Determining Optimal Residual Meniscus Width and Risk Factors for Postoperative Decrease in Pediatric Discoid Lateral Meniscus

KyeongBaek Kim, Seong Man Jeon, Joon Ho Wang

Introduction & Purpose

- Currently, the preferred treatment for patients with symptomatic DLM is meniscal reshaping through arthroscopic partial meniscectomy with or without repair, rather than total or subtotal meniscectomy
- Reshaping surgery aims to is to restore a normal meniscal shape while leaving sufficient functional tissue intact. Previous studies have suggested that the width of the remaining peripheral rim should be approximately 6–8 mm

Ahn JH et al. Arthroscopy, 2008

- Recent studies recommended preserving a width of approximately 10 mm due to meniscal deformation, decreased width, and extrusion after reshaping surgery are associated with the progression of osteoarthritis of the knee.

Nishino K et al. AJSM, 2021

- **This study aimed to determine the ideal remaining discoid meniscal width after reshaping surgery and investigate the preoperative risk factors for changes in the meniscal width.**

Methods

1 Patients

We retrospectively analyzed 29 pediatric patients (39 knees) who underwent arthroscopic reshaping surgery for symptomatic discoid lateral meniscus (DLM) between 2016 and 2022.

2 MRI assessments

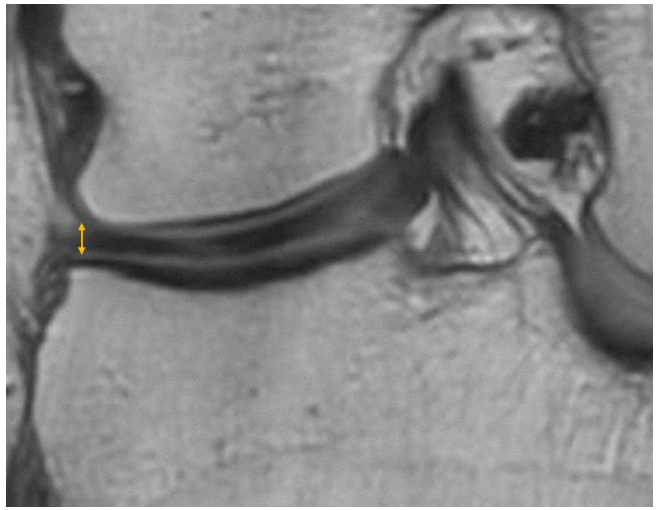
Magnetic resonance imaging (MRI) assessments were performed immediately after surgery and during at least one of the postoperative follow-ups, at 6 months or 1–2 years.

3 Analysis

Changes in the meniscal width were measured and analyzed and logistic regression was used to identify the preoperative risk factors for decreased meniscal width. Using receiver operating characteristic (ROC) curve analysis, we identified the cutoff values for preoperative factors and the remaining meniscal width after surgery that were associated with a residual meniscal width of less than 5 mm on the final MRI assessment.

Methods

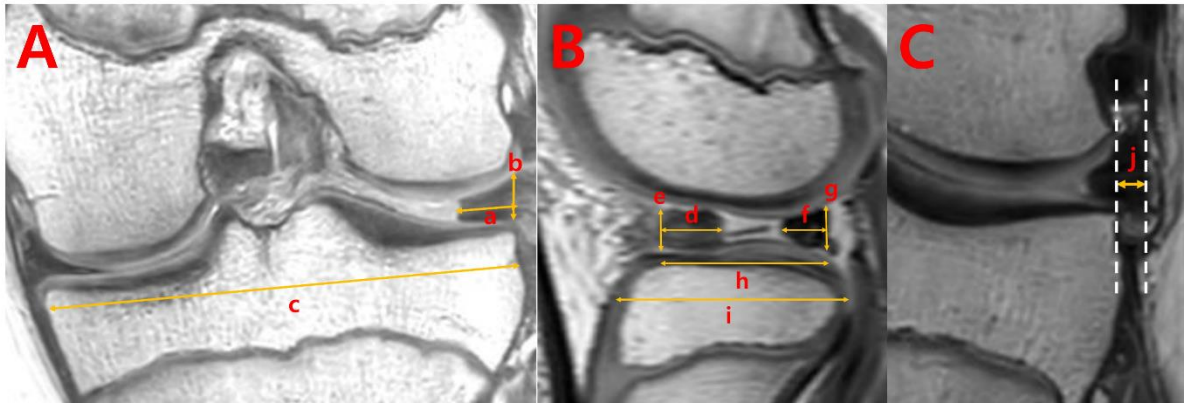
- Preoperative magnetic resonance imaging scan of the right knee



The yellow line indicates measurement of the height of the discoid lateral meniscus.

Methods

- Measurement of residual meniscal parameters on magnetic resonance imaging scans



Measurement of residual meniscal parameters on magnetic resonance imaging scans. (A) Coronal plane where the midbody appears to be the smallest, (a) Width and (b) height of the midbody, and (c) mediolateral length of the tibial plateau. (B) Sagittal plane with the maximal meniscal diameter. (d) Width and (e) height of the anterior horn; (f) width and (g) height of the posterior horn; (h) meniscal diameter; (i) anteroposterior length of the tibial plateau. (C) (j) Extrusion of the midbody. Standardized meniscal width of the midbody = a/c × 100 (%), anterior horn = d/i × 100 (%), posterior horn = f/i × 100 (%). Relative percentage of extrusion = j/a × 100 (%). Standardized meniscal diameter = h/i × 100 (%).

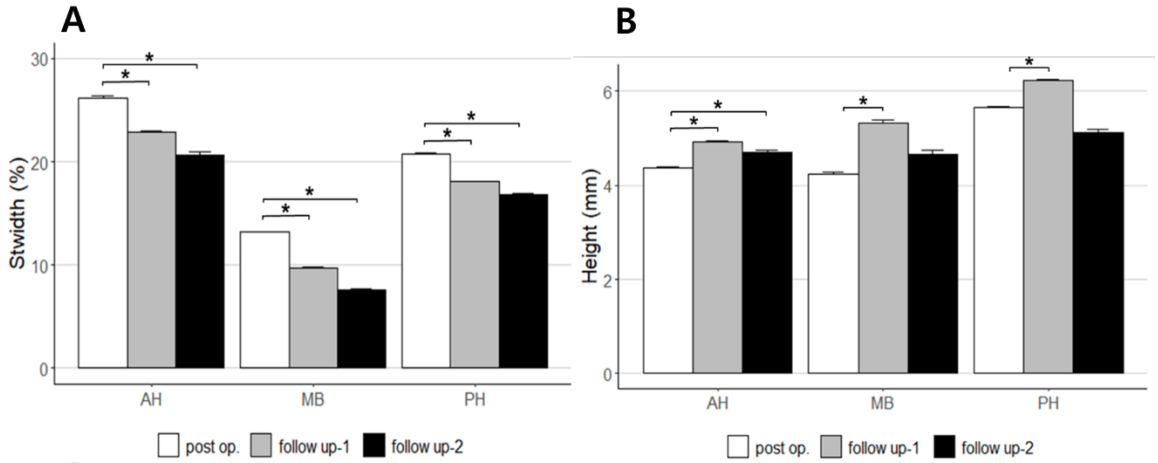
Results

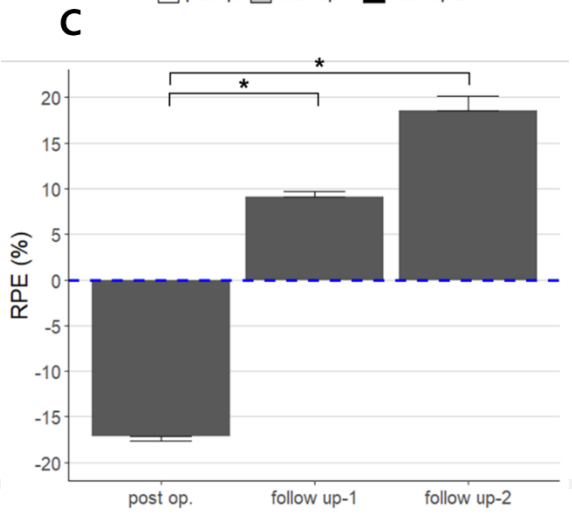
- Measurement of Meniscus Morphology Changes on

	post op.	f/u-1(n=32)	P Value	f/u-2(n=16)	P Value	△postop. – f/u-1(%)	△postop. – f/u-2(%)
Midbody							
Width, mm	8.5 (2.0)	6.5 (2.2)	<0.0001	4.9 (1.7)	<0.0001	25.7 (22.1)	38.1(18.0)
Height, mm	4.2 (1.3)	5.3 (1.6)	<0.0001	4.7 (1.4)	0.0564	-27.2 (27.2)	-12.1(21.2)
St Width, %	13.2 (2.5)	9.7 (3.1)	<0.0001	7.6 (2.2)	<0.0001	3.8 (3.3)	5.2(2.7)
Extrusion, mm	-1.4 (1.5)	0.5 (1.2)	<0.0001	0.7 (0.9)	0.0011	NA	NA
RPE, %	-17.1 (21.9)	9.1 (20.6)	<0.0001	18.6 (25.3)	0.0011	27.14 (20.28)	30.61(26.09)
Anterior horn							
Width, mm	9.8 (2.2)	9.0 (1.9)	0.0325	8.0 (1.8)	0.0042	7.4 (15.8)	12.9 (14.9)
Height, mm	4.4 (0.9)	4.9 (1.2)	0.013	4.7 (0.8)	0.0534	-14.5 (26.5)	-13.4 (27.1)
St Width, %	26.2 (5.9)	22.9 (5.3)	0.0034	20.7 (3.9)	0.0004	3.0 (5.3)	5.7 (4.9)
Posterior horn							
Width,mm	7.7 (1.4)	7.1 (1.2)	0.0092	6.4 (1.0)	0.0088	6.4 (15.1)	12.7 (20.0)
Height, mm	5.7 (1.0)	6.2 (0.8)	<0.0001	5.1 (1.0)	0.0233	-9.9 (11.6)	7.9 (12.3)
St Width, %	20.7 (4.1)	18.0 (3.1)	0.008	16.8 (2.3)	0.007	2.1 (3.2)	5.1 (4.8)
St Meniscal diameter, %	73.5 (10.7)	79.1 (8.9)	0.001	80.0 (7.2)	0.0054	-5.7 (8.9)	-7.9 (9.4)

Results

- Morphological changes of the residual meniscus





(A) Standardized width of the anterior horn, midbody, and posterior horn. (B) Height of the anterior horn, midbody, and posterior horn. (C) RPE of the midbody. AH, anterior horn; MB, midbody; PH, posterior horn. * $P < 0.05$

Results

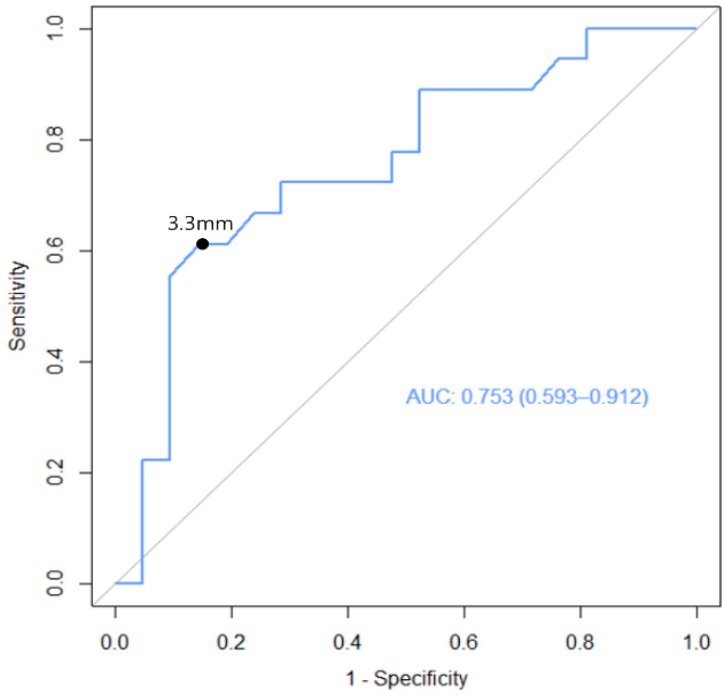
- Logistic Regression Analysis of Preoperative Factors Associated with Decreased Meniscal Width

	Univariable analysis		Multivariable analysis	
	β [95% CI]	P-value	β [95% CI]	P-value
Age	-1.75 [-3.85–0.35]	0.112		
Sex (female)	-3.25 [-16.55–10.06]	0.635		
BMI	0.49 [-1.04–2.02]	0.534		
Complete DLM	36.88 [14.85-58.91]	0.002	26.0 [2.70–49.30]	0.036
HKA angle	0.32 [-1.84–2.47]	0.774		
Meniscal height	-6.86 [-11.87–(-1.83)]	0.011	-4.51 [-9.54–0.53]	0.048

[a] Factors included in the multivariate model were those with P < 0.1 in the univariate analysis. CI, confidence interval; BMI, body mass index; DLM, discoid lateral meniscus.

Results

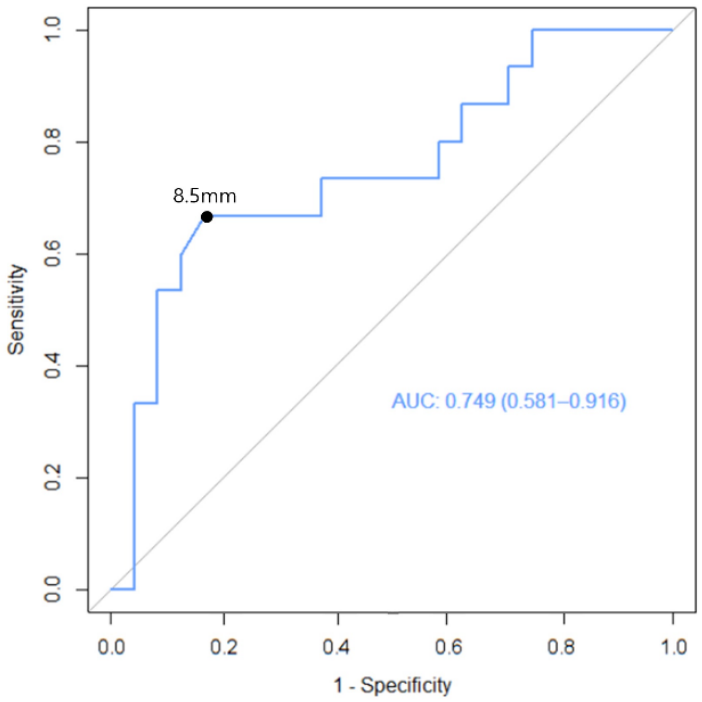
- ROC curve of the of the preoperative meniscal height



Receiver operating characteristic (ROC) curve of the preoperative meniscal height as a related factor for the midbody meniscal width being less than 5 mm at the time of the last follow-up. The area under the curve is 75.3%. Based on the ROC curve analysis, a cutoff preoperative meniscal height of 3.3 mm shows a sensitivity of 61% and a specificity of 86%

Results

- ROC curve of the of the the remaining meniscal width



Receiver operating characteristic (ROC) curve of the remaining meniscal width after surgery as a related factor for the midbody meniscal width being less than 5 mm at the time of the last follow-up. The area under the curve is 74.9%. Based on the ROC curve analysis, a cutoff meniscal width of 8.5 mm shows a sensitivity of 67% and a specificity of 83%

Conclusion

- ✓ The width of the discoid lateral meniscus gradually decreases after reshaping surgery.
- ✓ The results of this study suggest that **the ideal remaining width of the meniscus after surgery should be at least 8.5 mm to prevent the meniscal width from decreasing to less than 5 mm.**
- ✓ **Additionally, when preoperative risk factors are present, such as a complete DLM or a meniscal height of less than 3.3 mm, it is necessary to consider preserving a larger meniscal width.**