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## CHAPTER

# 36

# Minimal Invasive Unicompartmental Knee Arthroplasty

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## INTRODUCTION

Osteoarthritis (OA) is the most common form of arthritis and is a leading cause of disability in the aging population of the developed world. There is a rapid rise in number of hip and knee arthroplasties being performed globally with substantial associated economic and social burden.<sup>1</sup> On average, a person with OA makes nine visits to a physician each year and has 0.2–0.3 hospitalizations each year lasting 7–8 days each.<sup>2</sup>

The role of unicompartmental knee replacement (UKR) has been well established in the treatment of OA of the knee over the past 20 years, with the potential advantages being preservation of bone stock, preservation of cruciate ligaments, and normal knee kinematics.<sup>3–6</sup> In a registry-based study of 89,132 total knee arthroplasty (TKA) and unicompartmental knee arthroplasty (UKA) outcomes, Liddle et al. concluded that although both TKA and UKA improve patient-reported outcome measures (PROMs) at 6 months postsurgery, UKA resulted in significantly better early outcomes in terms of joint specific and health-related quality of life scores. Patients undergoing UKA had an odds ratio of 1.59 of attaining an “excellent” outcome compared to TKA, and the likelihood of not improving at all following surgery was significantly greater following TKA, with an odds ratio of 1.31.<sup>7</sup>

Nevertheless, UKR has not generally been performed in large numbers compared with total knee replacement (TKR) (Fig. 1). In spite of being more bone conserving, the procedure was traditionally carried out through the same approach as TKR, with the same risks and complications, and because of the long list of contraindications,<sup>5</sup> surgeons have generally opted for TKR in the management of patients who would be suitable for UKR.

Furthermore, some of the traditional UKRs have generally resected more bone than a standard TKR,

making salvage surgery eventually for failure much more difficult (Fig. 2).

Over the last 2–3 years, several developments have prompted resurgence in interest in UKR, specifically:

- Improved instrumentation, specifically introduction of minimally invasive surgery (MIS) cutting blocks.
- Improved surgical technique coupled with computer/robotic assisted surgery allowing improved implant positioning.
- More bone preserving designs, allowing easier conversion to TKA once revision is required.

## THE NATURAL HISTORY OF UNICOMPARTMENTAL OSTEOARTHRITIS

A study by the University Department of Orthopedics in Lund, Sweden, was presented as a poster presentation at the annual meeting of the American Academy of Orthopedic Surgeons in 1987. In this study, 370 knees were classified by X-ray methods described by Ahlback,<sup>8</sup> they found that in 85% of cases, the OA was confined to only one compartment, with medial compartment affected 10 times more than lateral. Only 2% showed involvement of both the medial and lateral compartments of the knee joint.

Disease progresses in one compartment over 13 years to produce tibiofemoral subluxation, or lack of knee alignment.

The conclusions of this study can be summarized as follows:

- Primary OA is *focal*, either medial or lateral.
- Primary OA is rare before age 55 years.
- In younger men, OA is usually secondary to trauma (sports).
- Medial and lateral cartilage loss is suspect of rheumatoid arthritis (RA).
- The prognosis for OA in the knee is worse than the hip.



**Fig. 1:** Conventional cemented total knee replacement.



**Fig. 3:** Advanced tricompartmental osteoarthritis.



**Fig. 2:** Excessive tibial bone resection in older style unicompartmental knee replacement.

The conclusions from the natural history data is that there is the need for a pre-TKR procedure that may last long-term, and that unicompartmental OA knee should not be overtreated with a TKR.

### LONG-TERM RESULTS OF UNICOMPARTMENTAL KNEE REPLACEMENT

- Various publications have presented excellent survivability for patients treated with TKR, approaching 95% at 10–15 years.<sup>9</sup> However, this is only for patients treated age 75 years or older. Patients treated with TKR at age 65 years or younger resulted in prosthetic survival rates in the low 80% range.<sup>3,4,10</sup> If the statistics are valid, one can anticipate generating one TKR revision for every five primary TKRs over a 10-year-period when working with patients (65 years or younger).

- The Swedish National Joint Replacement Registry, which records every joint prosthesis used in that country, indicates in follow-up of over 2,000 UKRs by the Marmor technique, a 10-year survival rate in the low 90% range. The revision rate of UKRs at 10-year was twice that of TKR.<sup>11</sup>
- Unicompartmental knee replacement has reasonable intermediate survival capabilities, but longer term (>10 years) is unpredictable and not comparable to TKR.
- More recent data from multiple joint registries have shown that survivorship greatly improves with increase annual surgical volume; for surgeons performing fewer than 10 UKA per year, the mean 8-year rate of survival of the UKA was 87.9% compared with 92.4% for those who performed 30 UKA or more per year.<sup>7,12-14</sup>
- In the most recent report from England/Wales Joint Registry, using a commonly used implant, they reported a 96% 5-year survivorship.

### MINIMALLY INVASIVE SURGICAL APPROACH WITH BONE PRESERVING IMPLANT (REPICCI)

By the early 1990s, TKR was well accepted as the ultimate knee salvage procedure in the United States.

During this time, Repicci recognized that knee arthritis occurs in two common formats, tricompartmental (Fig. 3) and unicompartmental, each with a distinct clinical presentation.

In tricompartmental OA, pain is often so debilitating that activities of daily living are severely restricted, making TKR the procedure of choice.

In unicompartmental OA, pain typically is inconvenient but not disabling. As these patients are often younger with early anteromedial disease (Fig. 4), they are often far more active, and generally will not be satisfied with simple pain relief, but may desire restored function and return to activities of daily living. Such patients are good candidates for UKR, particularly through a less invasive procedure.

Minimally invasive UKR is highly advantageous because it avoids disturbing knee physiology, interfering with lifestyle and compromising future treatment options.

The recognized benefits to the patient include:

- Smaller incision
- Less blood loss
- Less infection, bleeding, or wound problems
- Rapid return to normal knee function



**Fig. 4:** Isolated medial compartment osteoarthritis.



**Fig. 5:** Ideal patient for minimally invasive unicompartmental knee replacement using the Repicci technique.

- Shorter hospital stay, potentially as a day only procedure
- Less bone removed (3 mm) making salvage surgery simpler
- More normal feeling, kinematic knee for the patient for the younger and more active patients.<sup>15</sup>

The preservation of soft tissues and the avoidance of patella dislocation are almost certainly responsible for the diminished postoperative pain and decreased rehabilitation time associated with minimally invasive UKR. When it is presented as an arthritic bypass option with morbidity similar to arthroscopic procedures, patients with unicompartmental OA consistently choose minimally invasive UKR over TKR, preferring to delay a potential TKR for 8–10 years.

Repicci describes his procedure as a “patch and repair” operation to buy time before the need for TKR if necessary. He likens it to a dentist filling a tooth, hopefully to delay the need for an extraction (Figs. 5 and 6).<sup>16,17</sup>

I began doing UKR through a minimally invasive approach using the Repicci technique in August 1998, having worked with Dr John Repicci in Buffalo, New York, and learning the procedure.

Between September 1998 and April 2004, 508 knees in 490 patients have been operated upon by me personally using this method. All patients have been admitted the day of surgery and mobilized as rapidly as their own physical factors would allow. The average age is 66 years, with 97% medial and 3% lateral UKR. There have been eight failures to my knowledge (two osteoporosis related, two over correction of deformity with progression of disease on the lateral side, and four subsidence of tibial baseplate



**Fig. 6:** Postoperative radiograph of Repicci unicompartmental knee replacement of the medial compartment.

possibly due to stress fractures) (Figs. 7 and 8). All cases have been successfully revised to a standard TKR.

In this series of 508 knees, there has been only one readmission to hospital (for pain relief), and one superficial wound infection. There have been three deep vein thrombosis treated with prolonged anticoagulation. The average length of stay is 1.57 days, with 41% of patients returning home the same day (Fig. 9).

Successful rapid discharge and mobilization requires intensive preoperative education about the procedure and what to expect. Patients are educated as group the day before surgery, by the senior nurse educators, as well as the physiotherapists and occupational therapist. Postoperative pain control utilizes regular oral analgesia

and anti-inflammatory medication, but without injectable narcotics. Patients are taught how to change the dressing at day 3, and to mobilize as they tolerate. First follow-up is at 2 weeks.

Patient satisfaction with this procedure is extremely high, around 98%, probably because recovery is rapid and the knee often feels and functions quite normally once swelling settles in around 6–8 weeks. Patients frequently regain motion rapidly postoperatively, compared with TKR, because there is less trauma to the knee with the minimally invasive approach (Figs. 10 to 13).

However more recently, I have started noticing increasing number of patients complaining of unremitting medial tibial pain with use of all polyethylene tibial



**Fig. 7:** X-ray following a Repicci unicompartmental knee replacement in which the tibial polyethylene is too thick, resulting in overcorrection leading to wear of the lateral side.



**Fig. 8:** X-ray demonstrating increased density under tibial baseplate which eventually resulted in a stress fracture through a pin hole.



**Fig. 9:** Patient walking 2 hours after Repicci procedure in the recovery ward of day surgery unit. Patient was discharged directly home shortly thereafter.



**Fig. 10:** Patient demonstrating near normal active knee flexion after Repicci minimally invasive unicompartmental knee replacement.



**Fig. 11:** Patient demonstrating full active extension of the operated knee early after Repicci minimally invasive unicompartmental knee replacement (UKR).



**Fig. 13:** Patient squatting after bilateral Repicci unicompartmental knee replacement.



**Fig. 12:** Small wound after minimally invasive unicompartmental knee replacement.

components despite an uneventful surgery and satisfactory postoperative X-rays. Exploring the literature, it has recently become evident that all polyethylene tibial components, due to their lack of rigidity, pathologically overstrain the underlying tibial cancellous bone. This results in a spectrum of problems, beginning with pain, accumulation of microfractures, and ultimately tibial loosening and revision.<sup>18-20</sup>

Therefore more recently, I have moved to utilizing Zimmer unicompartmental knee (ZUK), unicompartmental knee replacement system (Zimmer Biomet) which is a metal backed, measured resection prosthesis with excellent 10 years survivorship data. This prosthesis allows for a bone preserving MIS with added benefit of metal backing,

eliminating abnormal excessive loading of the proximal tibia. There is also an option for patient specific cutting guides, which has the potential for further reducing operative time and improving accuracy.<sup>21,22</sup>

## SUMMARY

The renewed interest in UKA on the part of both orthopedic surgeons and patients coincides not only with improvement in surgical technique and design, but also with the introduction of minimally invasive UKR. This approach is highly advantageous because it does not interfere with physiology, lifestyle, and future treatment options. Avoiding patella dislocation and nonessential tissue dissection result in lower morbidity and rapid rehabilitation. Because minimally invasive UKR may be performed on an outpatient basis, with full independence achieved by 4 hours postoperatively, rapid rehabilitation, and return to activities of daily living, it addresses patient satisfaction issues regarding lifestyle. Pain is managed through preoperative patient education, multimodal anesthesia in form of oral paracetamol, nonsteroidal anti-inflammatory drugs (NSAIDs), local anesthetic infiltration of all incisional tissue, as well as slow release infusion devices such as intra-articular or adductor canal catheters. Using the above technique, parenteral narcotics can be avoided in majority of cases, allowing more rapid mobilization of the patients with associated reduced hospital stay.

Overall, UKR have shown to be highly successful in alleviating pain and restoring function along with high rates of patient satisfaction. The prostheses have been shown to function well up to and beyond 10 years. A

small percentage of patients will require revision due to progression of the disease and very rarely due to wear or loosening of the prosthesis. However, although these prostheses allow rapid return to normal life, I would still advise caution in patients who want to continue running on their knee. Consideration should be given to a high tibial osteotomy in these patients.

Overall, the single most important factor affecting survivorship of all UKR, regardless of design or use of minimally invasive approach, is proper surgical technique. Therefore, it is critical that surgeons who choose to pursue UKR receive proper training to ensure the surgical expertise required to successfully perform this type of surgery.

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