

C A S E R E P O R T

Early failure of cement with loosening and dislocation of the femoral component in a unicompartmental knee replacement: a case report with microscopic assessment

Francesco Mancuso¹, Paolo Di Benedetto^{1,2}, Elia Colombo³, Enrick Miani³, Lorenzo Fedrizzi⁴, Michele Mario Buttironi¹, Araldo Causero^{1,2}

¹Clinic of Orthopaedics, ASUFC Santa Maria della Misericordia Hospital of Udine, Udine; ²Medical Department, University of Udine; ³Orthopaedics and Traumatology Unit, ASUFC Tolmezzo General Hospital, Udine; ⁴Polytechnic Department of Engineering and Architecture, University of Udine, Udine

Abstract. *Background:* Medial unicompartmental knee arthroplasty (UKA) is a valuable and well-known option in the treatment of medial osteoarthritis (OA). Early recovery and good results are usually reported. Failure mechanism include septic and mechanical loosening, bearing dislocation and lateral or patello-femoral joint OA evolution. The rare case of an atraumatic dislocation of the cemented femoral component of a UKA is presented together with a literature review and a microscopic analysis of the loosened component. *Methods:* The case of a 60-years old man who suffered a UKA failure due to a complete loosening and migration of the cemented femoral component 5 months after its implantation is reported. A review of the literature pertaining early similar catastrophic failures is discussed. Furthermore a stereo-microscopic and scanning electronic microscopic evaluation of the femoral component was performed. *Results:* A UKA-to-TKA revision was performed. Septic loosening was ruled out and one-year follow up showed patient satisfaction with good clinical and radiographic results. Few cases of complete dislocation of the UKA femoral component are reported in the literature. Macro- and microscopic evaluation showed an almost completely smooth surface at the cemented surface of the posterior condyle of the femoral component. *Conclusions:* Whilst mobile bearing dislocation is a well-known complication of UKA, few cases of this potentially catastrophic complication are reported in the literature. Early UKA failure with complete implant loosening may be determined by a suboptimal cementing technique with inadequate cement penetration into the trabecular bone. In the present case, the absence of cement penetration into the posterior condyle may be one of the reason of the component dislocation after standing up starting with the knee in a highly flexed position.(www.actabiomedica.it)

Key words: Unicompartmental knee arthroplasty, cement failure, aseptic loosening, component dislocation

Introduction

Unicompartmental knee arthroplasty (UKA) is a widely used option to treat osteoarthritis affecting only one knee compartment especially the medial one. The reasons for this success are the reduction in invasivity, postoperative pain, blood loss and the improvement in rehabilitation path with lower complications (1,2). Furthermore, it has not to be considered as a gateway

procedure to delay the total knee arthroplasty (TKA) but it may be the definitive approach in those patients affected by localized disease (3).

Despite many advantages, UKA may fail due to the usual complications of articular implants, in particular septic and aseptic loosening, polyethylene wear, periprosthetic fracture, fracture of the femoral component or unexplained pain but also for design-specific events, for example bearing dislocation or osteoarthritis evolution (4).

We report the case of a patient who suffered from a catastrophic failure of his UKA with the dislocation of the cemented femoral component due to an early loosening.

Methods

Case presentation

The patient is a 60-years-old male, who underwent a medial partial knee replacement for medial osteoarthritis with a tibial all-poly implant (SIGMA® High Performance Partial Knee System). At the operation, patient's body mass index was 33 Kg/m². The early post-operative stage is reported as regular with early discharge from hospital and usual rehabilitative approach. During the first months, the patient experienced mild medial pain without significant limitation in its daily activities. Standard clinical and radiological checks failed to show any loosening signs. However, 5 months after the index operation, the patient, after getting out of a chair, felt a sudden excruciating medial pain with immediate functional impairment. Urgent X rays showed complete loosening with migration of the femoral component of the UKA (Figure 1).

Informed patient consent to publication of his case was obtained. Ethics committee approval was not required for this kind of study.

Macroscopic evaluation

The cemented side of the loosened femoral component was assessed with low magnification for its macrostructural features, like trabeculae, porosity or cracks.

Microscopic evaluation

Furthermore a stereo-microscopic (Nikon SMZ1000) and scanning electronic microscopic (SEM) (EVO 40 ZEISS) assessment of the femoral component was then performed.

Literature review

PUBMED and Google Scholar databases were searched for articles including case reports and case series (in the English language) of similar UKA catastrophic failures.

Scientific publications were searched for the following keywords: “unicompartmental”, “knee replacement”, “knee revision”, “knee arthroplasty” and “knee surgery” (search one). Another search was conducted for articles containing any of the following keywords: “failure”, “loosening”, “dislocation” and “femoral component” (search two).

Only 2 case reports were found. The information about patient demographic (age and sex), knee im-

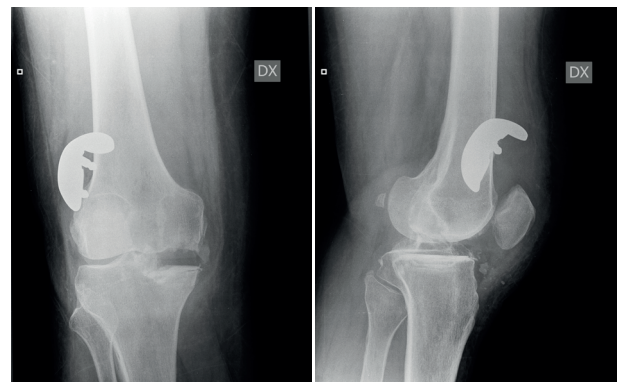


Figure 1. X-ray showing complete loosening with migration of the femoral component of the UKA (antero-posterior and lateral view).

Table 1. Literature review

Author	Year, Journal	Cases	Implant	Timing	Dislocation mechanism	Treatment
Argelo et al	2014, Journal of Medical Case Reports	1 male, 64 years old	Oxford partial knee	3 months	Acute pain after sitting in a cross-legged position.	TKA PS design
Soufi et al	2014, Orthopedic & Muscular System: Current Reserch	1 male, 68 years old	Oxford partial knee	years	Kicked and crushed between a calf and a wall	TKA PS design
Present report	2020	1 male, 60 years old	Sigma partial knee	5 months	Acute pain after getting out of a chair (extension from an over-flexed position)	TKA CR design

plant, timing and mechanism of dislocation were recorded and reported in Table 1.

Results

A revision uni-to-total knee replacement was then planned. The all-poly tibial component was well fixed while femoral component was found into the lateral sub-quadriceps space. Anterior cruciate ligament was macroscopically normal and functional. Intra-operative cultural samples were taken and resulted negative to rule out septic loosening. The good residual bone stock allows the use of a first implant cruciate retaining cemented TKA without the need for augments. At one year of follow up the patient was satisfied with good clinical and radiographic results.

Few cases with similar features are described in literature and reported in Table 1 (5,6).

Macroscopic evaluation of the loosened femoral component showed a very rough morphology of the cement mantle covering the area in between the two pegs at the level of the distal femoral cut. That rough-

ness retrace the bone porosity on which the component was fixed.

On the other hand, at the posterior aspect of the implant, at the level of the posterior femoral cut, the cement was less represented with a smoother surface (Figure 2).

Microscopic evaluation confirmed the macroscopic appearance with a well represented cement trabeculation on the distal cut demonstrating an adequate cement pressurization with good penetration into the cancellous bone during the implantation phase, which unfortunately was not the case of the smooth posterior portion of the implant (Figure 3).

The highly rough surface showed bumps of about 700 to 1000 micrometers and therefore comparable with the cancellous bone porosity (Figure 4).

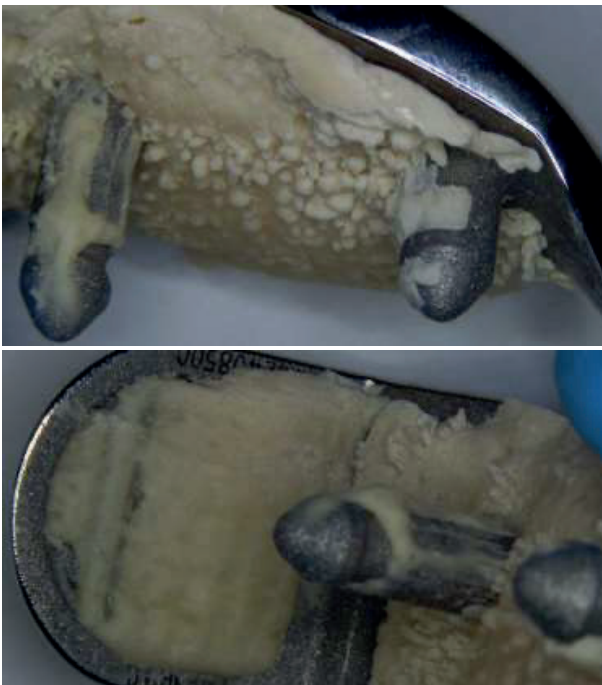


Figure 2. Macroscopic assessment: a. rough cement in between the two pegs; b. smooth surface on the posterior aspect of the implant.

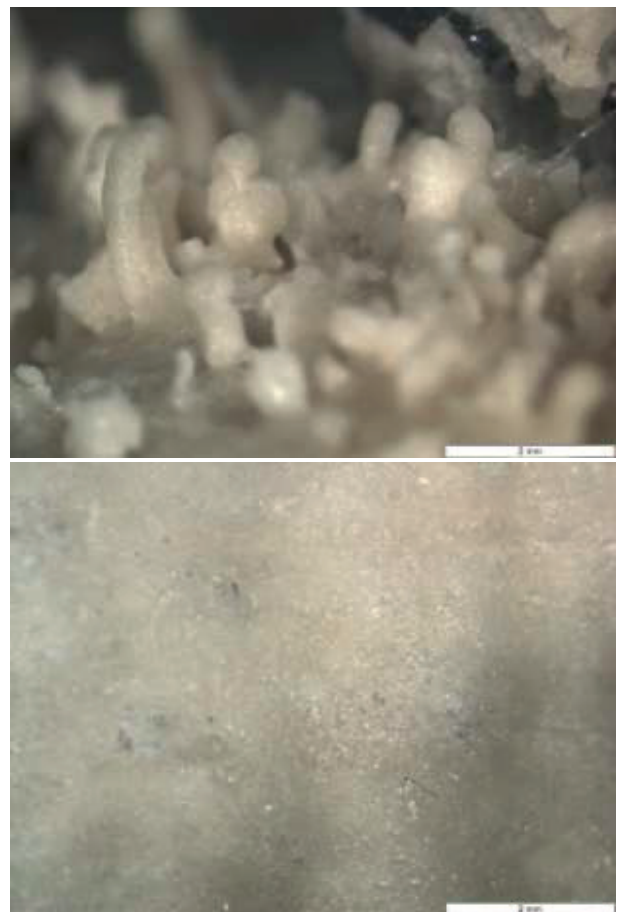


Figure 3. Microscopic assessment: a. rough cement in between the two pegs; b. smooth surface on the posterior aspect of the implant.

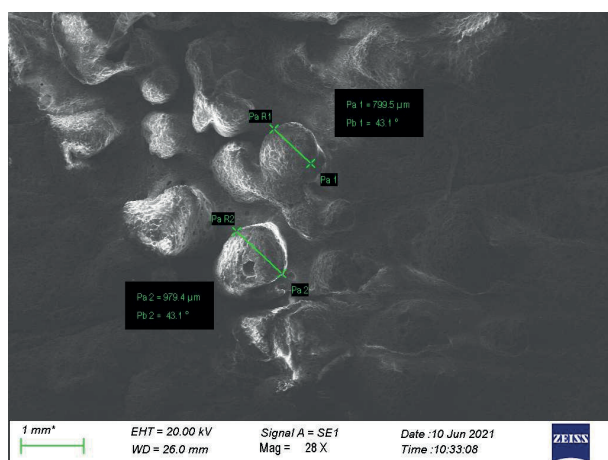


Figure 4. Cement bumps' size at SEM

Discussion

Unicompartmental knee arthroplasty is widely used an option to treat osteoarthritis affecting only one knee compartment especially the medial one. The reduction in invasivity, postoperative pain, blood loss and the improvement in rehabilitation path with lower complications are the main reasons of its success. One more advantage is the usual possibility to revise it with standard primary TKA (7).

Loosening of the implant is a well-known complication of arthroplasty, despite being less frequent thanks to new materials and implant design. It may be determined by a periprosthetic infection or by a mechanical failure of the components. Possible risk factors for the latter are younger age, overweight and varus deformity (8).

In mobile UKA, bearing dislocation is the predominant mechanism of failure, whereas polyethylene wear and aseptic loosening happen especially in the fixed UKA.

If persistent medial pain is the commonest clinical manifestation of this complication, the presented case shows a catastrophic evolution with the dislocation and consequent migration of the femoral component, despite it is known that tibial component loosening is usually more frequent, especially in the all-poly designs in comparison to the metal-backed ones (9-11).

To our knowledge, few reports of traumatic femoral component dislocation are described in literature. Dislocation in the absence of a significant reported trauma is otherwise uncommon. In the above reported case an impending mechanical loosening, associated to an over

90° flexion movement getting out of a chair, could have caused an increased force perpendicular to the distal cut of the femur and directed from proximal to distal on the posterior aspect of the implant, determining a complete migration of the femoral component.

As shown at the microscopic assessment, the absence of posterior cement roughness may have not provided enough resistance to that force inducing the femoral component to be pulled out after a daily physiological movement.

Microscopic assessment by itself could not explain the reason of the reported event. The absence of posterior roughness on the cement surface, which contributed to the reduced resistance to physiological stress, may have been caused by the presence of sclerotic bone on the posterior cut or by a suboptimal cementing technique during the washing of the bone surfaces or during the final pressurization. In an experimental cadaver study, Clarius et al have already showed that the posterior plane facet is the weak point of the cement-bone interface due to the incompleteness of the cement mantle and a lack of interdigitation (12).

Regarding the treatment options, UKA-to-UKA revision has limited indications (ligament integrity and sufficient bone stock) and is usually not recommended even if UKA-to-TKA could be a demanding and not straightforward procedure (13-15) with hidden follow up costs, despite price of components not being significantly higher in comparison to a standard primary TKA. Issues may arise from the failure mechanism and its consequences on bone stock and ligament integrity. If arthritis progression in the lateral compartment following medial UKA is present, the addition of a lateral UKA instead of TKA may be a good option in appropriately selected patients (16).

A standard primary TKA should be used if allowed by local conditions but metal augmentations and stem should be available. According to Craik et al, about one third of patients undergoing UKA-to-TKA required revision components, as augments, stemmed implants or bone grafts, usually on the tibial side (17).

If blood loss and transfusion rate in conversion of a failed UKA are similar to primary TKA, outcomes are reported to be poorer in the first group but it seems to be a consequence of worse preoperative function of the failed UKA patients (18).

Conclusions

Whilst mobile bearing dislocation is a well-known complication of UKA, few cases of this potentially catastrophic complication are reported in the literature.

Early UKA failure with complete implant loosening may be determined by a suboptimal cementing technique with inadequate cement penetration into the trabecular bone. Extreme care should be used in the cementation process to prevent potential early loosening and failure.

In the present case, the absence of cement penetration into the posterior condyle may be one of the reasons for the component dislocation after standing up starting with the knee in a highly flexed position.

UKA remains a valid option for the treatment of medial osteoarthritis. If revision becomes necessary, it should be dealt with a conversion UKA-to-TKA, usually planned with a standard primary implant but with revision components available in the operating theater.

Conflict of interest: Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article

References

- Lombardi AV Jr, Berend KR, Walter CA, et al. Is recovery faster for mobile-bearing unicompartmental than total knee arthroplasty? *Clin Orthop Relat Res* 2009;467:1450–1457.
- Liddle AD, Judge A, Pandit H, et al. Adverse outcomes after total and unicompartmental knee replacement in 101,330 matched patients: a study of data from the National Joint Registry for England and Wales. *Lancet* 2014;384:1437–45.
- Mittal A, Meshram P, Kim WH et al. Unicompartmental knee arthroplasty, an enigma, and the ten enigmas of medial UKA. *J Orthop Traumatol* 2020;21:15.
- Kim KT, Lee S, Cho KH, Kim KS. Fracture of the medial femoral condyle after unicompartmental knee arthroplasty. *J Arthroplasty* 2009;24(7):1143.
- Argelo KD, Burger MA, Hoozemans MJ, Temmerman OP. Femoral component failure in the Oxford unicompartmental knee arthroplasty: a case report. *Journal of Medical Case Reports* 2014;8:419.
- Soufi M, Khunda A, Kallou D, Patel K. A Traumatic Dislocation of a Unicompartmental Knee Replacement: A Case Report. *Orthop Muscul Syst* 2014;3:177.
- Sierra RJ, Kassel CA, Wetters NG, Berend KR, Della Valle CJ, Lombardi AV. Revision of unicompartmental arthroplasty to total knee arthroplasty: not always a slam dunk! *J Arthroplasty* 2013; Sep;28(8 Suppl):128–132.
- Collier MB, Eickmann TH, Sukezaki F, McAuley JP, Engh GA. Patient, implant, and alignment factors associated with revision of medial compartment unicompartmental knee arthroplasty. *J Arthroplasty* 2006;21(06, Suppl 2):108–115.
- Vasso M, Corona K, D'Apolito R, Mazzitelli G, Schiavone Panni A. Unicompartmental Knee Arthroplasty: Modes of Failure and Conversion to Total Knee Arthroplasty. *Joints* 2017;5:44–50.
- Barrett MC, Wilkinson FO, Blom AW, Whitehouse MR, Kunutsor SK. Incidence, temporal trends and potential risk factors for aseptic loosening following primary unicompartmental knee arthroplasty: A meta-analysis of 96,294 knees. *Knee* 2021; Aug;31:28–38.
- Saenz CL, McGrath MS, Marker DR, Seyler TM, Mont MA, Bonutti PM. Early failure of a unicompartmental knee arthroplasty design with an all-polyethylene tibial component. *Knee* 2010;17:53–56.
- Clarius M, Mohr G, Jaeger S, Seeger JB, Bitsch RG. Femoral fixation pattern in cemented Oxford unicompartmental knee arthroplasty--an experimental cadaver study. *Knee* 2010; Dec;17(6):398–402.
- Berend KR, George J, Lombardi AV Jr. Unicompartmental knee arthroplasty to total knee arthroplasty conversion: assuring a primary outcome. *Orthopedics* 2009;32(09).
- Khan Z, Nawaz SZ, Kahane S, Esler C, Chatterji U. Conversion of unicompartmental knee arthroplasty to total knee arthroplasty: the challenges and need for augments. *Acta Orthop Belg* 2013; 79(06):699–705.
- Jonas SC, Shah R, Mitra A, Deo SD. 5-Year cost/benefit analysis of revision of failed uni-compartmental knee replacements (UKRs); not “just” a primary total knee replacement (TKR). *Knee* 2014;21(04):840–842.
- Pandit H, Mancuso F, Jenkins C, Jackson WFM, Price AJ, Dodd CAF, Murray DW. Lateral unicompartmental knee replacement for the treatment of arthritis progression after medial unicompartmental replacement. *Knee Surg Sports Traumatol Arthrosc* 2017 Mar;25(3):669–674.
- Craik JD, El Shafie SA, Singh VK, Twyman RS. Revision of unicompartmental knee arthroplasty versus primary total knee arthroplasty. *J Arthroplasty* 2015;30(04):592–594
- Cankaya D, Della Valle CJ. Blood loss and transfusion rates in the revision of unicompartmental knee arthroplasty to total knee arthroplasty are similar to those of primary total knee arthroplasty but are lower compared with the revision total knee arthroplasty. *J Arthroplasty* 2016;31(01):339–341.

Received: 10 December 2021

Accepted 18 January 2022

Correspondence:

Francesco Mancuso

Clinics of Orthopedics, ASUFC Santa Maria della Misericordia Hospital of Udine, Udine

E-mail: francesco.mancuso@gmail.com