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Analysis of Risk Factors for Medial Meniscus Extrusion Focusing on the Meniscal Tear Type

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Introduction

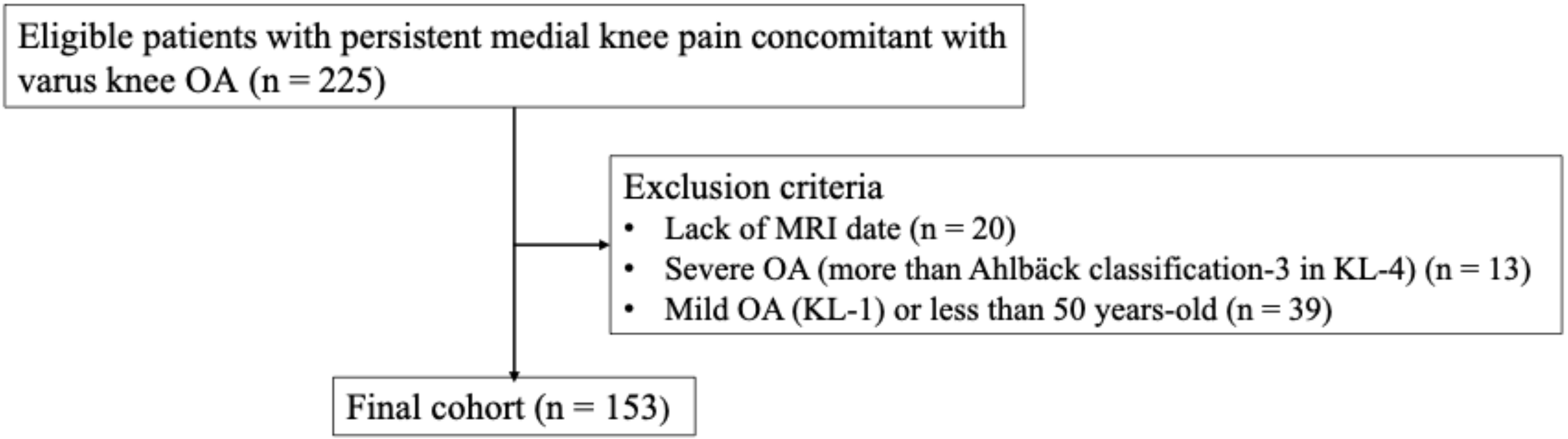
- ✓ Medial meniscus extrusion (MME) has been reported to be a strong predictor for the development and progression of varus knee osteoarthritis (OA)

- ✓ Medial meniscal posterior root tear (MMPRT) is a significant cause of MME

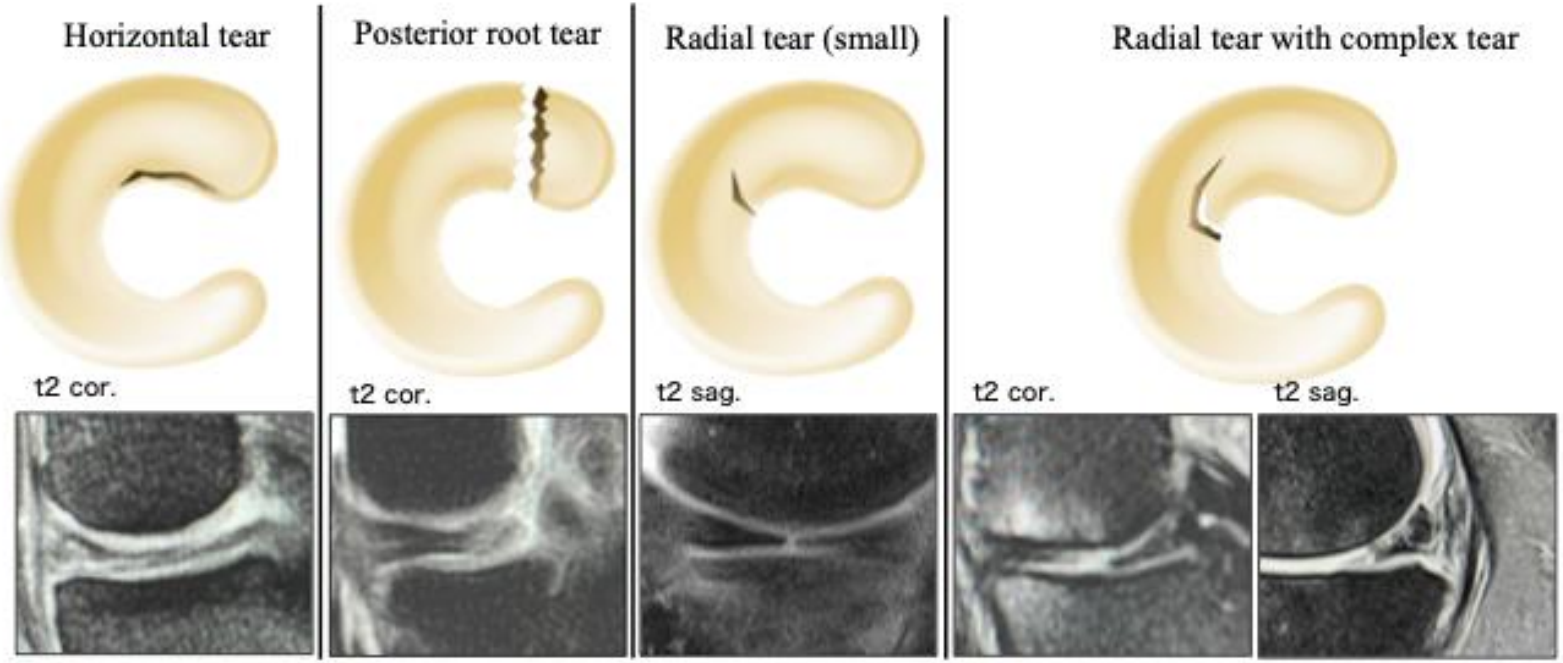
Purpose

To elucidate the relationship between medial meniscus extrusion (MME) and meniscal tear type in osteoarthritic knees. It was hypothesized that the type and extent of meniscal tears in osteoarthritic knees would be relevant factors in triggering MME.

Inclusion criteria

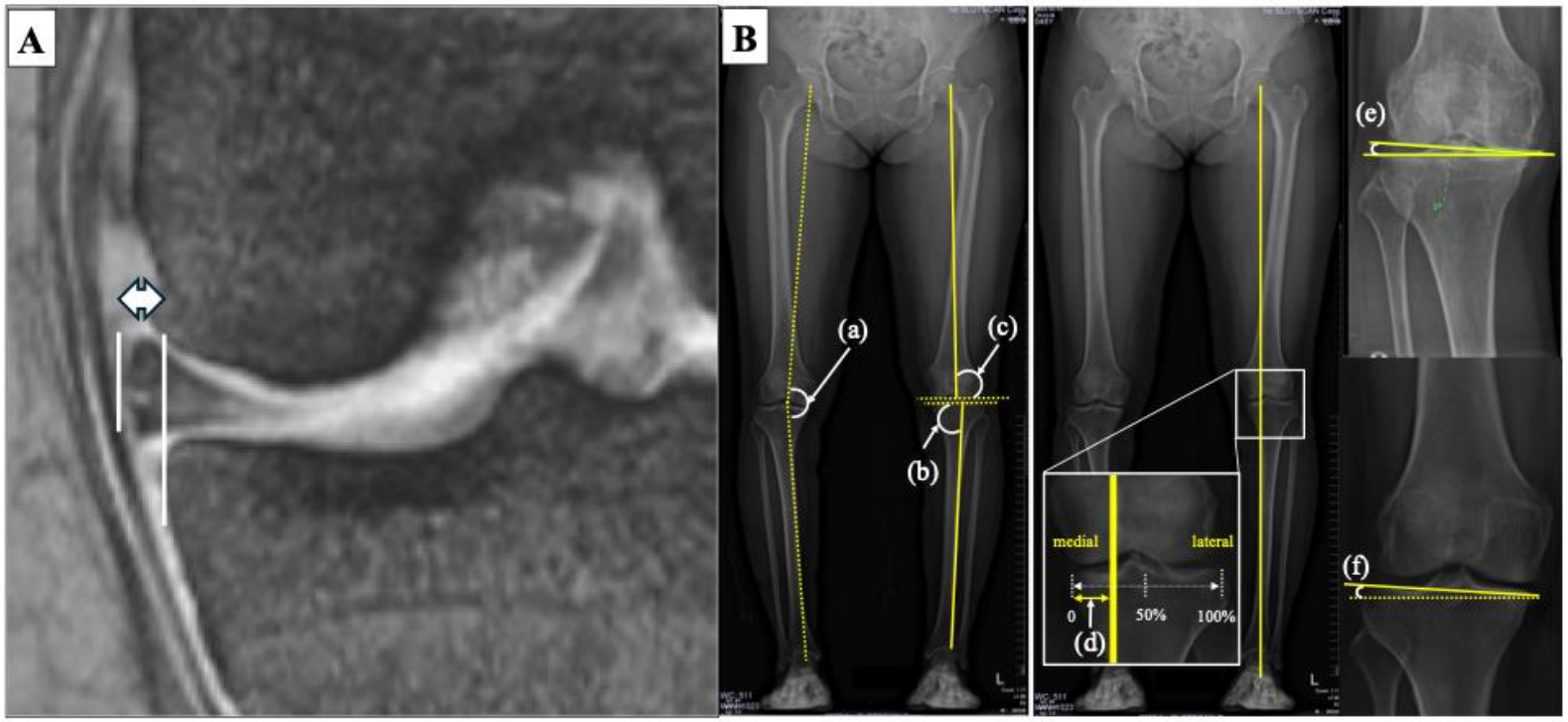


MRI and radiological evaluation



Meniscal tears were classified into four types: horizontal tear, MMPRT, small radial tear and radial tear combined with complex tear as detected on MRI. MRI images were classified based on specific signal patterns to identify each of the different types of meniscal tears. A posterior root tear was diagnosed when a high signal intensity line or discontinuity of the meniscal image was observed at the posterior meniscal attachment on a coronal image. A horizontal tear was indicated by a high signal intensity line extending horizontally to the articular surface. A small radial tear was identified by a high signal intensity line transecting the meniscal body on a single slice image. Finally, a radial tear was classified as complex if high signal lines were detected on both the sagittal and coronal planes of the MRI [8]

MRI and radiological evaluation

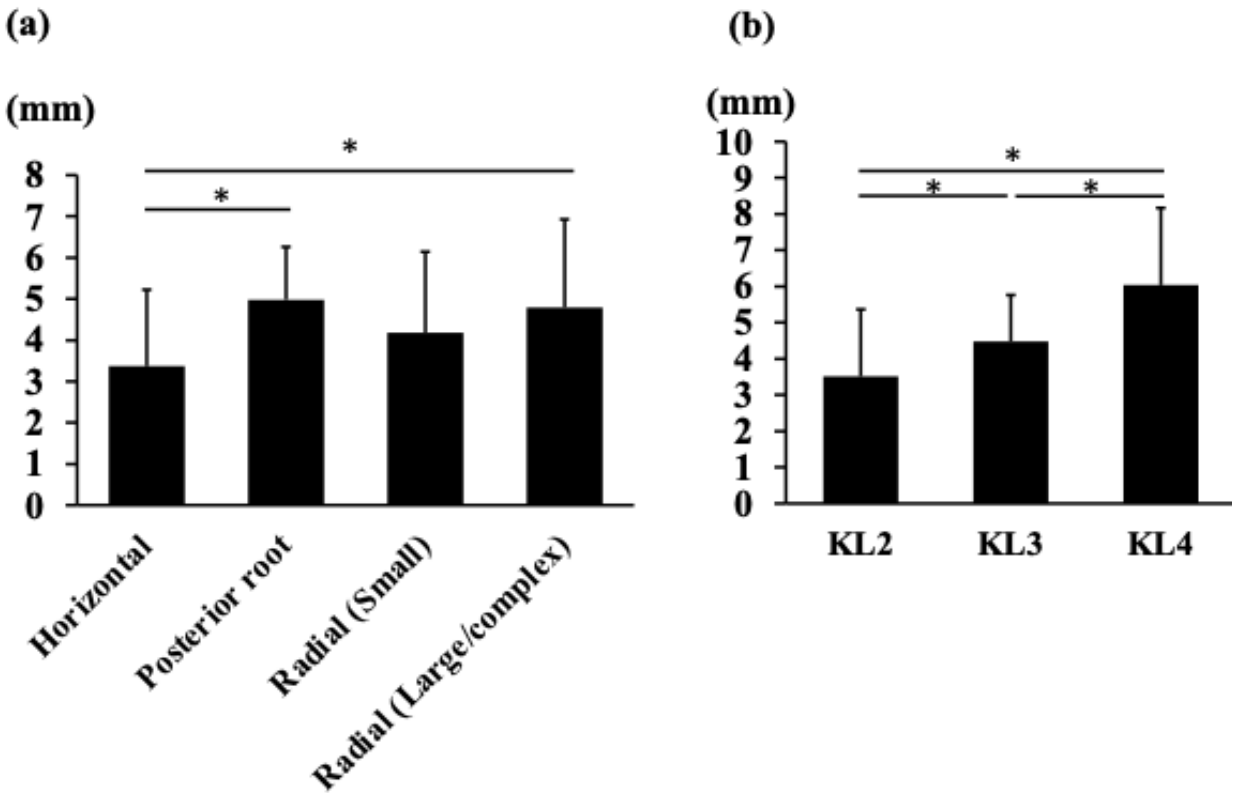


(A) Measurement of MME on the coronal MRI image. The measurement of meniscal extrusion was conducted by determining the distance from the edge of the extruded meniscus to a parallel line drawn perpendicularly from the medial tibial margin, excluding the bone spur. (B) Measurement of radiological parameters on a long-leg radiograph. (a) Hip-knee-ankle angle (HKA). (b) Mechanical medial proximal tibial angle (mMPTA). (c) Mechanical lateral distal femoral angle (mLDFA). (d) Percentage of mechanical axis (%MA). (e) Joint line convergence angle (JLCA). (f) Joint line obliquity angle (JLO).

Patients demographic date

Variable	Value
Total patients, n	153
Age (y)	58.0 ± 7.5
Sex, male / female	76 / 77
Laterality, right / left	73 / 80
Δ MME (mm)	4.4 ± 2.1
MME < 3mm / MME > 3mm	35 / 118
Horizontal / Posterior root /Radial (Small) / Radial (Large/ complex)	42 / 25 / 20 / 66
KL classification 2/3/4	53 / 70 / 29
%MA (%)	26.6 ± 12.0
HKAA (°)	5.3 ± 3.4
MPTA (°)	84.9 ± 2.5
mLDFA (°)	87.5 ± 1.8
JLO (°)	1.37 ± 2.96
JLCA (°)	2.90 ± 1.95

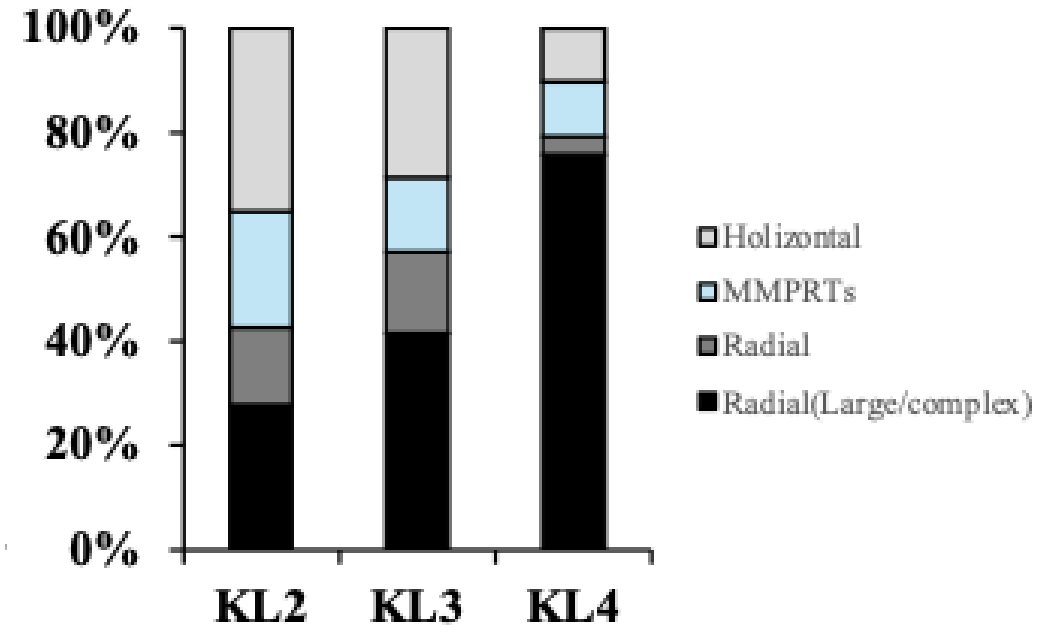
The average ΔMME



4.98 ± 1.28 mm for MMPRTs, 4.18 ± 1.95 mm for small radial tears, and 5.0 ± 2.19 for large/complex radial tears. The ΔMME for MMPRTs and large/complex radial tears was significantly greater than that of horizontal tears .

As for KL classification, ΔMME averaged 3.51 ± 1.46 mm for KL-2 knees, 4.48 ± 2.00 mm for KL-3 knees, and 6.03 ± 2.28 mm for KL-4 knees. When compared between cohorts of different KL grades, ΔMME in KL-3 knees was significantly greater than in KL-2 knees, and ΔMME in KL-4 knees was significantly greater than in KL-3 knees

The ratio of meniscal tear types in KL classification



For KL-2, the distribution of tear types was as follows: horizontal tears constituted 35.2%, MMPRTs accounted for 22.2%, small radial tears represented 14.8%, and large/complex radial tears comprised 27.8%. For KL-3, horizontal tears were 28.6%, MMPRTs were 14.3%, small radial tears were 15.7%, and large/complex radial tears were 41.4%. For the ratio of KL-4, horizontal tears and MMPRTs were each 10.3%, while small radial tears accounted for 3.5%, and large/complex radial tears made up 75.9%.

Correlation of ΔMME with patient characteristics and radiological parameters.

Δ MME (mm)		
Variables	Correlation coeffect	*P* Value
Age	0.311	**0.0001**
BMI	0.001	0.91
%MA (%)	-0.277	**0.0006**
HKAA (°)	0.324	**<.0001**
MPTA (°)	-0.134	0.16
mLDFA (°)	0.156	0.06
JLO (°)	-0.083	0.31
JLCA (°)	0.187	**0.02**

Multivariate Logistic Regression Analysis of Risk Factors for MME

	MME (> 3mm)		
Variables	Odds ratio	95% Confidence Interval	*P* Value
Age	1.087	1.022 to 1.159	**0.006**
HKAA (°)	1.099	0.952 to 1.271	0.202
KL classification	1.235	0.499 to 3.175	0.652
Posterior root tear	10.7	1.984 to 201.3	**0.003**
Radial tear (Large/complex)	3.03	1.226 to 7.696	**0.013**

Conclusion

The present study showed that presence of a radial tear aggravated to a complex tear configuration was significantly correlated with MME, similarly to MMPRT. This finding indicates that radial tears, when extending in another direction, may elevate the risk of MME, potentially leading to further progression of knee OA.