The Utility of Stability and Tear Location in a Classification System for Discoid Meniscus Surgical Planning

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Introduction

- Discoid Meniscus (DM) is a congenital variant that typically affects the lateral meniscus.
- These abnormal variants contain disorganized collagen fibers and can prevent normal anatomic contact between the knee's articular surfaces, causing mechanical damage[1].
- Lateral discoid menisci have been reported to occur at a rate of 3-5% in the general population, increasing to 15% of all knees in Asian populations[2,3].
- The most commonly used classification system for discoid meniscus, proposed by Watanabe et al., groups discoid menisci based off of stability and arthroscopic appearance[4].
- Despite the presence of multiple classification systems for DM, no system has demonstrated utility in treatment planning[5].

Methods

- We searched the orthopedic database at our institution for patients who underwent surgical treatment for lateral discoid meniscus between 1991 and 2017.
- Clinical records were reviewed to determine the type of DM surgery performed (surgery with or without repair) as well as DM morphology, stability, tear presence, tear location, and tear type.
- Stability was classified based off of operative records describing discoid meniscus stability with arthroscopic probing.
- Univariate associations between DM characteristics and surgery type were calculated and a logistic regression model of surgery type was created.
- The categories "tear presence" and "tear location" were combined to create a new variable, "tear," consisting of 3 categories (no tear, central tear, peripheral tear), for use in logistic regression models of surgery type.
- Based off of univariate and logistic regression models, we propose a new classification system for discoid meniscus.

Tables and Figures

Table 1: Discoid Meniscus Characteristics and Univariate Associations with Surgical Treatment Type

Characteristic	Category	Total (n=434)	Surgery With Repair, n=204, n (%) or Med (P25, P75)	Surgery Without Repair, n=230, n (%) or Med (P25, P75)	P-value*
Stability	Stable	225 (54)	22 (10)	203 (90)	<0.001
	Unstable	192 (46)	179 (93)	13 (7)	
Morphology	Incomplete	255 (68)	120 (47)	135 (53)	0.74
	Complete	120 (32)	54 (45)	66 (55)	
Tear Presence	No tear	149 (34)	63 (42)	86 (58)	0.156
	Tear	283 (66)	141 (50)	142 (50)	
Tear Location	Central only	131 (54)	30 (23)	101 (77)	<0.001
	Includes Periphery	113 (46)	85 (75)	29 (25)	
Tear Pattern	Radial	25 (13)	15 (60)	10 (40)	0.387
	Horizontal Cleavage	61 (33)	38 (62)	23 (38)	
	Bucket Handle	20 (11)	10 (50)	10 (50)	
	Oblique	3 (2)	1 (33)	2 (67)	
	Complex	57 (31)	26 (46)	31 (54)	
	Vertical	1 (1)	1 (100)	0 (0)	
	Longitudinal	8 (4)	3 (38)	5 (62)	
	Degenerative	11 (6)	4 (36)	7 (64)	
Watanabe Class	1	107 (25)	43 (40)	64 (60)	<0.001
	2	231 (54)	101 (44)	130 (56)	
	3	43 (10)	37 (86)	6 (14)	
	4	49 (11)	21 (43)	28 (57)	
Gender	Male	191 (44)	88 (46)	103 (54)	0.772
	Female	243 (56)	116 (48)	127 (52)	
Age at surgery	Years	12.4 (9.3, 14.8)	12.6 (9.5, 15.2)	12.2 (9.0, 14.6)	0.217
	Range	0.1-20.6	2.8-19.9	0.1-20.6	

**based on Fisher's exact or Wilcoxon rank sum tests

Table 2: Logistic Regression Models of showing the incremental predictive value of stability, tear location, and their interaction over the Watanabe classification

Model	Variable	P-Value	Log Likelihood (-2)	P-Value Comparing Models
(1) Watanabe Only	Watanabe	<0.001	542.9	
(2) Watanabe + Stability	Watanabe	0.143	232.5	<0.001 (1 vs 2)
	Stability	<0.001		
(3) Stability	Stability	<0.001	238.7	0.101 (2 vs 3)
(4) Stability + Tear Location	Stability	<0.001	223.2	<0.001 (3 vs 4)
	Tear Location	<0.001		
(5) Interaction Model	Interaction	<0.001	201.7	<0.001 (4 vs 5)

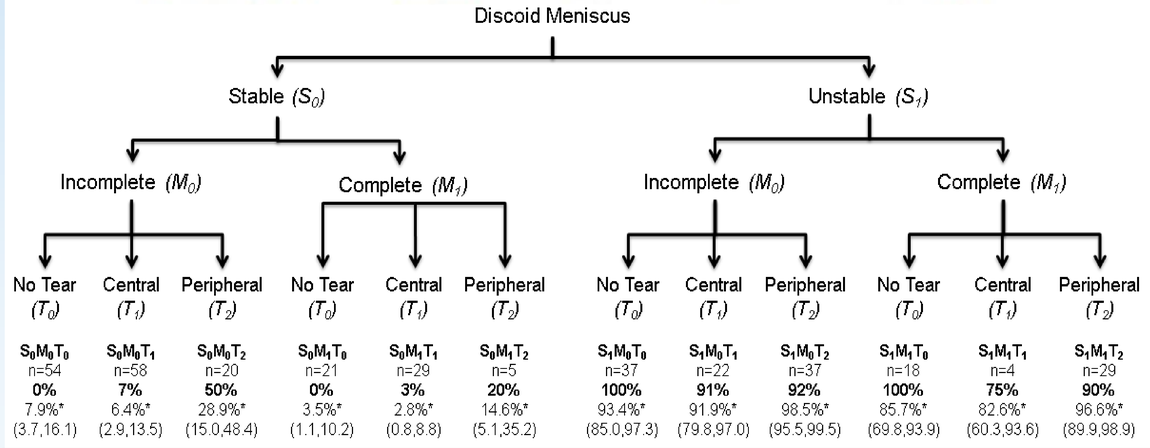

Figure 1: Discoid meniscus classification system based off of stability, morphology, and tear. Diagram shows all potential classifications with the total number of patients per classification and the percentage of patients receiving surgery with repair per classification (bolded). (*) Indicates the predicted probability estimates (with 95% Confidence Interval) of surgery with repair based on our logistic model using stability, morphology, and tear. Instability was the main driving force behind receiving surgery with repair. Of note, 100 (23%) of the 4343 patients had incomplete data.

Results

- There were 434 knees with discoid lateral menisci that received surgical treatment at our institution between 1991 and 2017.
- In univariate analysis, unstable menisci (93%, p<0.001) and menisci with a tear including the periphery (75%, p<0.001) were more likely to receive surgery with repair **(Table 1**).
- By itself, instability demonstrated 89% sensitivity and 94% specificity in predicting surgery with repair.
- The main effects logistic regression model including stability and tear showed that that the odds of unstable lateral discoid menisci receiving surgery with repair was **133.1 times higher** than stable menisci (p<0.001) while lateral discoid menisci that had a tear including the periphery had **6.54 times higher** odds of receiving repair than those that had a tear in the central portion only (p<0.001).

Discussion

- Lateral discoid menisci stability and tear location were associated with surgical treatment type in both univariate analysis and logistic regression models **(Table 2)**.
- Based on our results and clinical relevance, we propose a new classification system for DM with utility in surgical treatment planning. Menisci are classified by stability (Stable (S0), Unstable (S1)), morphology (Incomplete (M0), Complete (M1)), and Tear (No tear (T0), Central tear (T1), or Peripheral tear (T2)) **(Figure 1)**.
- Our proposed new classification system, consisting of stability, morphology, and tear, is easily remembered and demonstrates utility in predicting surgery with repair for discoid menisci

References

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