



Role of Preoperative Bone Marrow Edema on Long-term Outcomes and Survival After Unicompartmental Knee Arthroplasty

Hong Yeol Yang, MD, PhD

Jong Keun Seon, MD, PhD

Dept. of Orthopaedic Surgery Chonnam National University Hwasun Hospital Chonnam National University College of Medicine

INTRODUCTION



Unicompartmental Knee Arthroplasty

*****UKA is an established treatment option for the management of medial compartment osteoarthritis

- Indications are expanding to include younger, active patients with development of surgical methods and techniques
- Long-term : Approximately <u>95%</u> survival rates at 10 years

Song EK et al. J Arthroplasty 2016 Koh IJ et al. J Arthroplasty 2015 Fu D et al. J Arthroplasty 2013 Berger RA et al. JBJS (Am) 2005 Berger RA et al. CORR 1999



BME on UKA Outcomes

Subchondral bone marrow edema (BME)

- MRI : <u>Decreased</u> SI on T1WI, <u>Increased</u> SI on T2WI
- BME is related to loss of cartilage and increased pain

Felson DT et al. Ann Intern Med 2003 Starr AM. Acta Radiol 2008

*****BME on outcomes of UKA : Controversial

- 3 studies regarding BME so far
 - 2 Studies by Jacob & Berend : Correlated
 - 1 study by <u>Jacob</u> : **Not** correlated

Jacob et al. J Arthroplasty 2016 Berend et al. J Arthroplasty 2017

Associations between BME and UKA outcomes are on debate



Clarify the association between preoperative BME with clinical outcomes and survival rates after UKA at long-term follow-up

*****Hypothesis

• Severe BME would correlate with worse outcomes and survival rates





METHODS

Patients

*****140 patients (150 knees): Jan 2003 ~ December 2014

Inclusion

- Patients who underwent UKA (Zimmer; Warsaw, IN, USA) with a minimum follow-up of 5 yrs
- Preoperative MRI scans taken within 6 months

Exclusion

- Traumatic arthritis, inflammatory arthritis
- Degenerative change or BME on lateral, patellofemoral compartment
- Previous open procedures around the operated knee
- Follow-up period of < 5 years





Finally, 150 knees were included (Average : 10 years)

MRI Assessment of BME

*****One of the most common methods

• 1st Method: MRI Osteoarthritis Knee Score (MOAKS) criteria

*****Inter-rater reliability: Cohen's kappa coefficient

Hunter et al. Osteoarthritis Cartilage 2011



Grade 1





BME Assessment (MOAKS classification)



Grade 1 Grade 2 Strade 1 Grade 2 Grad 2 Grade 2 Grade 2 Grade 2 Grade 3

- **0:** No BME lesions
- 1: < 33% of subregional volume
- 2: 33-66% of subregional volume
- **3:** >66% of subregional volume





BME Assessment (MOAKS classification)

*****BMEsum Scores Method with the MOAKS Classification

- **Group 1 (Absence of BME lesion):** BMEsum 0
- **Group 2 (Mild BME lesion):** BMEsum 1 to 2
- **Group 3 (Moderate BME lesion):** BMEsum 3 to 4
- **Group 4 (Severe BME lesion):** BMEsum 5 to 6

Kim MS et al. AJSM 2019



Clinical Assessment

*****Range of motion (ROM)

Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC)

- Pain
- Stiff
- Function
- Total

Forgotten Joint Score

*Complications



Radiographic Assessment

Mechanical femorotibial axis (mFTA, optimum, 2° varus)

Kennedy protocol

- Straight line was drawn from the center of the femoral head to the center of the ankle mortise
- The number of patients with a mechanical axis lying in the Kennedy's central zone (C zone) or Zone 2 were calculated.
- Kellgren-Lawrence grade





Survival and Risk Factor Assessment

*****Definition of failure mode – Reason for revision to TKA

Survival rates

- ✓ End point: <u>Conversion to TKA</u>
- ✓ Risk factors that affected survival
 - Sex
 - Age
 - BMI
 - Preoperative K-L grade, mFTA angle, severity of BME grade
 - Postoperative alignment regarding Kennedy's zone



Statistical Analysis

Non-normally distributed variables

- Kruskal-Wallis and Wilcoxon signed-rank tests
- Mann-Whitney U test with Bonferroni correction for post-hoc comparisons

*****Strength of correlation between the extent of BME

• Spearman's rank correlation analysis

Survival rates

• Kaplan-Meier survival analysis with log-rank test

Relationship between the risk factors and survival rates

Hazard ratios (HR) calculated from Cox proportional hazards model





RESULTS

Demographics

Female [<i>no</i> . (%)]	125 (83.3)
Age (yr)	64.0 ± 6.5
Operation side, left [no. (%)]	75 (50.0)
Mean follow-up† (yr)	10.0 (5.1 to 17.7)
BMI* (kg/m^2)	25.6 ± 3.1
Preoperative K-L scale	3.6 ± 0.5
Preoperative mFTA (varus)	6.1 ± 3.4
Postoperative 1-year mFTA (degree)	1.9 ± 3.0
Final Postoperative mFTA (degree)	4.0 ± 4.0
MA in the central zone or Kennedy zone 2	117 (78.0)



Location of BME

Exclusively shown in the MTP	11 (7.3)
Exclusively shown in the MFC	18 (18.7)
Simultaneously in the MFC and MTP	78 (52.0)





Reliability of Evaluating **BME**

	MOAKS classification			
	Grade 0	Grade1	Grade 2	Grade 3
Tibia	105 (44.9)	96 (41.0%)	23 (9.8%)	10 (4.3%)
Femur	90 (38.5)	104 (44.4%)	26 (11.1%)	14 (6.0%)

* IRR by Cohen's kappa coefficient : 0.85 / 0.89 (MOAKS)



	BMEsum Method with the MOAKS Classification			
	Group 1	Group 2 (BME 1-2)	Group 3 (PMErry 3-4)	Group 4
	(DIVIESUIII U)	$(\mathbf{DWIEsum 1-2})$	(DIVIESUIII 3-4)	(DIVIESUM 5-0)
No. (%)	33 (22.0)	63 (42.0)	43 (28.7)	11 (7.3)



ROM According to BME



No difference of postoperative ROM between 2 groups

WOMAC Score According to BME



Significant differences of postoperative pain between groups

Forgotten Joint Score According to BME



Significant differences of postoperative Forgotten joint scores between groups

WOMAC Pain According to BMEsum



Post hoc analysis showed significant differences between Groups <u>1 and 2, 1 and 3, 1 and 4, 2 and 4</u>

WOMAC Pain According to BMEsum



Moderate correlation (rho = 0.43) was demonstrated between BMEsum and postoperative WOMAC pain

Forgotten Joint Score According to BMEsum



Post hoc analysis showed significant differences between Group <u>1 and 2, 1 and 3, 1 and 4, 2 and 4</u>

Forgotten Joint Score According to BMEsum



Weak correlation (rho = -0.34) was demonstrated between BMEsum and postoperative Forgotten joint score

Survival Analysis Curve



• No significant differences in survival rates according to BME



Risk Factor Analysis



BMI (hazard ratio, [HR] = 1.42, p = 0.021), Postop malalignment (HR = 10.53, p = 0.019) were related to implant failure.

CONCLUSIONS



Takeaway

*****Greater BME was associated with adverse UKA outcomes, specifically pain, at long-term follow-up. However, UKA led to an excellent survival rate at 10 years, <u>regardless of BME severity</u>

Sody mass index and postoperative malalignment seem to be significant risk factors associated with failure

Further, preoperative BME should not be considered as a contraindication, but rather a potential indication for UKA







Thank You

