint surfaces (eg, bioactive surfaces like hydroxyapatite).
- Mobile-bearing knee replacements are being improved. In a mobile-bearing knee replacement both the femoral and tibial components move across a polyethylene insert, creating a dual surface articulation and helping to reduce wear and loosening.
- Improved kinematics.
- Improved fixation.
- Use of navigation-guided surgery. Mini-incision for knee joint replacement is another term for use of navigation-guided instruments which allow smaller incisions and less tissue destruction. NICE guidance from 2010 supports use of the procedure but only by suitably trained surgeons and only with various measures in place to audit results.^[12] The prostheses used are essentially the same.

Prognosis

If carefully and correctly selected for surgery, a good outcome is expected. There should be relief of pain and restoration of function, even allowing patients to participate in some gentle sporting activity. Longer-term studies are showing low failure rates of around 5% after 12–15 years. Cementless prostheses have not been followed up for as long.

A pooled registry data study in the *Lancet* (2019) reveals that advances in technology and surgical techniques have extended the life of both unicompartmental knee replacements (UKRs) and total knee replacements (TKRs). You can advise patients that in the region of 82% of TKRs and 70% of UKRs will last for 25 years.^[14]

Prevention

Reducing the need for knee replacement will depend largely on progress in the prevention of OA and perhaps an holistic approach to management of those patients with OA.^[5]

Further reading

- [Joint replacement \(primary\): hip, knee and shoulder](#); NICE Quality standard, March 2022
- [Vaienti E, Scita G, Ceccarelli F, et al](#); Understanding the human knee and its relationship to total knee replacement. *Acta Biomed.* 2017 Jun 7;88(2S):6–16. doi: 10.23750/abm.v88i2-S.6507.
- [Riviere C, Iranpour F, Auvinet E, et al](#); Alignment options for total knee arthroplasty: A systematic review. *Orthop Traumatol Surg Res.* 2017 Nov;103(7):1047–1056. doi: 10.1016/j.otsr.2017.07.010. Epub 2017 Aug 31.

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