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REVIEW ARTICLE

Unicompartmental Arthroplasty of the Knee

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ABSTRACT

Unicompartmental knee arthroplasty (UKA) is now well-established as a treatment option for isolated compartment osteoarthritis (OA) of the knee. Improvements in surgical technique, instrumentation, component design, and rapid rehabilitation has resulted good long-term survivorship and in the wider acceptance for UKA. The experiences from several centers have been key in the education of surgeons with regards to patient selection, technical considerations, and importantly avoiding common pitfalls can lead to early failure of the components. A younger patient may require revision in their lifetime, but modern UKA design allows this to be performed with minimal surgical difficulties and with good outcome.

Keywords: Arthritis arthroplasty, Knee, Unicompartmental.

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INTRODUCTION

Unicompartmental knee arthroplasty (UKA) was introduced in the 1970s and is now well-established as a treatment option for isolated compartment osteoarthritis (OA) of the knee.[1-3] Early designs, however, yielded high revision rates and poor outcome which resulted in many surgeons holding reservations about UKA.[4,5]

Improvements in surgical technique, instrumentation, and component design has resulted good long-term survivorship ranging from 91 to 100% and 15 years survivorship of 93%. This combined with minimally invasive techniques, wider ranging indications, and rapid rehabilitation has resulted in the wider acceptance for UKA.

Unicompartmental knee arthroplasty is a good alternative to total knee arthroplasty (TKR) in selected patients having the advantages of less soft tissue dissection, minimal blood loss, bone stock preservation, lower complication rates, faster recovery and more physiological function.[6,7]

Reports from the center for disease control and prevalence suggest the prevalence of arthritis is projected to increase to nearly 67 million by 2030 with activity limitations effecting 25 million people.[8] Surgical management of these patients will pose a challenge to health services across the world and is reserved for those where pain and functional limitation cannot be controlled medically.

INDICATIONS

Indications for UKA have changed only slightly since publications by Kozinn and Scott in 1989.[9] The patient should have only unicompartmental knee pain with associated diagnosis of OA, post-traumatic arthritis or spontaneous osteonecrosis within the same symptomatic compartment (Figs 1 and 2).

Clinical Indications

- Significant knee pain from one compartment
- Low demand activity patient
- Varus or valgus deformity less than 10°
- Arc of motion to 90° with minimal flexion contracture (5° or less)
- Intact and functional anterior cruciate ligament (ACL).

Contraindications

- Inflammatory arthritis
- Restricted arc of motion with flexion contracture

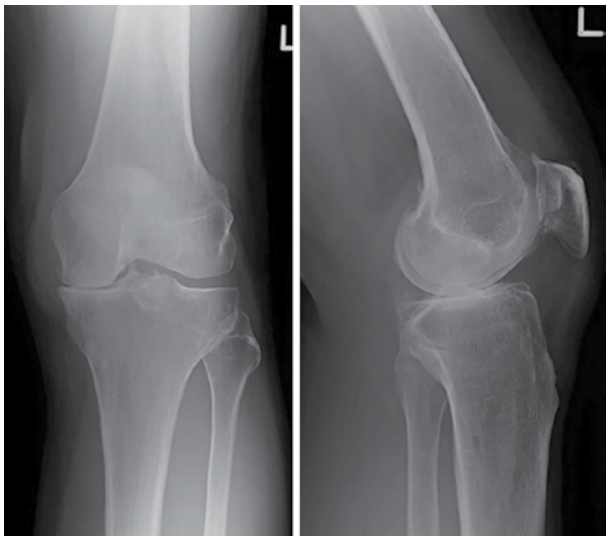

Fig. 1: Preoperative X-rays of left knee showing isolated medial compartment arthritis

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Fig. 2: Postoperative X-rays of left knee showing unicompartmental replacement *in situ*

- Obesity
- Very active lifestyles (atheletes).

These indications are continuously being evaluated and modified as evidence grows. Degenerative changes in the patello femoral joint, age below 60, and obesity can now be considered relative contraindications. With the evolution of implants and improved surgical techniques it is now more common to see the use of UKA in younger and heavier patients.[10-13]

UKA *VS* HIGH TIBIAL OSTEOTOMY

High tibial osteotomy (HTO) remains a proven treatment option, and preferred procedure for some, in the management of isolated unicompartmental arthritis. UKA has shown better functional outcome and longer survival compared to HTO at both 2-10-and 12-17-years follow-up.[14] The other reported advantages of UKA over HTO include fewer complications, less blood loss, quicker recovery, improved long-term results and easier revision to TKA.[15-17] There is presently no definite evidence as to which technique to use and when currently exists, however, with more evidence this should become clearer. The fact that either procedure should always be done by surgeons carrying out reasonable numbers of either procedure on a regular basis is now very well-documented.

In the Asian subcontinent, the popularity of HTO in comparison to UKA is well-known. This may be related to the delayed presentation of patients, the inherent Tibia vara, and the fact that arthroplasty as a procedure is still a procedure in relatively infancy.

UKA *VS* TOTAL KNEE ARTHROPLASTY

The review of the literature has shown several studies with long-term survival comparable to TKA.[18-20] In comparison to TKA, UKA has advantages including preservation of bone stock, maintenance of more normal joint kinematics due to ACL sparing techniques, better proprioception, better range of motion (ROM), reduced intraoperative blood loss, reduced morbidity, faster recovery, reduced inpatient stay and decreased cost.[21,22]

Registry data do however, suggest UKA has a higher reoperation and failure rate and some debate remains over the ease and outcome of revision to TKA.[23] There is also evidence from the registry data that the results are poorer in the hands of the surgeons who do not carry out the procedure frequently enough.

SURGICAL TECHNIQUES

The experience of the surgeon is one of the most significant factors to the overall survival of the implant and good outcome for the patient.

Minimally invasive surgery techniques with modern instrumentation allows subluxation of the patella rather than dislocation or eversion and is a key factor for UKA regaining popularity. Studies have highlighted faster recovery and reduced length of stay in mini-incision groups compared to TKA and to UKA performed through larger incisions with dislocation or eversion of the patella.[24]

NAVIGATION ASSISTED UKA SURGERY

Navigation assisted arthroplasty is growing in popularity. It can improve component sizing and alignment and can aid minimally invasive surgical techniques. Implants that are well aligned improve function and longevity of the prosthesis.[25] Early results of navigation-assisted surgery have shown significant improvement in accurate and reproducible limb alignments.[26,27] Navigation assisted surgery is likely to be a key area of growth in joint arthroplasty in the future. It is however, interesting to note that the popularity of navigation went down quite significantly in the west and the number of TKA done using navigation was only 3.8% as reported in the British national joint registry (NJR) 2012.

JOINT REGISTRY DATA

The recent data from the British national joint registry show use of UKA, as a percentage of all primary knee replacement procedures over the last 6 years remained stable at 8%. A similar pattern is shown in the Norwegian registry (Tables 1 and 2). However, the Australian national joint registry has shown a decline from 14.5% in 2003 to 4.4% in 2012.[28]

IMPLANT DESIGN

Cemented *vs* Uncemented

Uncemented implants have higher rate of loosening and implant failure due to poor bony in growth as

compared with the cemented designs. The proponents for uncemented UKA are increasing and recent evidence is promising.[29] However, cemented UKA currently remains the gold standard.

Fixed Bearing *vs* Mobile Bearing

There are still no clear indications for the use of a mobile *vs* a fixed bearing implant. Both can show good results.

Mobile-bearing UKA offer more congruent bearing surfaces with a large contact area and generate less contact stresses, theoretically decreasing the risk of aseptic loosening, polyethylene wear, and implant revision in the long-term.[30]

In addition, mobile bearings restore physiological joint kinematics over fixed bearing implants.

Technical difficulties at time of implantation, potential for overstuffing the medial compartment, bearing dislocation, and contralateral compartment degeneration had limited their use[31,32] but improved implant design and instrumentation has largely helped to address these problems.

Fixed-bearing UKAs are generally easier to implant without the risk of dislocation but with potentially increased risk for implant loosening and polyethylene wear.[33] The potential wear of one design over the other continues to be a source of debate but recent cent meta-analysis comparing mobile and fixed-bearing UKAs has not provided significant difference in the clinical and radiographic outcomes between the 2 designs.[34]

Fixed bearing implants involve a lower complication rate in cases with ligament laxity. Their use in low demand patients can be of benefit as wear related problems could be of lesser importance.

The use of mobile or fixed-bearing design should be tailored to the individual.

Metal Backed *vs* Polyethylene Tibia

The metal backed tibial tray potentially requires are larger bone resection to allow for an appropriate thickness polyethylene insert. The larger bone resection can make revision surgery more demanding. New implant designs and improvements in the manufacturing of polyethylene, has resulted in thinner polyethylene inserts which in turn reduces the bone resection required. The results for either component type are promising.

MALE *VS* FEMALE

No significant differences, in terms of clinical and radiological outcome, have been found between men and women following UKA. Gender should not influence the decision to perform a UKA.[35]

FAILURES OF UKA

The established modes of failure associated with any joint arthoplasty are present in UKA, however there are a few specific potential mechanisms of failure to be noted.

Polyethylene Wear and Associated Wear

Polyethylene wear followed by aseptic loosening has been reported as the most common cause for UKA revision.[36] The improvement in tribological properties of modern implants and surgical techniques have made wear comparable to that of TKR. Correct patient selection, for example avoiding UKA in very high body mass index patients, has contributed to improved survivorship of UKA.

Contralateral Compartment OA

The progression of OA to the contralateral side remains one of the most common causes for revision surgery. The

Table 1: Type of primary knee replacement procedures undertaken between 2006 and 2012—British national joint registry

Year	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*
TKR using cement	83%	83%	83%	83%	85%	86%	86%
TKR not using cement	7%	6%	6%	6%	5%	4%	3%
TKR Hybrid	1%	1%	1%	1%	<1%	<1%	<1%
Patellofemoral	1%	1%	1%	1%	1%	1%	1%
Unicondylar	8%	8%	8%	8%	8%	8%	8%
Number of procedures	62,430	73,767	77,754	79,071	81,427	84,230	84,833

Table 2: Type of primary knee replacement procedures undertaken between 2003 and 2009—Norwegian arthroplasty register

Year	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*
TKR with patella	6.5%	4%	3.6%	3.6%	4.1%	2.9%	2.2%
TKR without patella	77.9%	80.5%	82.1%	83.1%	82.9%	85%	87%
Unicondylar	15.5%	15.4%	14%	12.9%	12.8%	11%	10.4%
Patellofemoral	0.1%	0.1%	0.3%	0.4%	0.2%	0.5%	0.4%
Bicompartmental	–	–	–	–	0.0%	0.0%	0.0%
Number of procedures	3035	2903	3254	3103	3587	3993	4449

assessment of the contralateral side, at the time of UKA, for significant degenerative change is essential. From a technical point of view, implant overstuffing, which can accelerate lateral compartment degeneration, should be avoided. It is now understood that under correction of the coronal plane deformity and well balanced soft tissues will lead to better outcome.

Patellar Impingement

Patellar impingement can result more commonly following lateral UKA resulting in patellofemoral symptoms. The improvement in implant design and surgical expertize has reduced this to a rare complication.

Malaligned Components

Surgical error and inexperience are the main causes of malaligned components and can result in early failure through increased wear, loosening and even implant breakage. Modern instrumentation, navigation assisted surgery and training largely addressed these issues.

Bearing Dislocation

The dislocation of the bearing has been reported more commonly in mobile bearing designs. It is more common in lateral UKA but is rarely seen nowadays.

Revision Surgery

Revision of UKA is most commonly due to polyethylene wear, aseptic loosening, and disease progression in the contralateral side. Bone loss is occasionally encountered but is rarely a significant problem. Revision of a failed UKA to another UKA is not advised in current practice. Modern UKA designs and bone preserving techniques has have made revision from UKA to TKA more straightforward with results comparable to primary TKA.[37] Some authors have commented revision of a UKA to TKA was less demanding than a revision of a TKA.[38]

LATERAL UKA

Lateral compartmental OA is less common in the general population than medial compartment disease. Only one lateral UKA is performed for every 10 medial UKA and can be undertaken through a lateral or medial approach. The results are good for primary OA however debate remains regarding use in post-traumatic arthritis. Although technically more demanding two long-term studies demonstrated survival rates 100% at 12.4 years[39] and 83% at 10 years and 74% at 15 years.[40]

BICONDYLAR UKA

Symptomatic arthritis involving only the medial and patellofemoral compartments, with a normal ACL and lateral compartment, can be managed with a bicompartmental arthroplasty. It is reported to offer decreased pain, good stability through intact ligaments, and bone preservation.[41] The procedure is more complicated than UKA but less invasive than TKA. Contraindications include rheumatoid patients, tricompartmental arthritis, fixed flexion contracture, significant deformity and functional ACL laxity. The use of this form of arthroplasty is not yet widespread and there is limited long-term evidence in the literature.[42]

CONCLUSION

Unicompartmental knee arthroplasty is an effective operation in the management of isolated compartment arthritis in appropriately selected patients. With improved implant design and surgical techniques it is a minimally invasive operation with comparable and or better outcomes compared to total knee arthroplasty. A younger patient may require revision in their lifetime, but modern UKA design allows this to be performed with minimal surgical difficulties and with good outcome.

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