PRINCIPLES OF UNICONDYLAR KNEE ARTHROPLASTY

INTRODUCTION:

Unicondylar tibio-femoral replacements should be seen as real resurfacings of the knee joint. An unicondylar replacement cannot change the original natural alignment or ligament balance of the knee. It should, in theory, also restore the normal kinematics of the knee. [1]

In the normal knee, movement between the tibia and the femur is controlled by the ligaments and the menisci. The individual morphology of the joint surfaces is adapted to the movement that the ligaments demand. Replacing either the medial or the lateral tibio-femoral articulation, but keeping all the ligaments intact, would demand that both the new femoral and tibial components be exact copies of the original articular surfaces and be placed in the exact same position as the original joint surfaces. With our present technology, this is of course not possible. At the moment there are two solutions to this dilemma.

The first solution is to have both a fixed femoral and fixed tibial component with low conformity between the two articular surfaces. This allows relatively unconstrained movement between the femoral and tibial articulations allowing the ligaments to control the movement. The downside to this is that the non - conformity between the femoral and tibial components results in high stresses in the tibial component which can lead to excessive polyethylene wear and component loosening especially if the polyethylene is thin.

The second solution is to have a free mobile bearing with absolute congruency between the metal femoral and metal tibial articulating surfaces. The mobile bearing can be steered in any direction by the ligaments while the maximum congruency is maintained through the full range of movement. The down side of this design is the possibility of a dislocation of the mobile articulating surface. The long term results of fixed and mobile bearing UKR's seem to be similar and does not favor a particular design. [2] It seems that good results in the mobile bearing UKR is more surgeon dependant than that in fixed bearing UKR. [3]

INDICATIONS:

It has been suggested that an UKR should be the first procedure for osteoarthritis in a young patient and the last procedure in the old patient. The argument put forward is that in a young patient an UKR is simpler, recovers quicker and there is a similar time to failure as the alternative osteotomy. It is also claimed that it is easier to convert a failed UKR to a TKR than it is to do a TKR after a failed osteotomy.

I would like to caution against these arguments as survival rates in UKR's have on the whole only been established in older patients. [4] In comparison survival rates after osteotomies have been done in a younger age group. [5]

There is a possibility that the survival rate for UKR's might be lower in young active patients than is anticipated.

It was further found, in our own studies, that the tibial insert, after revisions of UKR's, were significantly thicker then the tibial inserts used in TKR's after previous osteotomies. Others found that there was a greater use of tibial stems, augments and bone grafts after revisions of UKR's than with TKR's after failed osteotomies. [6, 7, 8]

As the natural alignment can only be restored and not changed with a UKR, this procedure would be contra-indicated in patients with a natural alignment of more than 5° varus or more than 5° valgus. Greater malalignment would result in excessive loads on the replaced compartment and probably early failure. [9]

Loads seen by the prosthesis is in direct proportion to the patient's mass. Considering that load over the normal knee is approximately four times body weight and that in neutral alignment, 75 % of this load is carried in the medial compartment, [10], a high BMI could lead to early failure.

In general, the following guidelines should be considered when planning an UKR: [11]

• Age	55 years or older.
• Alignment	Natural alignment of < 5° valgus or < 5° varus.
• Ligaments	Intact cruciate and collaterals ligaments. [12, 13]
• BMI	>30: UKR contraindicated
• Opposite compartment	▫ <u>Meniscus:</u> Must be in tact, slight fibrillation. Mild chondrocalsinosis is acceptable. ▫ <u>Articular cartilage:</u> The opposite compartment must be intact. Superficial fibrillation is acceptable.
• Flexion Contracture	Should < than 15°.
• Patellofemoral	Complete loss of articular cartilage would be a contra-indication.

- Inflammatory arthritis, rheumatoid arthritis, gout and other general arthritic conditions would be a contra-indication.

PRE-OPERATIVE PLANNING:

Proper X-rays is mandatory for patient selection and planning of an UKR. The following is essential in deciding whether the patient is a candidate and also in planning the operation:

A-P views	Standing in full extension. Standing in 40° of flexion.	Necessary for assessment of damage to the involved and uninvolved compartments.
Lateral views	True lateral, preferably standing view.	This is to determine, in the sagittal plane, the area of degeneration on the tibia. Posterior degeneration would indicate ACL insufficiency which is a contra-indication to an UKR.
Patello-femoral view	Preferably a 30° standing view.	For assessing degeneration in the p-f joint.
A-P, long leg views.	Supine stress view.	This allows assessment of natural alignment, the condition of the opposite compartment and the stability of the collateral ligaments.

SURGICAL PROCEDURE:

The principle is to restore natural alignment of the patient; the original ligament tension and the joint line.

The components should be placed in such a way that the tibial and femoral components are in maximum congruency in both flexion and extension. This means that the femoral and tibial components should be parallel to one another in both flexion and extension.

The components should be placed in the center of the compartment as an offset placement will result in weak fixation and early loosening.

The components should snugly fit the bone. An onlay tibial component should lie on the cortex with no overlay; with an inlay component there should be no damage to the surrounding cortical rim.
The femoral component should fit tightly to the posterior femur; anteriorly it should be flush with the articular cartilage to prevent patellar impingement.

Bone cuts, both in the saggital and coronal planes of the femur and the tibia, should be such that the joint line and ligament stability are restored in both flexion and extension. On the average, the normal tibial plateau is within 3° of varus to the tibial mechanical axis in the coronal view. In the saggital plane, there is an average of 9° posterior slope to the tibial plateau. There is a wide individual variation, in the coronal plane from 0° - 5° varus and in the saggital plane from 5° - 13° posterior slope. In order to restore natural alignment and ligament tension, these variations should be taken into consideration. An increase in the posterior tibial slope will increase the load on the ACL and should be considered if the ACL is intact, but attenuated. If the joint is tight in flexion and loose in extension, the tibial slope should be increased. If the knee is loose in flexion and tight in extension, the femoral component is either too proud or the posterior tibial slope is excessive. [14] Where doubt exist about ligament tension, slightly lax ligaments would be preferable to over tight ligaments.

With a MIS approach, an arthroscopy of the healthy compartment is recommended at the time of surgery. [15]. Planning should be such that the UKR can be abandoned in favor of a TKR should the damage in the healthy compartment be more than superficial fibrillation.

RESULTS:

In our experience, bleeding, post-operative morbidity and infection after UKR's is approximately 65 % less than after a TKR.

The long term failure rate for UKR's is about 1.8 times higher than that of TKR's. Over the past twenty years, the cumulative revision rate (C.R.R.) for TKR's have slowly decreased, but for UKR's the C.R.R. is unchanged. [15, 17]

The most common cause of failure was loosening of the components followed by progressive degeneration in the unreplaced components and then by polyethylene wear. [18, 19]

CONCLUSION:

UKR's are technically a demanding procedure with a low morbidity and excellent functional results in good cases.

Both short and long term failure rates are however substantially higher than that of TKR's. The most common cause of failure is component loosening which is multi factorial and caused amongst others by malpositioning of the components, overload of the replaced compartment as a result of persistent malalignment, over activity and a high BMI. The second most common cause of failure is progressive degeneration in the opposite compartment. It is probably caused by over stuffing of the replaced compartment or using an UKR in a knee where the opposite compartment is already compromised.

The percentage of patients suitable for UKR in a knee practice, is approximately 10% – 20 %. We believe that an osteotomy is still the procedure of choice in the younger and especially physically active patient. In patients with arthroscopic degeneration in the opposite compartment, a TKR is the procedure of choice except in the old frail patient where post operative morbidity might be a problem By using these guidelines as well as the previous mentioned, we believe that the long term survival rates of a UKR can equal that of a TKR while at the same time giving the patient a knee with better function and near normal kinematics.

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