Knee

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Medial compartment osteoarthritis of the knee: a review of surgical options

Daniel J. McCormack
Darren Puttock
Steven P. Godsiff

- Osteoarthritis of the medial compartment, where the lateral compartment and patella-femoral joint are relatively spared, is a common orthopaedic presentation.
- Most frequently, the treatment of choice would be a total knee replacement, which involves removing healthy joint surfaces in such patients.
- Arthroscopic debridement in the osteoarthritic knee has fallen out of favour due to poor clinical results.
- A trend has developed towards less invasive surgery with uni-compartmental knee replacement (UKR) and high tibial osteotomy (HTO) gaining increasing popularity.
- Surgeons differ in their relative indications and contraindications to performing these procedures.
- Total knee replacement (TKR) continues to have the lowest overall revision rate of the available options.
- Growing evidence demonstrates more favourable patient-reported outcome measures in UKR and HTO patients, compared to TKR.
- Knee joint distraction (KJD) has been demonstrated as an alternative method of treatment in such patients.

Keywords: knee; osteoarthritis

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Introduction

Many patients present to orthopaedic surgeons with a painful knee attributed to osteoarthritis of the medial compartment, where the lateral compartment and patella-femoral joint are relatively spared. Traditionally, the treatment of choice would be a total knee arthroplasty; however, this involves removing healthy joint surfaces. Arthroscopic debridement in the osteoarthritic knee has fallen out of favour due to poor clinical results.[1] Recently, a trend has developed towards less invasive surgery with uni-compartmental knee replacement (UKR) and high tibial osteotomy (HTO) gaining increasing popularity. Recent research has looked into potential benefits of these options over total knee arthroplasty. Knee surgeons differ in their willingness to offer patients such interventions. Those who do often differ in their relative indications and contraindications to performing them. In this instructional review article, we demonstrate the evidence for each option with particular focus on controversies and unanswered questions. The aim of the article is to provide an up-to-date evidence base for the treatment options for such patients.

Options

Ultimately, a patient with knee arthritis can be treated operatively or non-operatively. Non-operative management may include appropriately titrating oral analgesia, shock-absorbing footwear, supports to offload the joint and weight-reduction strategies. An intra-articular injection of either a corticosteroid, platelet-rich plasma (PRP) or hyaluronic acid may be considered. Orthotic treatments such as a hinged offloader brace can also be employed. Operative management might involve a total knee replacement (TKR), with other options being a uni-compartmental knee replacement (UKR) or high tibial osteotomy (HTO), if the patient and the disease characteristics allow. The indications and contraindications for UKR and HTO are open to ongoing debate. More recently, joint distraction has been employed as a method of offloading the affected medial compartment, with the proposed mechanism of cartilage regeneration.

UKR

In 1989, Kozinn and Scott recommended contraindications for UKR as patient < 60 years of age, weight > 82 kg, chondrocalcinosis, exposed bone on the patello-femoral compartment and those who are very active or undertake heavy labour.[2] It is widely accepted that these criteria are too strict and are now directly challenged in many instances. Current criteria have suggested the consideration of UKR in situations of uni-compartmental full-thickness osteoarthritis, a functionally stable anterior cruciate ligament with stable collateral ligaments, correctable intra-articular deformity and the absence of an inflammatory aetiology.[3]

High activity levels, once thought to be detrimental to patients undergoing UKR, have since been found to be beneficial in terms of implant survivorship and revision rates.[4] Patients also have higher rates of returning to sporting activities, particularly if low impact, compared to with TKR.[5]

The Oxford Group found that patients undergoing UKR with partial-thickness medial compartment cartilage loss on the femur, tibia or both, had poorer functional outcomes compared to full-thickness loss from both femur and tibia.[6] The authors suggest UKR should be reserved for patients with bone-on-bone arthritis, a so called 'kissing lesion'. A medial UKR has also been shown to have excellent long-term results in patients with osteonecrosis of the medial femoral condyle.[7]

ACL-deficient knees may still benefit from UKR; however, the knee should be assessed for evidence of functional instability which may be considered a contraindication to a mobile bearing UKR.[8] Functional instability is thought to be more prevalent in primarily ACL-deficient knees, usually resulting from trauma, compared to those with secondary ACL deficiency as a result of osteoarthritis, where the knee may still be functionally stable. A UKR should be avoided if the knee is expected to be unstable after the procedure. It must be noted that an ACL-deficient knee is predisposed to posterolateral tibial wear, which may mean a medial UKR is contraindicated as the arthritis may not be unicompartmental in nature.[9]

UKR differs from a HTO in approach to deformity correction. UKR will correct an intra-articular deformity caused by cartilage loss with the aim of restoring collateral ligaments to their normal tension.[10] An HTO differs in that the aim of the procedure is to alter the mechanical axis of the limb.[11] For this reason, UKR is contraindicated in large deformities (> 15 degrees), as they will not be corrected by the intra-articular procedure.

The decision to offer patients a UKR presents a dilemma for the surgeon. UK registry data suggests that low-volume surgeons have a higher revision rate; however, the traditional contraindications of Kozinn and Scott would mean only 6% of knees are appropriate.[12] Other studies have suggested that although currently fewer than 10% of knee arthroplasties are a UKR, up to 47% of patients requiring a knee replacement have uni-compartmental disease.[13] With this in mind, surgeons must decide individually whether they would benefit from adjusting their own indications for UKR to ensure they are adequately exposed to the technique, without compromising outcomes by offering UKR to patients who are unlikely to benefit. National Joint Registry evidence demonstrates the revision rate falls sharply until 10 cases are performed a year, with a levelling off at 30 cases a year.[14] The challenge lies in appropriate patient selection.

The TOPKAT Study Group have concluded that UKR is a viable option for patients with uni-compartmental knee arthritis both in terms of clinical and cost effectiveness after comparing UKR to TKR.[15] The inclusion criteria for this multi-centre randomized controlled trial (RCT) were isolated full-thickness cartilage loss of the medial compartment tibia and femur, a functionally intact ACL, full-thickness lateral cartilage presence and a correctable intra-articular varus deformity. Only medically fit patients with an ASA of 2 or less were included. Patients with inflammatory arthropathy, those requiring revision surgery, those with spine, hip or foot pathology were excluded. Patients with a past history of septic arthritis or previous surgery other than diagnostic arthroscopy were also excluded. Significant patella-femoral joint damage and an inability to perform the required clinical tests were also a contraindication for inclusion within this RCT. Whilst the trial found no difference in Oxford Knee Scores at five years between TKR and UKR patients, UKR was superior in terms of length of stay, overall cost, fewer complications and improvements in some satisfaction outcomes.[15]

Although the above study confirms that UKR is both cost effective and non-inferior to TKR in terms of five-year outcomes, UK registry data confirms UKR has a higher overall revision rate of 16.9% at 14 years.[16] Time will tell whether these clinical and cost effectiveness benefits at five years continue at medium to long term. Progression of lateral-sided disease is a mode of failure exclusive to UKR in comparison to TKR.

In the age of consent and shared decision making, it is important patients understand what to expect with a UKR as opposed to a TKR. A recent meta-analysis of available evidence demonstrated a significant reduction in length of inpatient stay with UKR.[17] Post-operative pain was no different between UKR and TKR; however, functional patient-reported outcome measures (PROMs) favoured UKR. Five-year revision rates were higher in UKR compared to TKR in RCTs, cohort studies and registry studies.[17] A recent radiographically matched cohort analysis gives further evidence towards improved PROMs in patients undergoing UKR, over those having TKR at one-year follow-up.[18]

When choosing between implants, surgeons must decide between mobile and fixed bearing UKR. The mode of failure differs depending on the type of implant, with mobile bearing UKR being more susceptible to polyethylene dislocation and fixed bearing being more susceptible to a combination of polyethylene wear and aseptic loosening.[19] A recent meta-analysis showed no difference in revision rate or complication rate between the two types of bearing.[20] Some surgeons have concerns about polyethylene dislocation with a mobile bearing prosthesis and, although the above study would suggest that this may not translate to an overall increased revision rate, a fixed bearing would act to prevent this complication occurring.

To summarize, UKR should be considered in patients who have isolated, non-inflammatory, medial compartment,

bone-on-bone arthritis in a stable knee without significant deformity. Patients can expect a shorter post-operative inpatient stay, though equal post-operative pain levels to those undergoing TKR. Increased activity levels should not act against a decision to perform a UKR and such patients may more realistically expect to return to low-demand sport, and sooner than patients undergoing TKR. Functional outcomes are equivalent at five years; however, overall revision rates are higher compared to TKR. Surgeons should be reluctant to offer UKR if they are unable to operate on at least 10 appropriate cases a year. If this is not attainable, patients would be better served by being referred to a higher-volume surgeon if they wish to consider UKR over TKR.

HTO

High tibial osteotomy is another option for patients with isolated medial compartment osteoarthritis. The aim of the procedure is to alter the mechanical axis of the lower limb to offload the arthritic medial compartment and relatively increase the load on the unaffected lateral compartment, thereby reducing pain and improving function. Researchers have hypothesized that this may lead to cartilage regeneration in the affected medial compartment.[11] High tibial osteotomy can be performed by a medial opening wedge osteotomy, or lateral closing wedge osteotomy, in cases of the varus mal-aligned knee.

Historically, HTO has been performed for patients with varus mal-alignment and isolated medial compartment arthritis with a stable knee, and the absence of varus thrust.[21] Osteotomies can also be employed to address associated instability at the time of the osteotomy. HTO can address the coronal alignment of the tibia, but can also alter the posterior tibial slope, which has a direct effect on anterior tibial translation. Reducing the posterior tibial slope can reduce anterior tibial translation in the setting of an ACL-deficient knee.[22] In patients with arthritis and instability, correcting the coronal alignment alone may be insufficient, as the altered knee kinematics caused by instability may be a key driver in their pattern of arthritis.[9] It is generally accepted that in patients with ACL instability whose dominant symptom is arthritic pain, a ligament reconstruction should be avoided.[21] Combined/staged HTO and ACL reconstruction is more often considered in patients with femoro-tibial mal-alignment whose main symptom is instability, but who also have medial compartment pain or signs of medial overload. Lateral/postero-lateral ligament insufficiency may also prevail in these circumstances. The HTO is usually performed first since this alone may give sufficient relief of symptoms, especially in low-demand patients, but ligament reconstruction can be considered at the same time as, or later than, the time of implant removal if necessary.[23,24]

Few randomized controlled trials have compared HTO to other interventions. A meta-analysis found no difference in walking velocity, knee scores, lateral disease progression or need for further surgery or revision when comparing with UKR.[25] Range of motion was better in HTO patients; however, UKR performed better in pain scores, functional assessment and number of complications.[25] An RCT in Norway has demonstrated no difference in clinical improvement when comparing closing or opening wedge osteotomy for medial compartment osteoarthritis.[26] More RCTs have looked into the different technical aspects of performing an HTO, rather than its efficacy over other treatment options.

Over the last five years, few RCTs have been performed comparing HTO to other treatments. HTO has been shown to be beneficial compared to non-operative management; however, there was no functional difference when compared to a medial offloading brace.[27] Due to poor compliance, an offloading brace is rarely used as a definitive management of patients with medial knee osteoarthritis. A trial of an offloading brace (a so called 'brace-test') has been shown to be beneficial in predicting the pain-relieving effect of a HTO, and thus holds significant clinical value.[28] A meta-analysis comparing UKR and HTO concluded neither procedure was superior, with both procedures giving good functional outcomes.[25] The authors suggest HTO in younger active patients, with these patients obtaining a slightly better range of motion.[25] An RCT looking at cartilage regeneration compared HTO to joint distraction, and concludes both procedures have efficacy.[29] The HTO patients had better patient-reported outcome measures; however, joint space increased more in the joint distraction group.[29]

Surgeons performing HTO differ in their suggested post-operative weight-bearing regimen. RCT evidence has demonstrated improved early functional outcomes with early full weight bearing, compared to six weeks of partial weight bearing only.[30]

A Finnish registry study estimated the survivorship of HTO to be 89% at five years and 73% at 10 years when taking conversion to TKR as an end point.[31] This is lower than the equivalent survivorship for both primary TKRs and UKRs at five and 10 years respectively, suggesting an increased likelihood of earlier major re-operation in patients undergoing HTO.

There is much less available evidence for the indications and contraindications of HTO as opposed to UKR. Less has also been published regarding the monitoring of outcomes and survivorship. Much of the high-level evidence compares the specifics of HTO surgery, for instance graft type or osteotomy location as opposed to its efficacy compared to UKR or TKR. Although a UK knee osteotomy registry exists, this is as yet non-compulsory,[32] in contrast to the National Joint Registry of England and Wales.[33] Selecting appropriate patients for an HTO is challenging. It is suggested that HTO is an option in patients with a significant varus mal-alignment

with medial-sided disease. It is often reserved for younger more active patients and ACL instability is less often seen as a contraindication. The trend towards offering HTO to more active patients is interesting, particularly as outcomes in UKR have been favourable in more active patients compared to more sedentary patients.[4] Further high-level studies are required to determine whether surgeons should be reluctant to offer UKR for these patients. One barrier to setting up such studies would be to address whether surgeons feel these two interventions are addressing the same type of disease, or whether they feel these procedures are addressing a heterogonous group of patients. Younger patients more commonly undergo an HTO than a UKR.[34] Unless the orthopaedic community agrees both options are viable in the same group of patients, meaningful randomized studies between the two options will be hard to come by.

In summary, an HTO is an option for patients with isolated medial compartment osteoarthritis. Patients can expect improvement in clinical outcomes after surgery; however, no study has proven a significant difference when compared to UKR or TKR. Younger, more active patients are generally considered for HTO; however, this does not currently appear to be based on any high-level evidence.

Knee joint distraction

Knee joint distraction (KJD), with an external fixator, for a period of 6 to 8 weeks has been proposed as a treatment for patients with end-stage osteoarthritis, to delay the need for total knee replacement.[35] An RCT comparing knee joint distraction to TKR concluded non-inferiority in outcomes when compared to TKA at one year. Knees were distracted by 5 mm for a period of six weeks.[35] The trial only included patients below the age of 65 years, with a BMI of $\leq$ 35, flexion $\geq$ 120 degrees and intact knee ligaments. A high incidence of pin track infections was reported in knee joint distraction patients (60%), which may partly account for its low uptake at present. There is no current evidence to suggest that these patients had an increased infection risk if subsequently undergoing TKR.[36] A further RCT by the same group compared HTO to knee joint distraction, demonstrating clinical improvement in both groups, with slightly better PROM data in the HTO group.[29] Although follow-up in this study was short, previous studies have suggested survival rates of 80% and 65% at five and 10 years respectively, when looking at conversion to TKR after knee joint distraction.

Knee joint distraction remains in its infancy for the treatment of osteoarthritis; however, from the studies performed, it appears to have some efficacy. The procedure avoids arthroplasty, and limb re-alignment, so has promise in the treatment of younger patients wishing to avoid these options. Although pin track infection rates are high, these were all successfully treated with oral antibiotics, so may not be of long-term consequence to KJD patients. There is also currently no evidence to suggest these patients are more likely to have an infection if subsequently treated with TKR. Caution must be taken, as KJD is the least studied of the three less-invasive methods of treating medial knee osteoarthritis.

Conclusions

If low revision rate is seen as the key indicator for success, TKR remains the most successful option for treating medial compartment osteoarthritis with an estimated revision rate of 4–5% at 14 years.[16] Many patients wish to avoid TKR. UKR, HTO and KJD are other options which can be considered. UKR and HTO both have reasonable evidence demonstrating some benefits over TKR in terms of PROM data; however, this should be considered at the cost of an increased revision rate compared to TKR. All three treatments have RCT evidence of their efficacy, although each comes with its own set of benefits and limitations. Orthopaedic surgeons should be aware of the options at their disposal so they can better inform patients, and ensure their own practice allows the best possibility of successful outcomes. It must be noted that surgeons should avoid such options if they cannot expect to perform them in adequate numbers, and local referral pathways should ensure there is no compromise of patient choice as a result.

Author Information
Department of Orthopaedics, University Hospitals of Leicester NHS Trust, Leicester, UK.

Correspondence should be sent to: Daniel J. McCormack, Department of Orthopaedics, University Hospitals of Leicester NHS Trust, Gwendolen Road, Leicester, Leicestershire, LE5 4PW, UK.
Email: daniel.mccormack@gmail.com

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