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ORIGINAL PAPER

Unicompartmental knee arthroplasty: all-poly versus metal-backed tibial component—a long-term follow-up study

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Abstract

Introduction While considered a satisfactory solution, unicompartmental knee arthroplasty (UKA) still raises concerns in regard to its durability. These concerns particularly focus on the tibial component. This study aims to compare two different cemented tibial components belonging to the same UKA design: all polyethylene (AP) versus metal backed (MB), at a long-term follow-up.

Materials and methods We retrospectively reviewed 143 successive patients, 83 of which underwent surgery with AP tibial component UKA (37 males, 46 females), and 67 with MB ones (17 males, 50 females). All implants had the same prosthetic design (Accuris UKA, Smith e Nephew) with identical femoral oxinium component but different tibial component, AP or MB. The KSS and KOOS were assessed at a mean of 11.5-year follow-up and compared to pre-operative, post-operative, and one year evaluation. Statistical analysis was performed with SPSS for Mac (version 17.0). To assess potential statistically significant differences, *t* test was used and significance was set at $P < 0.05$.

Results Final KSS at a mean of 11.5-year follow-up was 94.27 for the AP group and 96.12 for the MB ones. The final KOOS was 87 for AP components and 89.67 for the MB group. These results demonstrated, in all cases, statistically significant better results for MB tibial components compared to AP regarding KSS ($P = 0.048$), KOOS ($P = 0.000$), and pain ($P = 0.014$) at the 11.5-year follow-up. Survivorship for AP tibial component implants was 97.6%, while it was 89.5% for MB ones.

Conclusion While the survivorship rate has been found to be greater for AP implants compared to MB tibial components, this study reveals statistically better functional results according to KSS and KOOS, and pain, at a long-term follow-up for MB implants.

Keywords Unicompartmental knee arthroplasty · All-poly tibial component · Metal-backed tibial component · Knee pain

Introduction

Many are the advantages of unicompartmental knee arthroplasty (UKA) compared to total knee arthroplasty (TKA): smaller incision and arthrotomy, minor blood loss, shorter hospital staying, and earlier return to work activities. In addition, in case of failure, revision surgery to a total knee arthroplasty can easily be performed. Results are satisfactory even in the long term, mostly thanks to recent technological innovations and to adoption of strict selection indications. Despite its functional benefit, UKA still raises questions concerning implant survivorship and an increased revision risk [1, 2].

A lot of studies have demonstrated that in more than half of the cases, the reason of UKA revision was related to pain or problems with the tibial component: poly wear, loosening, or subsidence [3–5]. Finite element analysis, comparing two different tibial components, all polyethylene (AP) or metal backed (MB), showed that AP implants exhibited significantly higher strain measurements compared to MB implant [6] and were associated with increased subchondral microscopic damage [7]. MB baseplate was then supposed to be the right solution for its demonstrated capacity of decreasing tibial strains. Literature is not decisive with most studies reporting the experience of a single model of component, and only few of them comparing the two different components. While clinical outcomes and revision rates of AP TKA tibial components show satisfactory long-term results, sometimes even better than MB ones [8, 9], results for UKA are controversial,

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with registry data referring higher revision rates for AP components compared to MB ones, and report on cohorts of patients giving evidence of satisfactory long-term results with AP tibial components [10–12]. Moreover, AP components have the advantage of being a low-cost solution and being usable in allergic patients.

The aim of this study was to compare two different cemented tibial components belonging to the same UKA design: all polyethylene versus metal backed. Patient's subjective and surgeon's objective outcomes concerning knee function and revision rate were assessed in the long term.

Materials and methods

Between January 2004 and December 2010, a total of 161 patients underwent to UKA in our department. Mean age was 74 years (range 57–91). Nine patients were lost to follow-up. Nine patients, out of 152, needed subsequent revision surgeries. Therefore, the study population included 143 patients. Eighty-three patients underwent to AP tibial component UKA (37 males, 46 females) and 67 to MB ones (17 males, 50 females). Mean follow-up was 11.5 years (minimum 9 years, maximum 16 years). BMI was calculated for each patient: Mean BMI for the AP group was 28.45 (23.6–31.60) and 29.85 (22.9–32.9) for the MB group. All implants had the same prosthetic design (Accuris UKA, Smith e Nephew) with identical femoral oxinium component but different tibial one, AP or MB (Fig. 1). Assignment of one tibial component or the other was randomized, having rarely available, mostly at the beginning, MB component. Implants were all cemented. All surgeries were performed by a single surgeon. Patients were all reviewed with functional outcomes assessed by KSS (Knee Society Score) [13] and KOOS (Knee Osteoarthritis Outcome Score) [14], and radiographs were taken pre-operatively, 30 days after surgery, one year, and at yearly time points. Statistical analysis was performed with SPSS for Mac (version 17.0). To assess possible statistically significant differences, t test was used and significance was set at $P < 0.05$.

Results

No differences were observed in patient demographic characteristics or outcome scores at preoperative and post-operative examination. Pre-operative score according to KSS was 57.32 (range 40–70, DS 9.12) for AP tibial components and 57.34 (range 40–70, DS 10) for the MB group. Score at one month was 93.20 (range 70–100, DS 6.53) for AP components and 92.28 (range 72–100, DS 7.67) for MB ones. Final score at a mean of 11.5-year follow-up was 94.27 (range 70–100, DS 5.65) for the AP group and 96.12 (range 84–100, DS 4.25) for MB ones (Fig. 2).

The preop score according to KOOS was 59.41 (range 40–72, DS 8.81) for AP tibial component UKA and 59 (40–76, DS 9.64) for the MB group. The score one month after surgery was 85.22 (range 63–97, DS 8.14) for AP components and 87.20 (range 69–96, DS 6.29) for the MB group. The final score was 87 (range 63–97, DS 8.27) for AP components and 89.67 (range 70–96, DS 5.05) for the MB group (Fig. 3). Pain was assessed according to KSS subscale. The maximum score is 50 points, corresponding to complete absence of pain, and decreases according to symptoms. The pre-operative scores were similar for both groups with a value of 23.70 (range 10–40, DS 8.02) for AP tibial component and 24.32 (range 10–40, DS 9.79) for the MB group. One month after hospital discharge, pain score was 42.26 (range 24–50, DS 7.10) for AP components and 43.63 (range 20–50, DS 7.93) for MB ones. The score at long-term follow-up was 45.06 (range 24–50, DS 4.95) for AP components and 47.14 (range 40–50, DS 3.62) for the MB group (Fig. 4).

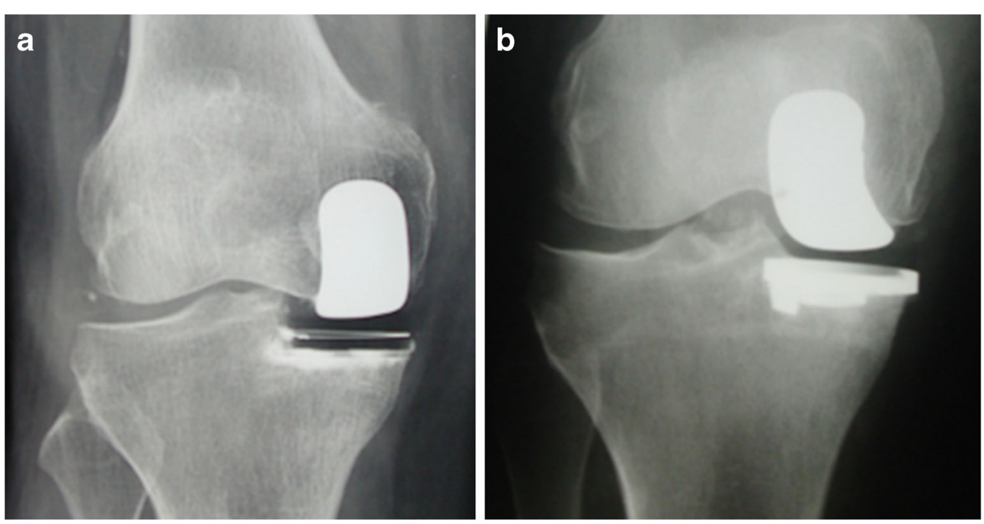

Fig. 1 Radiographic examples of UKA design. **a** Metal-backed tibial component UKA at the 16-year follow-up. **b** All-poly tibial components at a 14-year follow-up

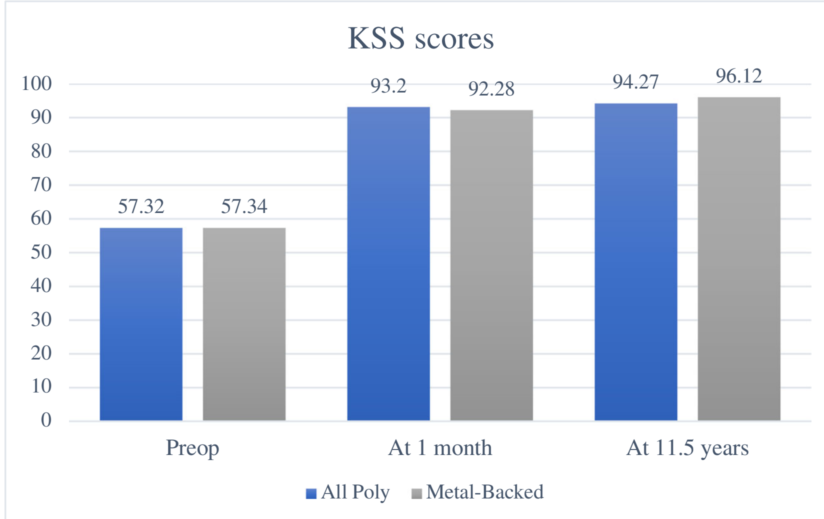

Fig. 2 KSS before surgery, at the 1-month follow-up and at the final follow-up. Comparison between AP and MB tibial component UKA. During the final evaluation, a slight but significantly better result for the MB group has emerged

Finally, ROM was analyzed. ROM before surgery was 99.67° (range 85–110°, DS 7.67) in patients with AP implant and 98.72 (range 80–115°, DS 11.27) in the MB group. At the post-operative evaluation, ROM had improved to 113.16° (range 85–120°, DS 10.92) in the AP implant and to 115.09° (range 100–130°, DS 7.54) in the MB group. The final score was 125.07 (range 110–130, DS 5.85) for the AP components and 125.61 (range 120–130°, DS 4.63) for the MB ones (Fig. 5).

Statistical comparisons of functional outcomes between the two groups were performed using Student's t test. Significance for all tests was set at a P-value <0.05. No statistical significant difference was detected for pre-operative and post-operative KSS and KOOS values. Results instead at the final 11.5-year follow-up were statistically different regarding KSS ($P = 0.048$), KOOS ($P = 0.000$), and pain ($P = 0.014$), showing in all cases better results for MB tibial components (Table 1).

Survival evaluated by the Kaplan-Meier analysis with failure as the end point, defined as conversion to TKA, was 97.6% for the AP tibial component arthroplasty and 89.5% for the MB one. Nine patients needed a revision surgery. Two of them belonged to the AP group and seven to the MB one. The 2 AP group failures were both related to poly wear, and underwent revision with primary TKA, respectively, one year and six years after surgery. Failures of the MB group are to be attributed to subsidence in four patients, with revision performed respectively one month, six months, 12 months, and 11 years after surgery. Three out of four of them had the highest BMI values of 30.3, 30.6, and 31.2 respectively. In two cases, failures were related to aseptic loosening, one detected three months after implantation and the other one eight years after surgery. The last revision was performed for infection, developed five years after surgery and treated with primary TKA through a two-stage technique.

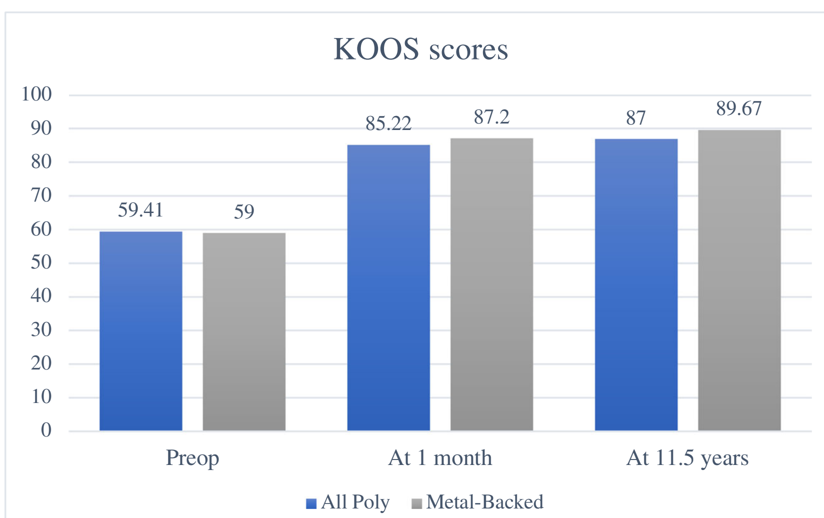

Fig. 3 KOOS before surgery, at the 1-month follow-up and at the final follow-up. Comparison between AP and MB tibial component UKA. During the final evaluation, a slight but significantly better result for the MB group has emerged

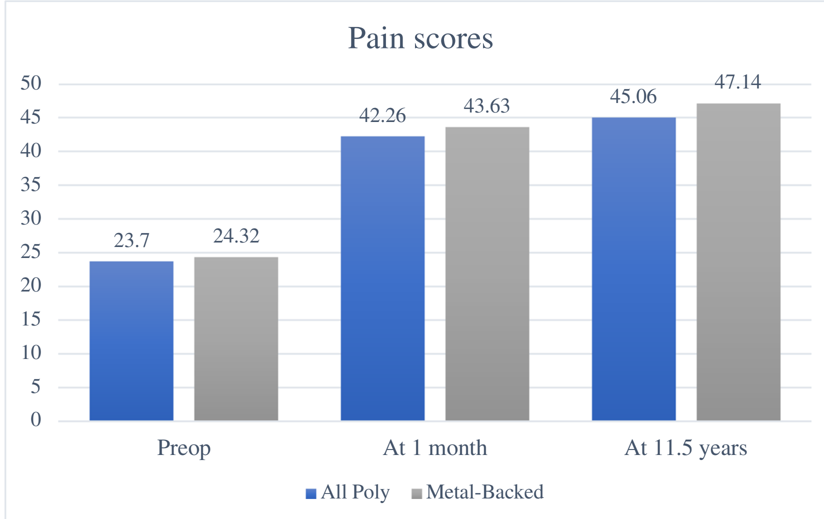

Fig. 4 Level of pain following UKA: comparison between AP and MB tibial component. At the final control, pain was significantly higher in the AP group

Discussion

AP tibial component TKA is an appealing and cost-effective alternative, associated with long-term results as equal to MB tibial component and even lower risk of revision [8, 15–18]. The early risk of revision for any cause was reported for AP monoblock component TKA as lower compared to MB ones even in young patients [19]. AP UKA implants instead do not find consensus in long-term result studies. Advantages of AP components are well known: less bone resection, less migration, and easier revisions. Indeed, revisions following an AP component are characterized by lower bone loss and simpler reconstruction procedures than after an MB implant [20].

MB components are generally preferred for a better load distribution [6], for their modularity, and for the possibility to limit revision to poly insert exchange. On the other hand, MB implants offer the risk of back side wear. Registries do not distinguish results between the two different implants. A review of patients who underwent surgery with same design model but different, AP and MB, tibial component, the same implant used by us, reported contrasting results compared to ours, with a survivorship rate of 56.55% at a seven year follow-up for AP tibial component and a rate of 93.8% for MB components [4]. Another study reports similar functional and radiological outcomes for both components at a two year follow-up, but an 11% rate of failure in the AP tibial component compared to 0% in the MB group [5]. This study also reported an increased adaptive bone remodeling on the medial tibial metaphysis not only still present after two years in the AP group, but also more progressive than in MB one, as a consequence of an impaired stress distribution. Scott reported a survivorship of AP tibial component UKA of 85.5% at a ten year follow-up and reason of failure was unexplained pain in 5% of cases, arthritis in the unaffected compartment in 4%, and tibial component loosening in 3.5% [21]. Biomechanical studies reported increased microdamage in composite bone models after implanting of AP tibial components

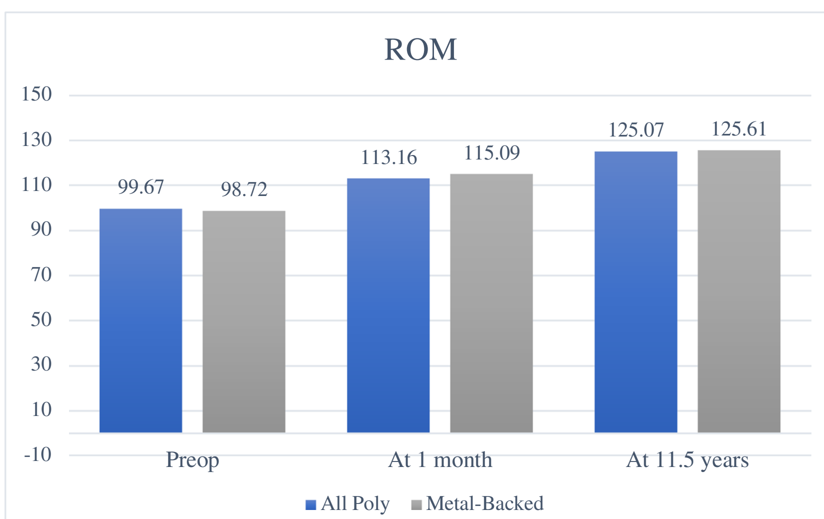

Fig. 5 Comparison of ROM between AP and MB tibial component UKA at 1 month and at final follow-up. At the final control, results were similar for both groups

Table 1 Pre-operative and immediately post-operative KSS and KOOS did not show significant differences as well as ROM did at any follow-up. At the final follow-up, KSS ($P = 0.048$), KOOS ($P = 0.000$), and pain ($P = 0.014$) scored significantly better in the group treated with metal-backed component. The first row assumes that the variances are the same in both treatments, and the second one does not make this assumption and represents the *P*-value

Statistical analysis

	t	dt	Sig. (2 code)	Difference of averages
KSS	1.921	113	0.057	1.84972
	2.002	112.975	0.048	1.84972
KOOS	3.787	113	0.000	5.06135
	4.045	109.365	0.000	5.06135
Pain	2.488	113	0.014	2.08225
	2.602	112.988	0.010	2.08225
ROM	0.530	113	0.597	0.53649
	0.548	112.485	0.585	0.53649

compared to MB ones [22], and finite element analysis demonstrated that elevated strain was dependent upon AP implant thickness [21]. Saenz reported a failure rate of 11% at three year follow-up with a poly thickness of 7.5 mm [3], where Simpson reported a 92% survivorship rate at 15 years using a 9-mm-thickness poly [22]. This could imply thickness playing a role in preserving poly from wear and bone from overload.

Van der List reported significant better overall functional results for patients undergoing MB tibial component UKA at five year follow-up when compared to those who had implanted an AP component. Revision rate was 7.7% for the AP group and 3.4% for the MB arthroplasty [23]. These conclusions are not widely shared. A clinical review conducted to compare MB versus AP tibial component UKA did not show a superiority of the MB tibial component in UKAs versus AP in terms of survivorship [24].

On the other hand, several favorable results are reported in literature for AP implants. Foster-Horvath related a 94.1% survivorship at five year follow-up and estimated 91.3% at 10 years [11] and Bruni referred an 87.6% survivorship rate in a series of 273 patients at ten year follow-up always for AP implants. The main cause of failure was aseptic loosening [12]. Lustig reported a 95.6% survivorship at a mean of five year follow-up and a 93.5% at ten years [25]. Patients were satisfied or very satisfied in 92.9% of cases. The main reason of failure was aseptic loosening of tibial component. Excellent results with a revision rate of 9% at a 15-year follow-up are reported in another study where the main reason for revision was always tibial component aseptic loosening [26].

Our study demonstrated better long-term clinical outcomes according to both KSS and KOOS scales for MB tibial component UKA compared to AP implants. Patients following MB component UKA also complained less about pain. Pre-operative and immediately post-operative KSS and KOOS, instead, did not show differences, as well as ROM did not at any follow-up.

Statistical analysis confirmed at the final follow-up, 11.5 years after surgery, slight but significantly better results (KSS $P = 0.048$, KOOS $P = 0.000$, and pain $P = 0.014$) in the group treated with metal-backed component.

Despite these better clinical results, revision rate for MB implants performed worse with a percentage of 10.5% compared to 2.4% for the AP group.

A larger number of failures resulted from the MB tibial component, and are mainly due to subsidence or to aseptic loosening. Within our series, failures for subsidence are related to the high BMI values, while failures for aseptic loosening are probably related to the flat MB surface. Aseptic loosening is commonly associated with poor fixation and, in another study where 2 different MB tibial component surfaces were compared, flat or with two pegs, 4% of cases of aseptic loosening were detected in the flat group compared to 0 in the two-peg group [27].

Limits of the study include the small number of cases and the short follow-up period. A larger number of cases and a longer follow-up would be necessary to deliver more reliable results.

Conclusion

Excellent KSS and KOOS in both AP and MB series confirm the reliability of UKA. This study demonstrates that MB tibial components performed statistically better compared to AP implants in terms of knee pain and function at final 11.5-year follow-up. Although there were no differences at the initial stage between the two groups, outcomes suggested a greater patient satisfaction over time for the MB group. Nevertheless, a total of nine patients experienced a failure and needed a subsequent revision surgery. Seven of them belonged to the MB group and only 2 to the AP group, which displayed better survivorship results.

Data availability Not applicable.

Declarations

This retrospective cohort study was conducted at S. Giovanni Calibita Hospital of Rome in accordance with the ethical standards of the institutional and national research committee, the 1964 Declaration of Helsinki, and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study. Patients were informed and gave consent regarding the use of their data for publication purposes.

Competing interests The authors declare no competing interests.

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