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Subchondral Bone Marrow Edema Had Greater Effect on Postoperative Pain After Medial Unicompartmental Knee Arthroplasty Than Total Knee Arthroplasty

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A B S T R A C T

Background: Although the relationship between pain and bone marrow edema (BME) in the osteoarthritic knee has been established, little is known about the effect of preoperative BME on postoperative outcomes after knee arthroplasty or if the influence of BME on postoperative outcomes differs between medial unicompartmental knee arthroplasty (UKA) and total knee arthroplasty (TKA). The purpose of this study was to compare pain, patient satisfaction, and revision rates between medial UKA and TKA patients with and without magnetic resonance imaging evidence of BME in the proximal tibia.
Methods: We identified 71 patients (72 knees) from our prospective outcomes database with magnetic resonance images taken before undergoing either medial UKA or TKA and recorded the absence or presence of tibial BME. We then compared preoperative and postoperative Knee Society pain scores, patient satisfaction, and revisions between groups of UKA and TKA patients with or without preoperative tibial BME.
Results: Pain scores for UKA patients with BME were worse both before and after surgery, whereas TKA patients with BME demonstrated greater postoperative improvements in pain scores when compared to TKA patients without BME. Similarly, significantly fewer UKA patients with BME were satisfied with their procedure than those without BME (8/11, 73% vs 17/17, 100%; $P = .05$), but BME did not affect patient satisfaction after TKA.
Conclusion: Preoperative BME did not influence TKA outcomes; however, pain scores for UKA patients with BME were worse both before and after surgery and fewer UKA patients with preoperative tibial BME were satisfied with their surgery.

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The severity of degenerative changes in osteoarthritic knees poorly correlates with patients' reports of pain and disability [1-4]. On the contrary, patients with bone marrow edema (BME) visualized on magnetic resonance imaging (MRI) have been reported to have significantly greater pain than those without BME [5]. In the long term, osteoarthritis patients with BME more often require total knee arthroplasty (TKA) than those without BME [6,7]. Although the relationship between pain and BME in the osteoarthritic knee has been established, little is known about the effect of preoperative BME on postoperative outcomes after knee arthroplasty. Furthermore, it remains unknown if the influence of BME on postoperative outcomes differs between medial unicompartmental knee arthroplasty (UKA) and TKA. As such, the purpose of this study was to compare pain, postoperative satisfaction, and complication rates between UKA and TKA patients with and without MRI evidence of BME in the proximal tibia. We hypothesized that BME would result in significantly worse preoperative pain for both UKA and TKA patients. We also hypothesized that BME would be associated with inferior postoperative pain and satisfaction for UKA, whereas BME would not have a direct influence on postoperative outcomes for TKA patients.

Methods

As part of our institutional review board–approved prospective outcomes registry, we routinely collect 1993 Knee Society scores and patient satisfaction after UKA and TKA procedures. Similar to previous reports, patient satisfaction was determined at each patient's most recent follow-up by asking patients if they were satisfied with their TKA and were given the options of answering “yes,” “no,” or “I'm not sure.” Satisfied patients were defined as only those who answered “yes,” with either the response of “no” or “I'm not sure” being indicative of a lack of satisfaction [2].

The patient population for this study was identified by cross-referencing UKA and TKA patients enrolled in our registry with billing records to identify patients who had an MRI before undergoing knee arthroplasty. Magnetic resonance images are not part of our standard preoperative routine for either UKA or TKA but were used in select cases to evaluate the condition of the anterior cruciate ligament (ACL)

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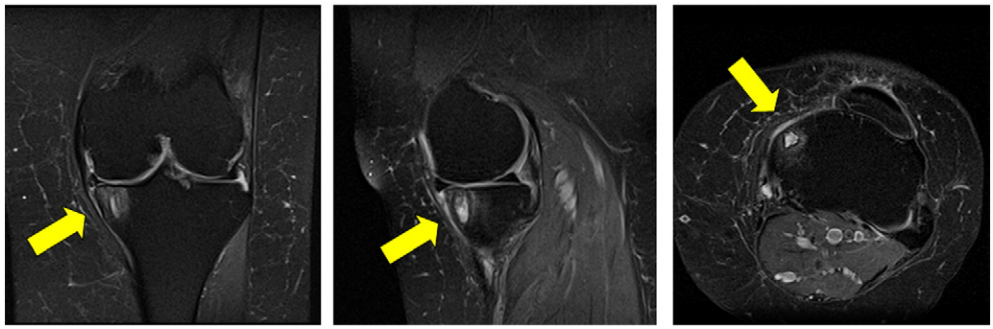

Fig. 1. Coronal, sagittal, and axial views of a representative patient with BME in the proximal medial tibia that would later report persistent pain after medial UKA.

and/or lateral compartment to help determine the most appropriate surgical option. Indications for medial UKA were consistent with the implant designers' indications and included an intact ACL and unaffected lateral compartment in addition to radiographic evidence of symptomatic medial compartment osteoarthritis and failed conservative treatments. Patients with medial and lateral compartment degenerative changes or a lax or absent ACL were treated with TKA. All surgeries were performed by a single, board-certified orthopedic surgeon using either a mobile bearing medial UKA implant design (Oxford Partial Knee Replacement; Zimmer Biomet, Warsaw, IN) or cruciate-retaining TKA design (Vanguard; Zimmer Biomet).

We identified 71 osteoarthritis patients (72 knees) treated between August 2006 and March 2014 with MRIs taken before undergoing either UKA or TKA who had complete preoperative clinical data with a minimum follow-up of 1 year. This was a sample of convenience as this group represented all medial UKA and TKA patients in our registry who had a preoperative MRI. Patients were not excluded on the basis of age, sex, body mass index, or presence of comorbidities. Tibial BME was assessed by a single evaluator using T2-weighted fat-suppressed images [7], and both the presence and location (medial or lateral tibia) were recorded provided BME was visible in at least 2 of 3 planes (axial, sagittal, and coronal) and in a minimum of 2 slices within each plane (Fig. 1).

Knee Society pain scores, which range from 0 to 50 with 50 representing no pain walking, navigating stairs, or when at rest, were compared between UKA and TKA patients using a $2 \times 2 \times 2$ two-way analysis of variance (procedure [UKA or TKA] × presence of BME [yes or no] × time [preoperative or postoperative]). The prevalence of satisfied patients and revisions were individually assessed for UKA and TKA patients based on the presence of preoperative tibial BME using Fisher exact tests. An α level of $P \leq .05$ was used for all analyses, and all analyses were performed using SPSS Statistics v22 (IBM, Armonk, NJ).

Results

Of the 72 knees, 28 underwent UKA, and 44 had TKA (Table 1). The mean time between MRI and either UKA or TKA was 1.2 years. Mean postoperative follow-up was significantly greater in the TKA group (TKA 2.7 ± 1.3 years, UKA 2.0 ± 1.0 years; $P = .01$); however, there were no differences in follow-up duration between TKA patients with or without BME or between UKA patients with or without BME (Table 1). Medial tibial BME was present for 11 of 28 UKAs (39.2%), and no patient in the medial UKA group had lateral tibial BME. In the TKA group, BME was noted in 20 of 44 (47.7%; 12 medial, 7 lateral, and 1 with both medial and lateral BME). A significant procedure × BME interaction was noted ($P = .005$; observed power, 0.81), indicating that the presence of preoperative BME had a different effect on UKAs than TKAs (Fig. 2; Table 2). In the UKA group, those with medial tibial BME had worse pain scores before surgery than those without BME (6.4 ± 7.4 vs 15.0 ± 12.4) and somewhat smaller improvements in pain scores postoperatively (22.7 ± 20.0 vs 26.2 ± 11.7). Conversely, there were no preoperative pain score differences between TKA patients with or without tibial BME (7.8 ± 11.6 vs 7.5 ± 12.4); however, those with BME before TKA demonstrated greater improvements in pain scores at their most recent follow-up (31.5 ± 14.5 vs 25.4 ± 22.2).

Similarly, the prevalence of satisfied patients differed by procedure and the presence of BME. All 17 (100%) of the UKA patients without preoperative BME were satisfied, whereas significantly fewer patients with preoperative medial tibial BME were satisfied with their operation (8/11, 73%; $P = .05$). In the TKA group, satisfaction did not statistically differ between those with (19/20, 95%) or without tibial BME (20/24, 83%; $P = .36$).

Although the effect of preoperative BME appeared to differ between UKA and TKA patients in regards to pain and satisfaction, the number of complications did not differ between those with and without BME. Two UKA patients required reoperation; however, only 1 reoperation might

Table 1
Patient Demographics for Medial UKA and TKA Patients With or Without MRI Evidence of Preoperative BME.

	Medial UKA			TKA		
	No BME	BME	*P*	No BME	BME	*P*
n	17	11		24	20	
Men/women	8/9	5/6	>.99	3/21	6/14	.26
Age (y)	63.4 ± 9.0	62.4 ± 9.8	.78	64.2 ± 10.9	64.3 ± 10.3	.97
Body mass index (kg/m^2)	34.0 ± 4.7	35.3 ± 6.3	.57	31.9 ± 6.5	34.2 ± 6.1	.24
Follow-up (y)	1.9 ± 1.0	2.2 ± 0.9	.46	2.7 ± 1.3	2.7 ± 1.2	.84

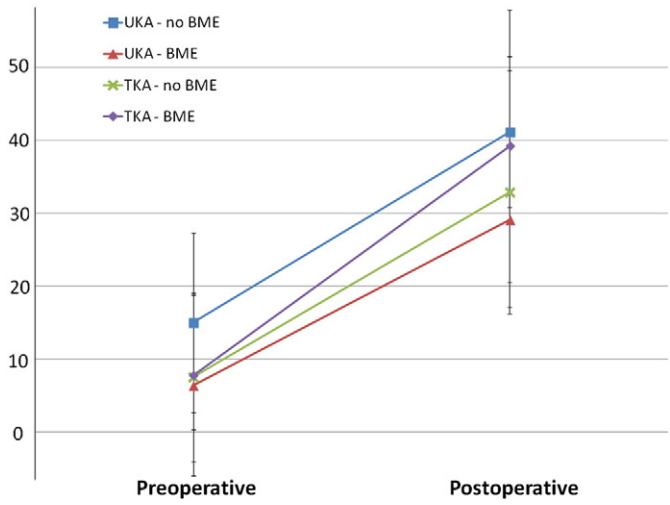

Fig. 2. Preoperative and postoperative Knee Society pain scores based on procedure (UKA vs TKA) and the absence or presence of BME. Pain scores for UKA patients with BME were worse both before and after surgery, whereas TKA patients with BME demonstrated greater postoperative improvements in pain scores when compared to TKA patients without BME.