

Meniscal Ramp Lesion, a Contact Characteristic Analysis in Cadaver.

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INTRODUCTION: Ramp lesion is defined as a longitudinal tear at the meniscocapsular junction or meniscotibial ligament of posterior horn medial meniscus. The meniscal ramp lesion may contribute to residual anteroposterior instability and affect knee biomechanics. Similarly, the meniscal root lesion, injury extended to the periphery have been believed to result in the reduction of meniscal hoop stress. The purpose of the study was to analyze the contact characteristic change of the tibiofemoral joint that occurs with an unstable ramp lesion of the medial meniscus

METHODS: 12 Cadaveric knees (6 matched pairs) were tested under 600 N of axial load with a custom testing jig that allowed positioning of the knee in 0°, 45°, and 90° of flexion without otherwise constraining the knee. Knees were randomly assigned to ramp lesion (n=6) and posterior root lesion (n=6). Four testing conditions were tested: (1) intact, (2) ramp lesion, (3) posterior root tear of the medial meniscus, and (4) combined ramp lesion and posterior root tear of the medial meniscus. Tibiofemoral force transmission, joint contact area, contact pressure, and peak contact pressure were measured with a flexible pressure sensor I-Scan System. Biomechanical testing data were compared for statistically significant differences.

RESULTS: Testing conditions significantly affected the medial tibiofemoral joint's force transmission and contact pressure (P = .04 and P = .036). Contact pressure in the isolated ramp lesion (1.71 ± 0.68 MPa, P = .877) and isolated posterior root tear (2.12 ± 0.92 MPa, P = .069) were non-significantly increased compare to the intact condition (1.77 ± 0.91 MPa). In the combined ramp and posterior root lesion, contact pressure (2.13 ± 0.67 MPa, P = .011) was significantly higher than in the intact condition. The knee flexion position significantly affected the medial tibiofemoral joint's contact area and contact pressure (P < .001 and P < .001).

DISCUSSION AND CONCLUSION: This study demonstrated no significant changes in force transmission, contact area, and contact pressure in isolated ramp lesions. However, ramp lesion combined with posterior root tear could significantly increase the contact characteristic change in the medial tibiofemoral joint than isolated posterior root tear.

Figure 2. Boxplots demonstrate contact area, contact pressure and peak contact pressure of the medial tibiofemoral joint in all testing conditions

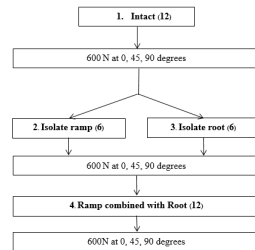
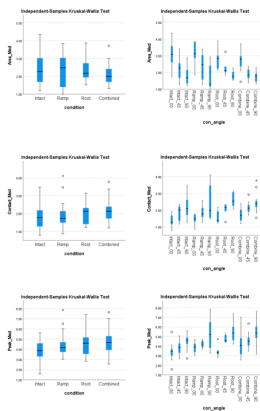


Table 1. Summary table of the contact characteristics of the medial tibiofemoral joint in all testing conditions *Values were significantly different from the intact condition with 0 degree flexion. †Values were significantly different from those average seen under comparable flexion degree with the intact condition. ‡P < .05.

Testing Condition	Knee flexion	Force (N)	Contact area (cm ²)	Contact Pressure (MPa)	Peak contact pressure (MPa)
Intact	0 degree	4079 ± 725	3.08 ± 1.06	1.29 ± 0.53	3.43 ± 0.73
	45 degrees	3787 ± 1096	2.26 ± 0.99*	2.01 ± 0.89*	3.86 ± 1.09
	90 degrees	3867 ± 1116	1.69 ± 0.89*	2.09 ± 1.11*	4.60 ± 0.90*
	Average	3917 ± 920	2.27 ± 1.15	1.78 ± 0.91	3.86 ± 1.12
Isolated ramp lesion	0 degree	4245 ± 2110	3.34 ± 1.20	1.48 ± 0.53	3.90 ± 1.05
	45 degrees	4323 ± 1790	2.48 ± 1.62	1.77 ± 0.72	4.21 ± 0.77
	90 degrees	4057 ± 1553	1.30 ± 1.41*	1.95 ± 2.89*	5.22 ± 3.16*
	Average	4196 ± 1483	2.48 ± 1.75	1.72 ± 0.68	4.15 ± 0.98
Isolated posterior root lesion	0 degree	3938 ± 1329	2.84 ± 1.00	1.58 ± 0.71	3.34 ± 0.76
	45 degrees	4465 ± 766	2.12 ± 0.39	2.16 ± 0.54*	4.58 ± 0.80*
	90 degrees	4669 ± 553.3*	1.77 ± 0.32*	2.54 ± 0.88*	5.37 ± 1.14*
	Average	4312 ± 81.3*	2.17 ± 0.87	2.12 ± 0.92	4.58 ± 1.70*
Combined ramp and root lesion	0 degree	4444 ± 1199	2.79 ± 0.66	1.70 ± 0.68	4.08 ± 1.76
	45 degrees	4012 ± 499	1.84 ± 0.56*	2.12 ± 0.44*	4.53 ± 0.89*
	90 degrees	4379 ± 1177*	1.80 ± 0.50*	2.40 ± 0.63*	5.37 ± 1.43*
	Average	4133 ± 960	2.00 ± 0.76	2.13 ± 0.67*	4.67 ± 1.47*