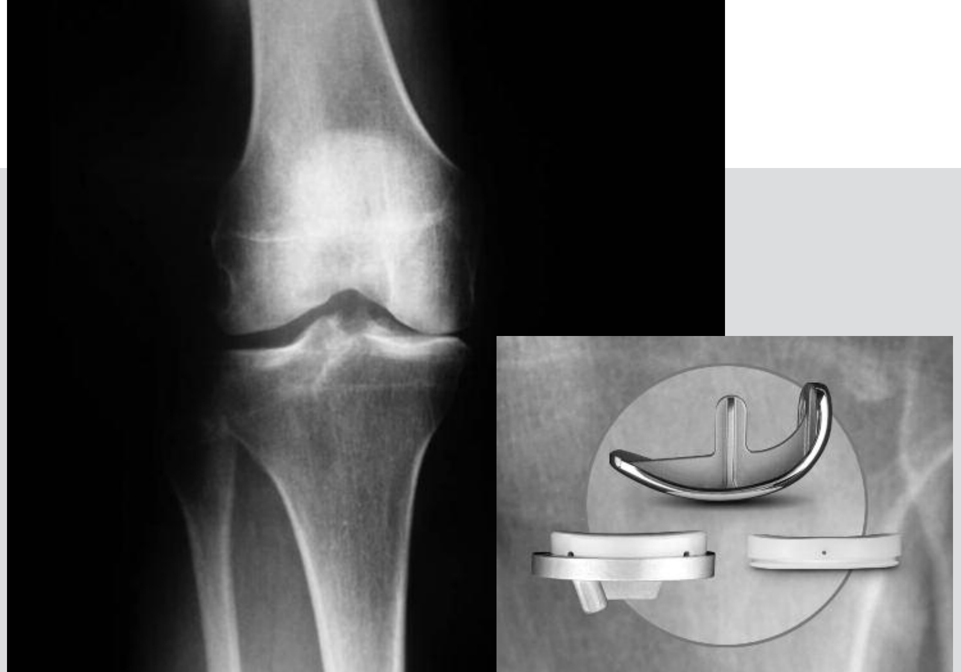

An Assessment of Indications for Inlay and Onlay Unicompartmental Knee Arthroplasty

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Introduction
In the United States, 15 million people are currently suffering from knee osteoarthritis (OA). From these, over 600,000 patients will undergo total knee replacement procedures. The average ages lie between 60 and 80 years old [American Academy of Orthopaedic Surgeons]. Unicompartmental knee arthroplasty (UKA) can serve as an alternative to total knee arthroplasty (TKA) for some patients and the cohort for potential patients can be large.

Difference Between Inlay and Onlay Implants
Patient selection, surgical techniques, and accuracy of UKA have improved since its initial introduction. More specifically, the type of UKA which can be performed and the choice by most surgeons is ever changing.

There are two general types of implants used in UKA procedures, inlay and onlay. Structurally, the femoral component for both implant types is similar. They take the anatomical shape of the femoral condyle. However, the main differences between inlay and onlay implants are in the tibial components. The implant choice is dependant upon several factors including the patient specific features and the surgeon's preference.

Inlay implants are inserted into a carved, flat pocket of the diseased region of the tibia. The implant is surrounded by a rim of cortical bone and supported by hardened, sclerotic bone. For example, the Repicci II tibial prosthesis recommends 3mm of anterior bone removal to 5mm of posterior bone removal. The surgeon should also ensure that sclerotic subchondral bone is left unaffected during this process [DeHaven 2003].

Onlay implants are not placed into any furrows and do not require hardened bone to support the tibial component, but instead rely on the direct support of a rim of cortical bone, as they are placed on top of a flat tibial osteotomy.

Although there may be several differences in indication for inlay and onlay, the primarily accepted difference between the components is the necessity for subchondral sclerotic bone of the medial tibial plateau to support the inlay component without the direct support of the cortical rim [Romanowski 2002]. Sclerotic bone does not serve any known purpose for onlay procedures.

Indications for UKA
One of the initial purposes of UKA was to treat unicompartmental osteoarthritis, preserve the unaffected compartment of the knee, and prolong the time before a potentially needed total knee arthroplasty. Although osteoarthritis is the primary indication for UKA, other less common conditions such as spontaneous osteonecrosis of the knee (SONK) or focal post traumatic arthritis may also be treated with UKA. It is important to note that physicians' experiences with various types of implants may change their opinions for indications.

Selecting the appropriate patient for UKA is a complex, multi-factorial process and includes variables such as age, physical factors and radiographic factors [Coon 2006]. The first UKA indications were established by Kozinn and Scott in 1989 and remain fairly intact today. The best candidates for UKA include patients above sixty years of age, below 180 pounds, and minimally active [Kozinn 1989]. However, a more recent study has shown predictable positive results with patients who are between 35 and 60 years old, active, and had an average weight of 198 pounds [Pennington 2003]. The pioneers of minimally invasive UKA consider body habitus, but do not consider weight over 250 pounds as a contraindication [Romanowski 2002].

Increasingly, UKA patients are stratified into two age categories: one group is undergoing UKA to "buy" them 10 or more years before conversion to a TKA; the second group of patients is older than 80 years and anticipates only one knee surgery in their lifetime.

Primary candidates should also have osteoarthritic pain in one compartment of the knee and lack any inflammatory arthritis in the region. Range of motion should be at least 90 degrees, flexion contracture less than 5 degrees, and a passively correctable deformity of less than 10 degrees varus or 15 degrees of valgus [Kozinn 1989, Argenson 2004, Scott 2006]. Repicci requires a ROM between 10 degrees and 100 degrees [Romanowski 2002]. Less stringent indications have set the limit of flexion contracture to 20 degrees [DeHaven 2003].

Several indications may vary depending on the physician and/or studies used as a reference. The state of the patellofemoral joint is mentioned in numerous studies and is important in the evaluation of a potential UKA patient. While mild deterioration, cartilage loss, or arthritis is not necessarily considered a contraindication [Price 2005, Romanowski 2002, Pandit 2002, Berger 2005], specific criteria vary among various studies. Patellofemoral pain, however, is a more likely contraindication. [DeHaven 2003, Berger 2005].

Physical examination of the patient should reveal an intact anterior cruciate ligament without mediolateral subluxation [Kozinn 1989]. Excessive tibial subluxation or notch impingement can often be seen radiographically [Coon 2006]. More recently, a deficient ACL is considered acceptable if the wear pattern is isolated to the anterior two-thirds of the tibial plateau, again with no mediolateral tibial subluxation [Scott 2006]. If this patient is chosen, an onlay tibial component should be implanted with little or no posterior slope. Chondrocalcinosis is sited by most authors as a contraindication as well as previous high tibial osteotomy.

Discussion

The current indications for inlay and onlay procedures are virtually identical, except for the requirement of a subchondral sclerotic bone bed for inlay UKA. However, more specific indications may surface as UKAs evolve. Some physicians prefer using the onlay procedure for patients over 250 pounds or with tibial erosion [Coon 2006]. Onlay procedures are currently better known and more widely used. For both procedures, patient selection is a key component for successful UKA. At the same time, some indications such as ROM, weight, age, and flexion contracture have become more liberal since the 1970s. These changes are likely due to modifications in surgical technique, devices, and procedures.

Time of diagnosis is congruent with onset of disease. Late diagnoses are more likely to display severe osteoarthritis making these patients unlikely UKA candidates. If UKA is an option, older patients who may experience other forms of bone degeneration are not as likely to

Table 1. Indications for Unicompartmental Knee Arthroplasty

Study	Age (years)	Weight (lbs.)	Clinical Selection	Preop ROM	Flexion Contracture	Contra-indications
DeHaven			Osteoarthritis; post-traumatic arthritis; subchondral sclerosis of the femur and tibia of single compartment		< 20º	Patellofemoral joint cannot be "bad" (extensive grade 4 changes with exposed subchondral bone)
Romanowski (inlay)	50 - 90; avg. 66	Criteria not used	Degenerative arthritis affecting one isolated compartment; weight bearing pain that significantly limited their quality of life	10º - 90º		Sclerosis of lateral patellar facet; lateral compartment reconstructions; avascular necrosis
Romanowski (inlay)	> 45	> 250 lbs. is not necessarily a contraindication	Inconvenienced, not disabled, by arthritis	10º - 100º		Sclerosis with loss of lateral joint space; inflammatory arthritis
Kozinn (onlay)	> 60	Below 180 lbs.	Osteoarthritis in either medial or lateral compartment; avascular necrosis of one compartment; minimal pain at rest	≥ 90º	≤ 5º	Generalized inflammatory disease; patellofemoral pain is a relative contraindication
Pennington (onlay)	≤ 60	110 - 255 lbs.; averaged 198 lbs.	Noninflammatory unicompartmental arthritis; post-traumatic arthritis; osteophytes or chondrocalcinosis in the knee; chondromalacia (Outerbridge grade 3 or 4)	≥ 90º	≤10º	Grade 2 or less chondromalacia of opposite compartment
Berger	> 50	< 275 lbs.	Osteoarthritis; osteonecrosis	≥ 90º	<15º	Inflammatory arthritis; hemochronmatosis; chondrocalcinosis; hemophilia; patellofemoral joint symptoms; positive patellar grind test; symptomatic knee instability
Price	< 60 and ≥ 60		Primary osteoarthritis of the medial compartment articular cartilage and an intact anterior cruciate ligament	> 15º		
Pandit	Not considered	Not considered	Osteoarthritis or avascular necrosis of medial compartment; intact ACL; full thickness cartilage in lateral compartment			
Perkins	> 60	< 82 kg	Osteoarthritis or necrosis of single compartment; sedentary lifestyle	> 90º	< 5º	Systemic or inflammatory arthritis; knee instability or subluxation; fixed flexion contracture; loss of ACL or PCL; intraoperative finding of eburnated bone (patella or opposite compartment)

have enough healthy bone required by an inlay implant. In this scenario, the patient is not a candidate for an inlay procedure, but may have excellent onlay indications.

Although older patients are normally less active than younger patients, the levels of possible activity will increase with further advances in both inlay and onlay UKA; the recommended ages will continually decrease. These two options for UKA provide a patient with more alternatives and increases the overall functionality of the knee.

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