Fixed versus Mobile Bearing Medial UKA (Medial Unicondylar Knee Arthroplasty)

Systematic review

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List of Abbreviations

Abb.	Full term
AP	*Anteroposterior*
CI	*Confidence Interval*
FB	*Fixed Bearing*
FE	*Finite Element*
FEM	*Fixed-Effects Method*
Inf.	*Inferior*
MB	*Mobile Bearing*
OA	*Osteoarthritis*
OCY	*Observed Component Years*
OKS	*Oxford Knee Score*
OUKA	*Oxford Unicompartmental Knee Arthroplasty*
PE	*Polyethylene*
PRISMA	*Preferred Reporting Items for Systematic review and Meta_Analysis*
PTA	*Post Traumatic Arthritis*
RA	*Rheumatoid Arthritis*
RCT	*Randomized Controlled Trial*
REM	*Random-Effects Method*
RLLs	*Radiolucent Lines*
SE	*Standard Error*
SMD	*Standardized Mean Difference*
Sup.	*Superior*
TKA	*Total Knee Arthroplasty*
UKA	*Unicompartntal Knee Arthroplasty*

ABSTRACT

Background: Unicompartmental knee arthroplasty (UKA) is a bone and ligament-sparing technique that can restore Knee kinematics and function for osteoarthritis (OA) limited to one knee compartment.

Objectives: The aim of the study is a systematic review conducted to examine and compare the clinical complications, revision rates, reoperation rates and survivorship differences between fixed and mobile bearing designs in unicompartmental knee arthroplasty.

Patients and Methods: Randomized controlled trials, including cluster RCTs, controlled (non-randomized) clinical trials or cluster trials, prospective and retrospective comparative cohort studies, case series and case-control will be included in this study. Those -that reported clinical outcomes with MB and/or FB UKA- provided details on the number of implants, if it could be estimated, the revision rate (i.e. if the number of implant component years) could be calculated. Studies in English. Between 2000 till 2018.

Results: About 293 articles were found using search keywords. By filtration and screening of the title and exclusion of unrelated articles, about 169 articles were found. By applications of all inclusion and exclusion criteria, only 10 articles were fit to undergo this meta-analysis.

Conclusion: So this study showed no significant difference in clinical outcome, revision rates, reoperation rates and survivorship between mobile and fixed bearing UKRs. Also more investigations should be directed toward the use of highly cross linked PE or vitamin E polyethylene with mobile bearing surfaces as these surfaces are highly conforming which might decrease the amount of wear. Unfortunately we have some restrictions such as the diagnosis, activity level, operative side, population heterogeneity and surgical technique of the unicompartmental knee arthroplasty within the included studies might have affected the results. We are still in need for more, large, well-designed RCTs with a long follow-up to assess the clinical, radiological and kinematic outcomes of mobile versus fixed bearing UKR.

Keywords: *Unicompartmental knee arthroplasty*, *Osteoarthritis*, *Uni-compartment knee arthroplasty, Minimally invasive mobile bearing partial knee replacement, Oxford phase III uni-compartment knee replacement*

INTRODUCTION

Unicompartntal knee arthroplasty (UKA) is a bone and ligament-sparing technique that can restore Knee kinematics and function for osteoarthritis (OA) limited to one knee compartment. [1-4]

It is a reliable surgical option for patients suffering from unicompartmental arthritis of the knee and it is a popular alternative to total knee arthroplasty (TKA). However, failure of UKA happens due to either wear of the polyethylene (PE) insert or progressive osteoarthritis (OA) in the other compartment.[5,6]

Function and survivorship after UKA improved as a result of improvements in designs, indications, materials, appropriate patient selection and surgical techniques.[7,8]

Several kinematic studies reported that sparing ACL in UKA may be better in survivorship, stairclimbing, patient satisfaction, and joint kinematics. [2,9-11]

There are currently two fundamentally different design concepts for UKA prostheses: fixed bearing (FB) and mobile bearing (MB), however controversy remains whether there is a clinical difference between fixed or mobile bearing UKR. [4,9,10-13]

The first design of the UKA was fixed bearing [7]. Fixed-bearing design has a flat tibial surface, which is less appropriate as flexion occurs and may lead to point loading. Supporters of fixed bearing designs argue that they provide similar satisfactory outcomes with reduced complication rates **(fig. 1)**. [14]

The polyethylene insert is rigidly connected with a metal tibial component either by screws or a snap-fit mechanism in fixed-bearing designs but the articulation for the range of motion occurs only between the superior surface of the PE insert and the femoral component. Many direction forces are applied to the PE insert via its superior surface. [15]

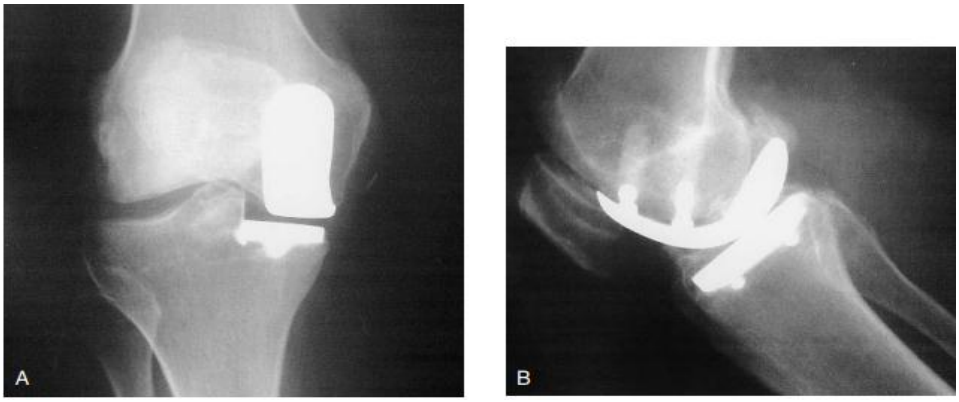

Figure (1): Plain x ray (AP & Lateral view) for Post operative UKR fixed bearing implant at 9 years followup [10].

The second design has a mobile meniscal polyethylene tibial bearing [10].

Mobile-bearing designs improve joint biomechanics by allowing articulating surfaces to conform more than in fixed-bearing designs. This leads to larger contact areas, lower contact stresses, and better wear complications. These aspects have been proposed to reduce wear in mobile bearing designs **(fig. 2)**.[15]

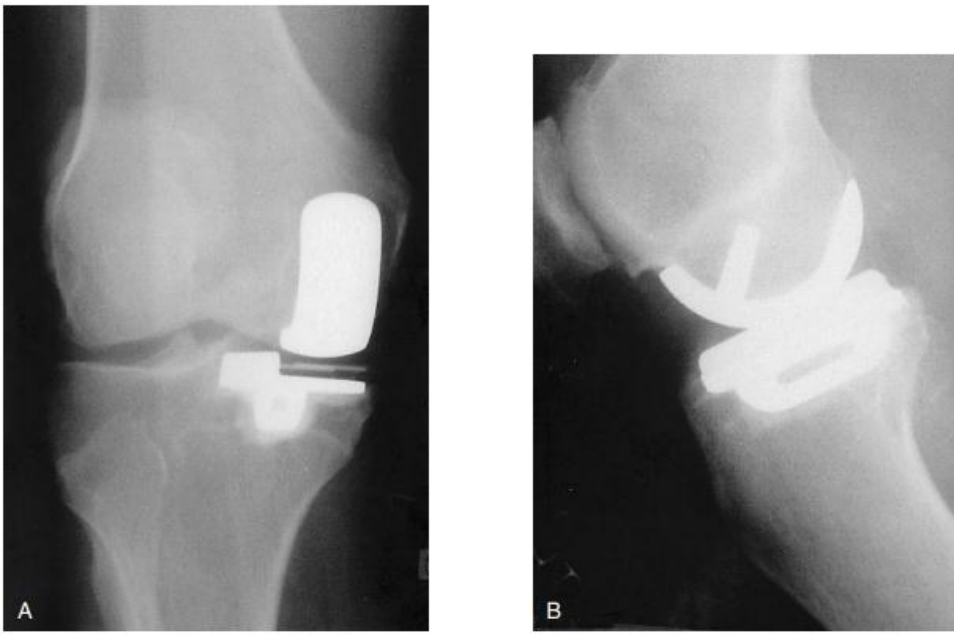

Figure (2): Plain x ray (AP & Lateral view) for Post operative UKR medial implant at 10 years followup [10]

Some studies have found that mobile-bearing designs performed better than fixed-bearing designs. The potential advantage of the mobile-bearing design with meniscal bearings is reducing the surface and subsurface contact stresses by offering a higher degree of conformity between articular surfaces, therefore larger contact areas and lower contact stresses than with a fixed-bearing designs, which would theoretically improve wear characteristics.[10,12,15]

Contact pressure area in the superior surface of the PE insert of the mobile bearing UKA is 4.2 times larger than that of the fixed bearing so lower contact stresses and lower wear in the mobile bearing is expected **(Fig.3).**[15]

Many studies supported this theory by showing lower wear rates with this fully conforming mobile-bearing UKA. That is why MB design is becoming increasingly popular due to its theoretical advantages over FB prostheses. [16,17]

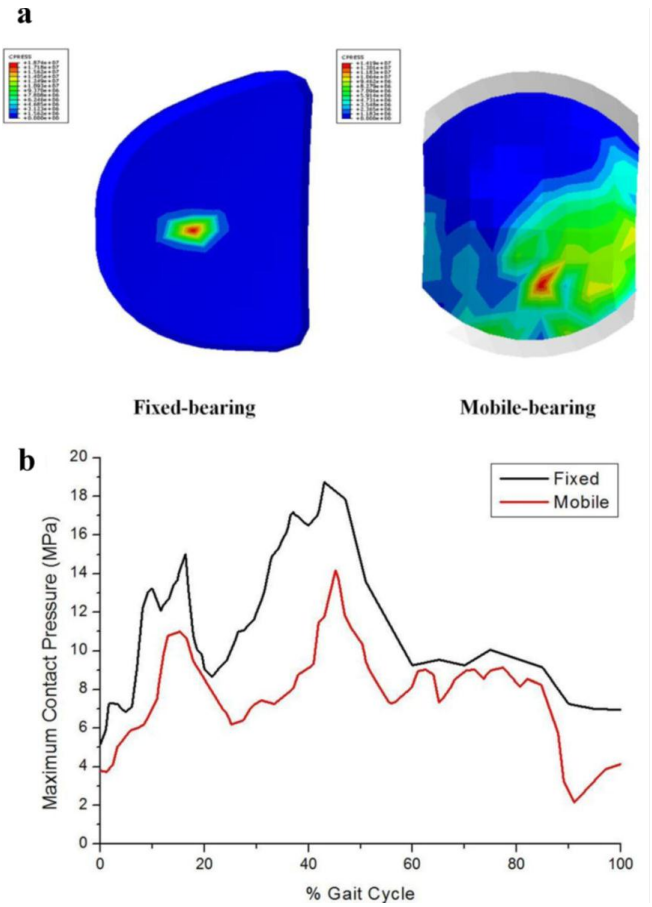

Figure (3): Maximum contact pressures in the sup. surface of the PE insert for fixed- and mobile-bearing UKA: (a)sup. surface of the PE insert contact pressure distribution at the maximum stress point; (b) sup. surface of the PE insert contact pressure recorded during the gait cycle.[15]

Furthermore in ***2006, Li et al.*** found better knee kinematics and lower incidence of radiolucencies in the MB group at 2-year follow-up despite equivalent Knee Society, WOMAC, and SF-36 scores between the two bearing designs.[4]

Also, in 2010 in a retrieval analysis of 43 UKA tibial components, ***Manson et al.*** found lower progressive wear scores in the MB design with no incidence of surface delamination or distortion, however, scratching wear was higher. [19]

In contrast surgeons proposed that the mobile bearing device is more difficult to implant technically, especially in respect to precise alignment and ligament balancing.[14]

So accurate alignment and ligament balancing are essential to prevent mobile-bearing dislocation or impingement and to avoid overcorrection, which may lead to rapid progression of arthritis in the opposite compartment.[10,12,18]

Not only that but also some studies suggested a higher early reintervention rate for the mobile-bearing design and failure mode. The time to reoperation were different as early failure from bearing dislocation occurred with the MB design while late failure from polyethylene wear occurred with the FB design, however the range of motion, limb alignment, patient-reported outcomes, incidence of aseptic loosening, and reoperation rates were equal between the two bearing designs,.[16,20]

Wear of PE insert, progression of arthritis and aseptic loosening are the most common complications requiring reoperation following UKA. Many studies suggested that progression of arthritis and aseptic loosening are more common in the knees with mobile bearings than fixed bearings. While no knees with mobile bearings were re-operated for wear, the most common complication requiring reoperation for mobile bearing UKA was progression of arthritis[4,17,18,20-23].

Several studies directly compared the two methods but the reported results varied. The wear of ultra-high molecular weight polyethylene (PE) in artificial knee joints is a particularly important factor in their longevity.Many of these studies suggested that there's no rotational and anteroposterior (AP) tibiofemoral translational differences during knee flexion between an FB and MB prosthesis in UKA[21,24-26].

This study has presented a systematic review and meta-analysis to determine whether the MB and FB designs of medial UKAs differ in clinical complications, revision rate, reasons and incidence of reoperation rate and insert survivorship differences.