



Unicompartmental Knee Arthroplasty with HLS UNI Evolution prosthesis: mid-term clinical and radiographic results

Prothèses unicompartmentale du genou type HLS uni évolution : Résultats clinique et radiologique à moyen terme

Deltour A.¹, Traore A.¹, Krah K.L.¹, Forthomme J.P.², Paulet D.³, Thienpont E.¹

From Saint-Luc University Hospital, Brussels, Belgium

1- MD, Orthopaedic surgeon, Department of Orthopaedic Surgery, Saint-Luc University Hospital, Brussels, Belgium

1- MD, Orthopaedic surgeon, Department of Orthopaedic Surgery, Yopougon University Hospital, Abidjan, Cote d'Ivoire

2- MD, Orthopaedic surgeon, Department of Orthopaedic Surgery, St Joseph Hospital, Mons, Belgium

3- MD, Orthopaedic surgeon, Department of Orthopaedic Surgery, St Jean Hospital, Brussels, Belgium

CORRESPONDENCE : Dr Alidou TRAORÉ

Department of Orthopaedic surgery, Cliniques Universitaires Saint-Luc, 10, avenue Hippocrate, B-1200 - Bruxelles, Belgium

E-mail: tralidou@yahoo.fr

ABSTRACT

The Unicompartmental Knee Arthroplasty (UKA) is a valid alternative treatment in the event of unicompartmental knee arthritis. This manuscript resumes clinical results, radiographic outcomes and survival curve of the HLS Uni Evolution prosthesis.

Material and Methods

62 patients (38 males and 24 females) were treated in our hospital for a medial (n=58) or lateral unicompartmental (n=4) osteoarthritis of the knee and they followed during mean course of 56.4 months. The Knee Score, WOMAC score and of the radiographic analysis were performed by an independent observer. Survival data were obtained in the Kaplan-Meier analysis

Results

The mean Knee Scores (Insall modification-1993) increased from 49.8 (range 19-66) points preoperatively to 79.8 (range 52-92) at the time of the final follow-up. The mean WOMAC score was 10.04 points at 5 years. The 5-year survival rate for the HLS Uni Evolution unicompartmental prosthesis was 86.4%. Eight medial knees required a revision. The lateral unicompartmental prosthesis demonstrated very good clinical results without revision at 5 years. Among re-intervention (n=8), 3 knees were revised by a TKA due to medial collapses with a complex reconstruction for 2 revisions.

Conclusion

The HLS Uni Evolution UKA constitutes a good indication for unicompartmental osteoarthritis with good results at mid-term course. The lateral prosthesis is tolerated very well. The most important complication is the medial collapse due to depression of the tibia plateau. Since the revision for collapse requires a complex reconstruction with poor results, our work suggests that all-polyethylene tibia is not appropriate for patient with osteonecrosis, important osteoporosis or obesity. In these cases, the use a metal-back should decrease the rate of revision for medial collapse.

RÉSUMÉ

La prothèse unicompartmentale (PUC) est une véritable alternative dans les arthroses unicompartmentales du genou. Cette étude a pour but d'évaluer les résultats cliniques, radiographiques et la courbe de survie à 5 ans de la prothèse HLS Uni Evolution.

Matériel et Méthodes

Il s'agit d'une étude rétrospective concernant 62 patients (38 hommes et 24 femmes) traités dans notre service pour une arthrose unicompartmentale du genou, médiale (n = 58) et latérale (n = 4). Le suivi moyen était 56,4 mois. Les scores du genou, le score de WOMAC et de l'analyse radiographique ont été effectués par un observateur indépendant. Les données de survie ont été obtenues dans l'analyse de Kaplan-Meier.

Résultats

Le score du genou moyen (Insall modifié 1993) a augmenté de 49,8 [19-66] en préopératoire, à 79,8 [52 à 92] au dernier recul. Le score moyen de WOMAC était de 10,04 à 5 ans. La courbe de survie à 5 ans a été de 86,4%. Huit prothèses unicompartmentales interne ont nécessité une révision. La prothèse unicompartmentale latérale était bien tolérée avec de très bons résultats cliniques et sans révision à 5 ans. Il y a eu 8 révisions avec une transformation en prothèse totale du genou (PTG). Parmi ces révisions, 3 étaient dues à un collapsus du plateau tibial médial avec une reconstruction complexe pour deux d'entre elles.

Conclusion

La prothèse HLS Uni Evolution constitue une bonne indication de l'arthrose unicompartmentale avec de bons résultats à mi-terme. La latérale est très bien tolérée. La complication la plus importante reste le collapsus du plateau tibial en interne, de plus, la révision est complexe avec des résultats médiocres. Le all-polyéthylène doit être évité chez les patients obèses, âgés ou avec une ostéonécrose du plateau tibial. Dans ces cas, l'utilisation d'un métal-back est une bonne indication pour réduire diminuer le risque de révision.



I. INTRODUCTION

Symptomatic severe osteoarthritis of the knee is a common clinical problem usually treated by a Total Arthroplasty (TKA) with or without patellar resurfacing [1]. Currently the Unicompartmental Knee Arthroplasty (UKA) is widely accepted. The incidence of unicompartmental knee arthroplasty in the USA increased from 6570 implants to 44990 between 1998 and 2005. Despite a higher rate of growth in unicompartmental arthroplasty incidences as compared with total knee arthroplasty incidence, unicompartmental arthroplasty still represented only 7.7% of knee arthroplasty procedures performed in 2004 [2-3]. Epidemiological studies of knee osteoarthritis showed that there are distinct patterns of disease which affect principally either the medial, lateral or patellofemoral compartments. The biomechanical characteristics of the lateral and medial side are entirely different. It was shown that unicompartmental knee arthroplasty demonstrated better survivorship on the medial than the lateral side of the knee [4-7].

UKA was introduced in the 1960s, but it was only generally practiced in the early 1990s. Early reports showed less predictable results with poor long-term survivorship [8]. The new interest in the UKA was attributed largely to the technological advances in biomaterial science, a refined surgical technique, improved patient selection criteria and the introduction of a minimally invasive approach [2, 4, 9-10]. Recently various types of UKA were demonstrated on the market with reported survivals ranging from 70 to 98% at mid-term. A mid-term result of HLS Uni Evolution UKA (Tornier, France) previously published were acceptable 74% and 97.5% at 5 years for the medial UKA and the lateral UKA respectively [5, 11-13]. Our work analyses clinical results, radiographic outcomes and survival curve by an independent mid-term study with a series of 62 patients at 5 years.

II. MATERIALS AND METHODS

A- Patients

Sixty-two patients (38 males, 24 females) were performed at our hospital for the treatment of unicompartmental osteoarthritis of the knee, 58 medial (Figure 1), 4 lateral (Figure 2), between 2003 and 2004 by HLS Uni Evolution (Tornier Saint-Ismier France) unicompartmental knee prosthesis. All procedures were performed by one surgeon. Inclusion criteria were severe morbidity as pain and considerable difficulty to walk and perform daily activities, associated with severe medial or lateral isolated osteoarthritis (Ahlbach 3 and 4) or osteonecrosis, showed by an X-ray confirmed with an Arthro CT-Scan. Patients presented a correctable varus or valgus deformity under 15 degrees and a good range of motion (at least 15/90 degrees). Preoperatively, the anterior cruciate ligament (ACL) was intact but a cumulative surgery ACL reconstruction and a UKA were found for one patient.

Exclusion criteria were patellofemoral joint degeneration with symptomatic anterior pain or inflammatory degenerative joint disease. The age and weight were no contraindication. 55 patients of the 62 patients included

in our evaluation were complaint, to complete the study. 4 patients were interviewed by phone and assessed through radiographs since the incapacity of these patients to be followed up repetitively through consultation. 2 patients were lost and one had died postoperatively from causes not related with the procedure.



Figure 1: Anteroposterior x-ray of medial unicompartmental arthroplasty



Figure 2: Anteroposterior x-ray of medial unicompartmental arthroplasty

The mean preoperative weight at time of index operation (range; kg) [min-max]: (13.3 80.40) [55-118], a mean preoperative age (range; years) [min-max]: (8.7; 67.3) [42- 84], a mean preoperative IKS (range) [min-max]: 49.8 (12.1) [19-66], Mechanical axis at the time



of index operation (range; degrees) [min, max]: Valgus (lateral UKA), 5.20 (1.9) [2-7]; Varus (medial UKA), 6.6 (3.3) [1-12]. Thirteen (13) patients were previously treated by meniscectomy.

Patient data were recorded prospectively and analysed retrospectively. A detailed physical of examination and knee score were established preoperatively, and at the final follow-up visit (at a mean time of 56.4 months course post-surgery), the Knee Score and the analysis of the radiographs were performed by an independent observer.

B- Surgical technique and postoperative treatment

Patient underwent surgery under spinal or total anaesthesia. A complete examination of the knee was performed to confirm that there was no laxity in the concavity and that the ACL was functionally present. A tourniquet was used in all cases.

The medial UKA was approached through a medial mid-vastus incision without eversion of the patella. All the osteophytes were removed under the medial ligament structure. The two other compartments were controlled to retain the integrity of the cartilage. The ACL was checked.

The lateral UKA was approached through a lateral (Keblish) incision with conservation of the femoral condyle osteophytes. With both approaches, no ligament release was performed.

The HLS Uni Evolution is a resurfacing prosthesis implanted since 1987 with previous reported good results. The aim of this prosthesis is to be the most anatomical as possible to reproduce the biomechanics of a normal knee. It's a symmetric chrome cobalt femoral implant with all-polyethylene tibia component. The sagittal curve of the femoral component allows minimal cuts. The front curve allows to reduce the pressure on the polyethylene and so to minimise the wear. It's a cemented prosthesis. The cut of the tibia was done with a guide who gives the possibility to reproduce the posterior tibia slope and to restore the epiphyseal varus or valgus angle of the patient.

The mechanical axis was not corrected but restored by a compensation of the osteoarthritis wear. The aim was to restore the epiphyseal axis [12, 14]. This procedure was associated to risk of an overcorrection with higher pressure on the opposite side, responsible for earlier degradation. The UKA changes the pressure spread in the knee. With an overcorrection of the UKA, a significant higher pressure was found on the opposite side and this increases the wear and the osteoarthritis development, responsible for poor results at mid-term.

With a 5 degrees overcorrection, an 88% increase of the pressure is on the opposite side.

With more than 10 degrees, a 100% increase of load on the opposite side was observed.

For all these reasons, we realised a hypocorrection between 3 to 5 degrees [7, 12, 14]. It's important to conserve a two millimetres joint laxity in extension to provide this overcorrection.

This tibia cutting was as thin as possible to preserve the bone stock. The average thickness of the all-polyethylene tibia liner used was 9mm, so more than the limit of polyethylene buckling being 6mm [12, 14].

The femoral cut concerned only the posterior condyle. The rest of the preparation consisted of relieving the cartilage with a milling cutter (a real resurfacing system). The femoral implant was focused in full extension on the tibia prosthesis.

The anterior extremity of the femur prosthesis was in front of the anterior side of the tibia in extension [15]

If it's too anterior, there is an overcorrection due to the femoral condyle. If it's too posterior, there is pain in extension with a risk of subluxation of the tibia implant, particularly with a bad quality ACL or a more than 5 degrees tibia slope.

C- The lateral UKA

The tibia cut was orthogonal. In lateral osteoarthritis, there is often an external condyle dysplasia due to the valgus. This dysplasia was compensated with a thicker tibia or condylar implant.

The centering of the femoral prosthesis was more lateral, obliging the conservation of the osteophytes to avoid any conflict with the tibia spines.

Prophylactic antibiotics were administered intravenously 30 min before the surgery and for 24 hours after the surgery in two doses. Wound suction drains were used for 48 hours. All patients were allowed to walk with full weight-bearing on the first postoperative day. The patients left the hospital at D-5 after the surgery.

D- Questionnaires and Physical examination

The patients were asked to fill in the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) questionnaire at the last follow-up. Scores were calculated in three dimensions, pain (scale 0-20), stiffness (scale 0-8) and physical function (scale 0-68). The summing score for WOMAC was also calculated.

The Insall Knee Society Score (IKSS) was assessed at the preoperative consultation and at the last follow-up consultation. IKS score or Knee score (Insall modification-1993) was the version of the knee score as modified by Dr John Insall in 1993. The scoring system combined a relatively objective Knee Score that is based on the clinical parameters and a Functional Score based on how the patient perceives that the knee functions with specific activities. The maximum Knee Score and Functional Score are 100 points respectively. A normally functioning knee gained 100 points, including 50 points for pain symptoms, 25 for the range of motion, and 25 for anteroposterior and mediolateral stability. Functional results were evaluated separately on a 100 points scale including walking distance on flat ground (range 0-50 points) and the ability to walk up and downstairs with or without an aid (range 0-50 points).



E- Radiographic evaluation

Weight bearing anteroposterior (AP) and lateral radiographs of the knee were taken at each visit. An analysis for radiolucent lines was made on anteroposterior and lateral radiographs.

F- Statistical analysis

The contingency tables were analysed with the χ^2 or the exact Fisher test where the first one was not valid (wide for the unspecified tables). Odds ratio (OR) and their confidence intervals to 95% (IC to 95%) were derived from the contingency tables.

We performed a multivariate analysis to identify the risk factors, using a logistic regression model. The potential risk factors of allograft contamination were tested for inclusion in the model by a progressive selection based on the likelihood ratio tests.

For all the analyses, p-values < 0.05 were considered significant. The software SPSS 15.0

achieved the statistical analyses.

The end point for survival was defined a revision when either one component or the whole implant was removed or exchanged. Kaplan-Meier survival data were used to construct the survival probabilities of the prosthesis at 5 years. The survival data obtained in the Kaplan-Meier analysis were compared to other prosthesis survival data.

III. RESULTS

The mean Knee Scores (Insall modification-1993) increased from 49, 85 (range 19-66) points preoperatively to 79.8 (range 52-92) ($p < 0.001$) at the final follow-up (Figure 3).

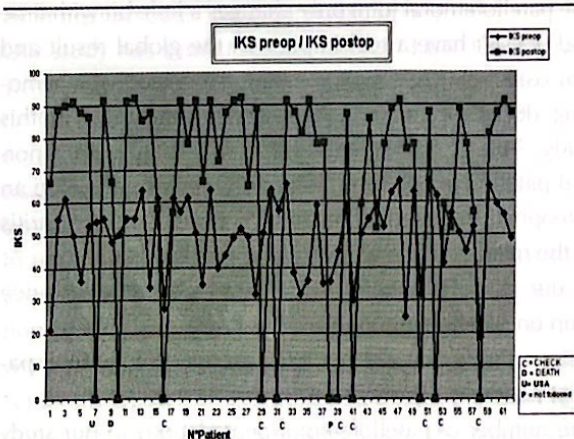


Figure 3: Comparison of the IKS preoperatively and at the end of the follow-up

The mobility preoperatively and postoperatively was also compared. The mean mobility increased from 116.1 (range: 85-140) to 125.2 (range: 75-140) ($p < 0.001$)

A- WOMAC Index and subjective satisfaction

The WOMAC (Western Ontario and McMaster Universities) Index uses 24 parameters. It is a subjective test. The mean score was 10.04 points (range 1-35).

Among 59 patients, a personal satisfaction index in

comparison with the clinical situation before the operation at three months postoperatively and at the end of the follow-up was asked (Table I).

Table I: Personal satisfaction index at the final follow-up

	Number	%
very satisfied	34 patients	57.6%
satisfied with 6 patients with temporary anterior knee pain	13 patients	22%
unsatisfied and thinking about a revision	4 patients	6.8%
revision surgery	8 patients	13.6%
TOTAL	59 patients	100 %

A direct link between the index of satisfaction and the IKS was found (Table II).

Table II: Link between index of satisfaction and IKS

Satisfaction Index	IKS
4 unsatisfied	55.9 (range 51.8- 60)
13 satisfied	67.5 (range 61.8- 73.1)
34 very satisfied	87.2 (range 85.4- 89)

B- Survival and revisions

The 5-year survival rate for the HLS Uni Evolution unicompartmental prosthesis was 86.4% (Figure 4).

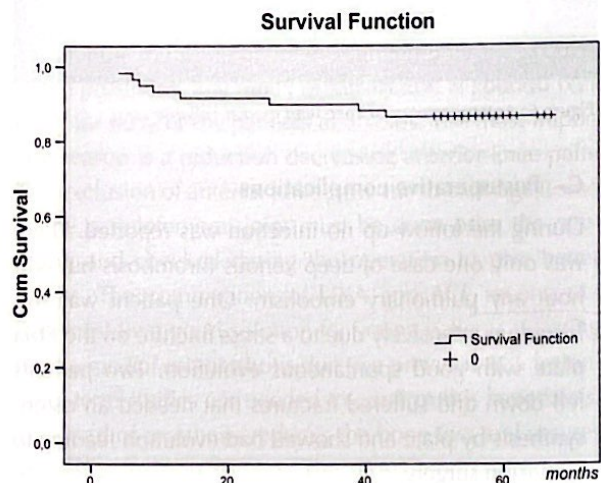


Figure 4: Cumulative survival of HLS

We consider the revision as the end point of the prosthesis to calculate the survival rate.

Among 59 knees, 8 required revision during the follow-up period. All revisions concerned medial unicompartmental prosthesis. The lateral unicompartmental prosthesis demonstrated very good results. There was no relation between the incidence of revision and the age ($p: 0.774$) or the body weight ($p: 245$).

Three knees were revised to a TKA due to medial collapses (Figure 5).

Two knees were converted to a TKA with complex reconstruction due to a trauma with fracture of the tibia plate. One knee was converted to TKA with primary component due to a tibia loosening by deficiency of the ACL. One knee needed a revision for tibia component loosening. At least, one knee was converted to TKA due to anterior knee pain.





Figure 5: Anteroposterior of knee with medial collapse

C- Postoperative complications

During the follow-up no infection was reported. There was only one case of deep venous thrombosis but without any pulmonary embolism. One patient was followed up intensively due to a stress fracture on the tibia plate with good spontaneous evolution. Two patients fell down and suffered fractures that needed an osteosynthesis by plate and showed bad evolution leading to a revision surgery.

IV. DISCUSSION

The principal findings of the present study was that patients treated with UKA with all poly component reduced significantly the pain and improved knee joint function in patients with medial or lateral unicompartmental disease. Unicompartmental knee arthroplasty were reported to have a number of advantages over total arthroplasty, including lower surgical trauma with the sparing of more of patient's anatomy, kinematics and more rehabilitation [7]. Our series demonstrates a similar survival curve than others studies over the HLS Uni Evolution already published in the literature, 74% of good results at 4 years [11], 95% at 7 years with 81 % of the patient with no any pain [13]. The loosening rate was around 20% and around 5% with medial and lateral UKA respectively.

Our results are similar than those reported in the literature over the others UKA designs, 85% of good results at mid-term [3, 17]. The 10-years survival of Miller-Galante

ii was 79% whereas it was 73% for UKA implanted for osteoarthritis of the knee [17].

Despite this very high survival rate, it's important to compare these results to patient satisfaction. Following the revision cases of unsatisfied patients, we had a total of 12 patients on 59 unsatisfied following this surgical solution. It constitutes 20% of the total patients included in this study. Residual pains were essentially anterior knee pain due to the degradation of the patellofemoral articulation. Patellofemoral complications were rarely reported after unicompartmental arthroplasty, and their long-term course consequences are not known [18]. Patellofemoral osteoarthritis is one of the controversial points in UKA. For few authors, it is a contraindication for the UKA surgery [18-19]. The status of the patellofemoral joint has a relative contraindication for UKA [20]. It seems that patellofemoral joint has a minor role when considering for UKA although there is also opposite findings reported in the literature [21-22]. They noted patellofemoral symptoms are present in 1.6% of patients at 10 years and 10% at 15 years with UKA (Miller-Galante II prosthesis). A radiographic osteoarthritis was found in 6 % of the UKA at 10 years and 26% at 15 years. Impingement of the patella is a specific complication of unicompartmental arthroplasty that led to patellofemoral symptoms and may affect the ability to surface the patella during a subsequent revision to total knee arthroplasty. Degenerescence changes also affect the long-term outcomes unicompartmental arthroplasty, particularly when there is abnormal joint congruity on preoperative radiography [18]. Patients with preoperative patellofemoral symptoms and a positive X-ray or patients with cartilage lesion visualised during the operation are not indicated for a UKA [16].

The patellofemoral joint only changes a little bit with time and doesn't have a real impact on the global result and real osteoarthritis is symptomatic. An osteophytic removing doesn't contraindicate UKA surgery [11]. In this study, 74% of the patients with a UKA stay with a normal patellofemoral joint, 18% of the patients develop an osteophytic transformation and 8% develop osteoarthritis of the medial or lateral area of the patella [11].

In our study, 6 patients (10%) developed anterior knee pain on patellofemoral

Osteoarthritis that did not exist preoperatively. One patient needed a TKA revision.

The number of patellofemoral degradations in our study is a lot more important than in the studies that appeared in the literature [23]. This illustrates the great importance of the history and the clinical examination of the patient in the decision for UKA in gonarthrosis. The pain must be localized to medial or the lateral tibiofemoral compartment, and isolated. The presence of anterior knee pain, increased in stair climbing, should be carefully quantified before decision for UKA. The Single photon emission computed tomography can be useful in the detection of patellofemoral pathologies [24].

The lateral UKA was very well tolerated (4 patients) without revisions in our study.



The functional indexes and satisfaction are excellent. These results confirm the study of Neyret et al[13], which published excellent results in correlation with other studies for lateral UKA with 97% of survival at 5 years and 93% at 10 years [25-26]. No difference in age of the patients between the results at mid-term, or male and female patient according with other studies was found [27-29]. One patient of 42 years old was operated of a UKA associated with an ACL reconstruction for medial osteoarthritis due to an ACL lesion. The results at 5 years are excellent with pain relieve, good stability and an excellent proprioception.

The ACL lesion is an absolute contraindication to UKA surgery. The ACL guarantees the stability of the prosthesis. Authors described around 21 % to 36% losing rate in case of ACL deficiency [11, 16, 30]. A positive Lachman increases the polyethylene wear rate in the posterior part of it leading to an early femoral or tibial loosening.

The results of the UKA with ACL reconstruction in young patients were very good at 2 years, with 90% of excellent results. It is a short-term result. The oxford score was higher than the score of the age-matched patients having a unicompartmental knee arthroplasty in the present of an intact ACL [22]. These results must be confirmed by other studies at long-term. This combined approach can be a viable option for young active patients with symptomatic medial compartment arthritis in whom the ACL has been disrupted [31-32]. The conservation of the bone stock is one of the arguments in favour of the UKA.

Indeed, a good bone stock facilitates revision surgery [33-34]. Actually, the losing rate at 10 years is around 10% and 15%. The common etiologies are the polyethylene wear, the aseptic loosening, residual laxity, cement fragmentation, osteolysis and the development of osteoarthritis in the two other compartments [34-37].

Our study has similar results with a 13.6% losing rate. The major different etiologies were tibia failure, a traumatic fracture treated first by an osteosynthesis medial and compartment collapse directly linked to the presence of a tibia plateau osteonecrosis [38], leading also to a revision surgery.

In most cases, revision surgery was realised with a standard TKA. Only the medial collapse needed a reconstruction by CCK prosthesis with wedge and stems. No UKA were revised by an other UKA. Following the Swedish National Register of arthroplasties, 7% of the UKA revisions were changed by an other UKA. The results were bad with 25% of losing at 4 years [39-40]. The UKA revisions by a standard TKA with no constraint give good results with 80% of satisfaction and provide a relatively economical procedure when performed by the community orthopaedic surgeon [3]. This score remains inferior to the score of standard TKA at 20 years. Some authors feel that exchanging unicompartmental prosthesis for a total knee replacement is not particularly difficult. UKA revisions are easier and cheaper than TKA revisions. 57% of the UKA revisions were changed by a standard TKA [3, 34, 40-41]. However, UKA produces frequently high bone loss and so, complex revisions with difficult

reconstructions, encountered major problems in revision surgery [42].

Wear remains a major concern for the long-term implant in joint arthroplasty. Aleto [43] published a study over the different etiologies of loosening UKA with an all-polyethylene tibia component. In this study, it was demonstrated that medial collapse constitutes 50% of the loosening. This result is clearly higher than with a metal-back component [16, 43-44]. The localisation of the bone defect is linked to the postoperative tibia slope (a posterior collapse), to the age of the patient and to the use of an all-polyethylene component. These different studies warned against the use of an all-polyethylene component to older patients, obese persons and to patients with tibia plate osteonecrosis. Marmor [45] already reported about this problem due to impaction of the tibia cancellous bone before.

The major problem in medial collapse is managing tibia bone defect. The revision is more complex. This can be perfectly controlled by using metal wedges, bone graft, while avoiding the use of constraint prostheses [46].

V. CONCLUSION

The HLS Uni Revolution UKA constitutes a good indication for unicompartmental osteoarthritis with good results at mid-term. The lateral prosthesis is well tolerated well. The age and the sex have no influence of the evolution of the prosthesis. The index of satisfaction is good to very good for 80% of the patients at 5 years. The most important reason is a reduction decreasing anterior knee pain. The exclusion of anterior knee pain due to cartilage lesion of the patellofemoral joint must be done prior the operation and checked during the operation to give better results. The combination of UKA and ACL reconstruction must be a good solution for young patients suffering from a medial osteoarthritis due to a previous ACL lesion. Long-term studies are needed to confirm this hypothesis. This kind of prosthesis reduces the bone loss and assures an easier revision surgery. The most important complication remains the medial collapse due to depression of the tibia plateau. Revisions for collapse are difficult and need a complex reconstruction with minor results. Several factors determine the success of UKA including careful patient selection, the nature of the implant and the experience of the surgeon. Therefore we think that all polyethylene tibias are not appropriate to patients with osteonecrosis, important osteoporosis and obesity and must be replaced by a metal-back tibia. This hypothesis should be confirmed by a prospective clinical study.

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