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ORIGINAL STUDY

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A prospective study of 93 unicompartmental knee prosthesis emphasises the appearance of radiolucencies under the tibial component

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Background and study aims: Here, we report the presence of radiolucent lines in a consecutive group of 93 partial knee replacements (UKA).

Materials and methods: The prospective study was conducted from 2011 to 2019 with a minimum follow-up of two years. Clinical data and radiographs were recorded. Of the 93 UKA, 65 were cemented. The Oxford Knee Score was recorded before and two years after surgery. In 75 cases, the follow-up was conducted at > 2 years. A lateral knee replacement was performed in 12 cases. In one case, a medial UKA with patellofemoral prosthesis was performed.

Results: In eight patients (8.6%), a radiolucent line (RLL) underneath the tibia component was observed. In four of these eight patients, RLLs were non-progressive, without clinical implications. In two cemented UKAs, RLLs were progressive and were revised with total knee arthroplasty. Early severe osteopenia of the tibia (zone 1 to 7) in the frontal view was observed in two cementless medial UKA cases. The demineralisation occurred spontaneously five months after surgery. We diagnosed two early deep infections, one of which was treated locally.

Conclusions: RLLs were present in 8.6% of the patients. Even in severe cases of osteopenia, spontaneous recovery of RLLs is possible with cementless UKAs.

Keywords: Total knee arthroplasty; partial knee prosthesis; revision prosthetic surgery.

INTRODUCTION

Patients that undergo unicompartmental knee replacement (UKA) recover faster and with better functioning than after total knee replacement (TKA). UKA is recommended for younger patients with unicompartmental arthritis *(1,2,3)*.

In joint registries, UKA presents higher revision rates compared to TKA. According to the National Joint Registry for England, Wales and Northern Ireland, the revision rate for UKA is 3.2 times higher than TKA *(4,5)*. Furthermore, in National Registry studies based on patient-reported outcome scores (PROMS), UKA is not reported as advantageous in terms of satisfaction or functional improvement *(5)*. In a recent study *(3)* using data from sixty randomised controlled trials, nationwide databases or joint registries and large cohort studies, UKA

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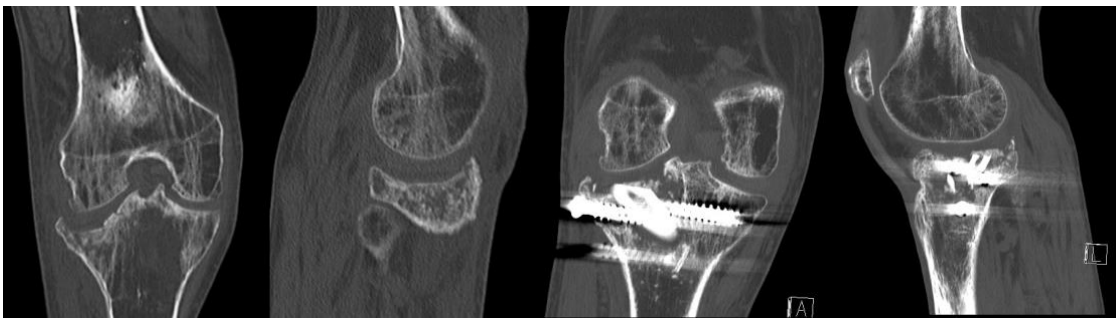

Fig. 1 a-d. — CT scan immediate and one year after allografting and screw fixation. Complete osteochondral necrosis of the lateral tibia plateau.

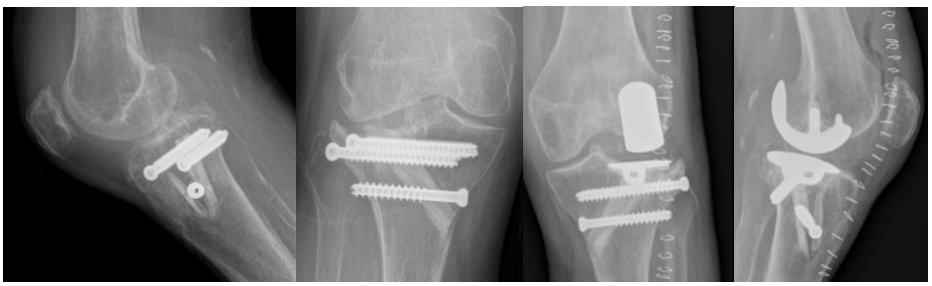

Fig. 1 e-h. — Radiographs after placement of a lateral UKA, the tibial keel was in close contact with the allograft.

presented better patient outcomes for the hospital stay, functional recovery, early revision rates and major complication rates than TKA, with no differences in postoperative pain. Also, the revision rates five years after surgery were higher for the UKA group.

The designers of Oxford UKA argue that the possible reasons for this high number of revisions are that revising UKA is easier than revising TKA and surgeons are overly alarmed about the development of radiolucent lines (RLLs) underneath the tibia plateaus of UKA. In this context, in cemented UKAs, RLLs have been reported to be up to 90% *(5)*, while increased RLLs associated with cementless UKAs have been observed *(6)*. However, there is no correlation between the presence nor absence of RLLs and loosening and/or impairment of the functional status *(7)*. In a large study on 1,000 cementless UKAs, 72 UKAs (8,9 %) with RLL were confirmed. The most common site of RLLs was zone 6 followed by zone 1 *(7)*.

In the present study, we found eight patients (8.6%) of the total study group with RLLs underneath the tibial component, two of which required revision surgery. Two out of these eight patients presented early aggressive osteopenia underneath the cementless fixated tibial components of the medial UKAs. There were also signs of progressive instability of the tibial implant. Spontaneous recovery occurred within six months, thus, avoiding revision surgery. To the authors' knowledge, there are no previous published reports of early-onset aggressive osteopenia with cementless medial UKA treated effectively by conservative means.

MATERIALS AND PATIENTS

Between December 1, 2011 and January 1, 2019, a consecutive cohort of 93 UKA patients (females: *N* = 69) were hospitalised in the Brugmann University Hospital of Brussels with end-stage arthritis of the medial knee compartment. The mean follow-up was 4.2 (1.3-9) years. Approval for this research was obtained from the institutional review board (CE2019/97).

In 57 cases, the UKA was cemented. We used cementless/cemented UKAs; specifically 68 Oxford UKAs, 13 Zimmer UKAs and 12 Hermes UKAs. In 12 cases, lateral degenerative arthritis was treated with lateral UKA with a fixed polyethylene bearing, six of which were performed due to post-fracture subchondral necrosis (Fig. 1). In one case with symptomatic patellofemoral degenerative arthritis, medial UKA was combined with patellofemoral prosthesis during the same surgical session.

Before the closure of the deep part of the wound (posterior capsule, perimuscular, Hoffa's fat pad), a solution of Ropivacaine (Narikin: 50 cc, 0.75%; epinephrine: 1 cc, 1:400.000, 5 µg/ml) was administered. In the case of cemented UKAs, all patients were encouraged to mobilise bearing full weight the day after surgery. After cementless fixation of the UKAs, a restricted weight-bearing regime was applied for two months.

The Oxford Knee Score (OKS) was calculated for all patients at two years (minimum) post-surgery. OKS is a battery of 12 questions that cover functioning and pain. The overall OKS score ranges from 0 to 60, with a score between 40 and 48 indicating good joint function without the necessity for further treatment *(5)*.

RESULTS

In total, 28 (30,1 %) complications were observed, four needed revision to a TKA, one varus osteotomy, one arthroscopic removal of bone cement and one debridement for deep infection. The indications for revision to a TKA were: early aseptic loosening (*N* = 3) and symptomatic lateral arthrosis (*N* = 1). TKA revision was performed within five years.

In one 68-year-old male patient with early aseptic loosening, a cemented medial UKA was placed to treat aseptic necrosis of the medial femur condyle (Fig. 2 a-d). In retrospect this was maybe not a good indication for a UKA.

In one patient with an iatrogenic fracture of the tibia plateau during surgery, screw osteosynthesis was performed. This patient was instructed to avoid weight-bearing for eight weeks. The tibia plateau fracture healed uneventfully, resulting in good functioning of the knee (OKS: 40).

Fig. 2 a-b. — Radiographies of a 66 years old male with a medial knee pain and functional loss due to a bone defect medial femur condyle.

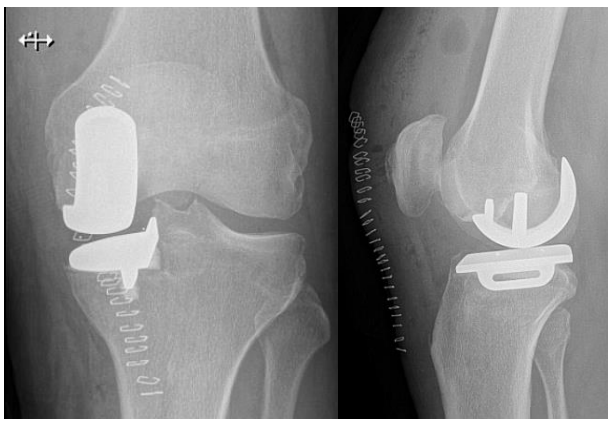

Fig. 2 c-d. — Radiographs immediately after placement of a cemented partial medial knee prosthesis.

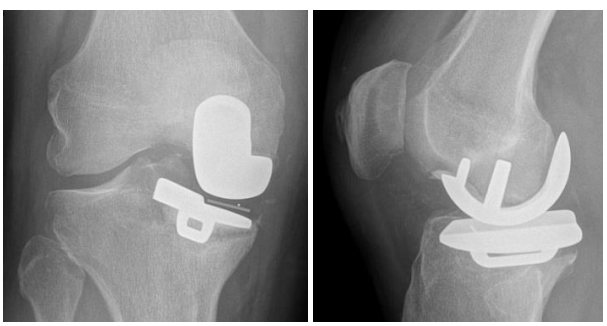

Fig. 2 e-f. — Radiographs six months after placement showing complete loosening of both femoral and tibial components.

Two patients needed additional mobilisation of their knees four months after UKA. They were quite anxious before and after the surgery, possibly explaining the slow functional progression after the knee surgery.

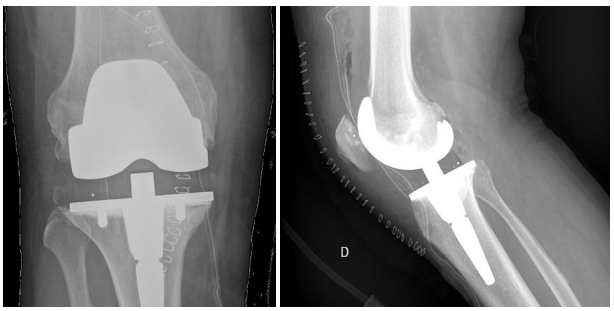

Fig. 2 g-h. — Radiographs after revising the partial knee prosthesis for a total knee prosthesis (Persona®, Zimmer-Biomet, Warshaw USA).

Six patients experienced prolonged postoperative pain. In three cases, the pain subsided progressively within one year. In one patient, the pain subsided after arthroscopic removal of a lump of bone cement that was moving freely within the joint.

A technical error in the placement of UKAs was diagnosed: in three cases, it was a medial overhang of the tibia component, and in two cases a posterior overhang of the tibia component. In three cases, a valgus orientation of the femoral component was observed.

One patient developed symptomatic valgisation of the knee within the first year, indicating progressive lateral degenerative arthritis. She refused UKA revision and was treated with open-wedge osteotomy of the distal femur with a Tomofix® plate (DePuy-Synthes, Dilbeek Belgium).

In 12 cases, a lateral UKA was placed to treat lateral degenerative arthritis ($N = 6$) or subchondral post-fracture necrosis ($N = 6$).The use of a fibular strut graft during the initial operative treatment of Schatzker III fractures resulted in the firm anchorage of the cemented lateral knee prosthesis (Fig. 1 a-g). These patients were satisfied with the regained stability of their knee as represented by the OKS of 42.

We also diagnosed two early infections, one of which was resolved with local treatment. The other infected knee was treated with debridement and replacement of the polyethylene spacer together with appropriate antibiotics.

Eight patients (8.6%) presented RLLs underneath the tibia component, six of whom did not require revision. Within this subgroup, two male patients [height: 1.89 m and 1.86 m (above average, tall); body-mass index: 25 and 30 (normal range: 25-29.9) developed pain at the medial tibia plateau shortly after surgery during weight-bearing. Infection was ruled out with a bone scan and diagnostic knee aspiration. Two months after surgery, the radiographs showed extensive osteopenia in zones 1-7 of the tibia plateau. One patient was already scheduled for revision surgery but refused to follow. Conservative treatment by refraining from weight-bearing and oral treatment with 1000mg of calcium and 800 IU vitamin D3 (cholecalciferol) was applied for four months. After one year, they remained pain-free with persistent good anchorage of the tibia component. In one patient, the slight valgus subsidence of the tibia plateau remained stable afterwards (**Fig**. 3 a-d and 4 a-d).

DISCUSSION

Partial knee replacement is a very efficient treatment of degenerative arthritis of the medial compartment of the knee *(3,9,10)*. The formation of patellofemoral arthritis and mild osteophyte at the rim of the lateral tibia plateau is not considered a formal contraindication for medial UKAs *(11,12,13)*.

The advantages of UKAs over TKA are multiple: short surgery time, minimal surgical exposure, sparing of the cruciate ligaments, less postoperative complications, quick recovery of the knee function and overall movement. In contrast to total hip arthroplasty, where the patient satisfaction score is good and/or excellent in 96%, TKA does not reach the same level of satisfaction *(3,4)*. Data from the National Joint Registry for England and Wales indicate that 71% of the patients with TKA perceived improvement in knee symptoms, but only 22% rated the results as excellent *(9,14)*. Kim et al. *(15)* reported that despite the clear evidence of improvement after TKA in terms of restoration of daily activities and pain relief, the PROMS-based patient satisfaction level was moderate, even though the reasons for this are not straightforward *(16,17,18,19)*.

Unfortunately, RLLs have been reported under the tibia component after cemented UKA implantation *(20)*. Although no relation between RLLs and early loosening has been found, the development of a

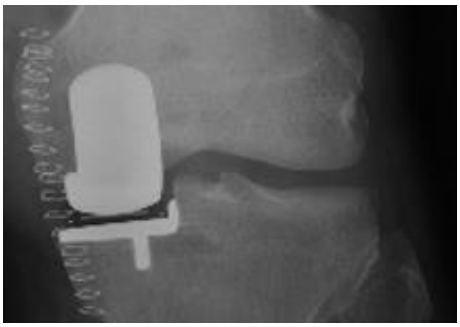

Fig. 3 a. — 62 years old male patient, radiographs immediate after surgery with Oxford Partial Knee prosthesis.

Fig. 3 b. — 62 years old patient, radiographs three months after surgery. Loosening of the tibial tray of a non-cemented Oxford Partial Knee prosthesis. Patient has difficulties in putting weight on the limb.

Fig. 3 c. — 62 years old male patient .Radiographs four months after sugery. One month non-weight -bearing and 1 gr de calcium and 800U Vit D3

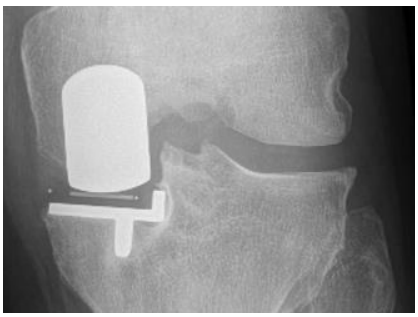

Fig. 3 d. — 62 years old male patient, radiographs eight months after surgery. Nearly complete mineralization of the osteolytic zones. Residual valgus of the tibial component. Patient is pain free.

Fig. 4 a-b. — 58 year old man immediate after placement of an Oxford Partial Knee prosthesis for post-traumatic degenerative arthritis of the medial compartment of his knee.

cementless version of UKAs was attempted, in the hope of diminishing the presence of RLLs *(20)*. Designer centres published some excellent results with the cementless Oxford Partial Knee replacement. Pandit et al. (2011) observed a drastic decrease of the number of RLLs (from 75% to 7%) when using cementless UKAs *(9,20,21)*.

Fig. 4 c-d. — Same patient 4 months after surgery. Weight bearing is painful.

Fig. 4 e-f. — Same patient after two months of non-weight-bearing and intake of 1gr.Calcium plus Vit.D3 800U.

Fig. 4 g-h. — Same patients six months of no-weight-bearing and intake of calcium 1gr.and Vit.D3. Patient is pain free.

Recently, the National Registry of England, Wales and Northern Ireland and New Zeeland published conflicting results. The revision rate for UKA is substantially higher than TKA *(9,22)*. The designers argue that the possible reasons for this high rate of revisions are that UKAs are more easily revised than TKAs and surgeons are overly alarmed about the development of RLLs underneath the tibia plateaus of UKAs. They concluded that non-progressive RLLs are not a reason for revising UKAs *(2,7,9)*.

In our study, 8 out of 93 patients presented RLLs (8.6%). In two tall male patients, early-onset aggressive osteopenia underneath the cementless

tibial component was observed. We hypothesise that the height and weight of these male patients played a role in the early loosening of the tibia tray. The presence of osteopenia with tibia tray instability was spontaneously resolved after six months of refraining from weight-bearing and treatment with 1000 mg calcium and 800 IU vitamin D3.

CONCLUSIONS

In this study the patient-related outcomes were comparable with those presented in the literature. The spontaneous disappearance of early severe osteopenia under a cementless tibia tray is not always an indication for revision surgery. In our two cases it disappeared spontaneously with reduced weight bearing and intake of calcium/vitamin D3.

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