

Heterotopic Ossification Following Multiligament Knee Injuries: A Novel Location-Based Classification

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INTRODUCTION: Multiligament knee injuries (MLKIs) pose significant challenges in terms of planning surgical treatment and guiding postoperative rehabilitation. Heterotopic ossification (HO) may occur following a MLKI as a result of both the blunt force trauma involved in high mechanism knee injuries and the structural disruption involved in ligament repair and reconstruction. The purpose of this retrospective study is to describe the patterns of heterotopic ossification found in multiligament knee injuries using a location-based grid.

METHODS: Patients who underwent treatment for an MLKI from a single surgeon at one level-1 trauma center were identified between January 2001 and May 2023. Only cases with an initial X-ray and follow-up X-ray at a minimum of 6 weeks follow-up were included. Demographic information, injury details, neurovascular status, laterality, mechanism of injury (MOI), surgical treatment, and radiographs were obtained from electronic medical records. Two senior musculoskeletal radiologists reviewed all patients for presence of HO in the most recent radiograph, with the initial X-ray for comparison. Among patients who developed HO following MLKI, the most recent radiograph was scored for presence of HO and described using a novel location-based grid using algebraic notation (Figure 1).

RESULTS SECTION: The studied cohort included 128 patients, of which 28 were excluded due to insufficient follow-up. Of these, 35 (35%) developed HO. The HO patients had an average age of 38 ± 12.5 years and were 78.9% male. Of the HO patients, 62.9% had a high velocity MOI, 28.6% had a low velocity MOI, and 8.6% had an ultralow velocity MOI. In terms of Schenck classification, 11.4% were a KD1, 8.6% were a KD2, 48.6% were a KD3, 14.3% were a KD4, and 17.1% were a KDV. The most common areas that HO developed on the anteroposterior view were 1A (77.1%), 2A (62.9%), 2D (45.7%), 1D (40%), and 3D (28.6%). The most common areas that HO developed on the lateral view were 5F (37.1%), 5G (37.1%), 4E (31.4%), and 5E (25.7%). No HO developed in 2B, 3B, 1C, 2C, 4G, 6G, 4H, 5H, and 6H.

DISCUSSION:

In this cohort of 100 patients who had MLKIs, the incidence of HO was 35%, a substantial proportion. This has large implications when counseling patients on prognosis and rehabilitation expectations, as HO can lead to loss of range of motion and lead to further surgeries. In this study, we also introduced a novel location-based grid to categorize areas of HO formation that is easy to understand due to the algebraic naming convention. We found that HO formation favored specific areas, indicating that HO development follows predictable anatomic distributions.

A limitation to our results is the retrospective nature of the study, and consequently the lost follow-up of patients who may have developed HO at a later time point.

SIGNIFICANCE/CLINICAL RELEVANCE: We report the largest series thus far on heterotopic ossification after multiligament knee injuries. HO is a common complication after multiligament knee injury and can be described in a novel location-based grid.

IMAGES AND TABLES:

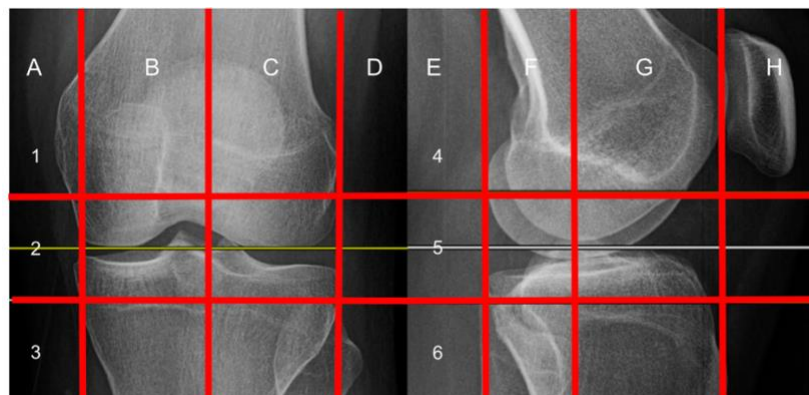


Figure 1. Location based grid

	HO (35)	No HO (65)	All (100)
Age	38 ± 12.5	34.2 ± 14.1	35.5 ± 13.6
Sex (Male)	27 (78.9%)	46 (70.8%)	73 (73%)
Mechanism of Injury			
High Velocity	22 (62.9%)	33 (50.8%)	55 (55%)
Low Velocity	10 (28.6%)	31 (47.7%)	41 (41%)
Ultralow Velocity	3 (8.6%)	1 (1.5%)	4 (4%)
Schenck Classification			
KD1	4 (11.4%)	11 (16.9%)	15 (15%)
KD2	3 (8.6%)	0 (0%)	3 (3%)
KD3	17 (48.6%)	29 (44.6%)	46 (46%)
KD4	5 (14.3%)	5 (7.7%)	10 (10%)
KD5	6 (17.1%)	20 (30.8%)	26 (26%)
KDV.1	1 (2.9%)	0 (0%)	1 (1%)
KDV.2	0 (0%)	1 (1.5%)	1 (1%)
KDV.3	4 (11.4%)	5 (7.7%)	9 (9%)
KDV.4	1 (2.9%)	1 (1.5%)	2 (2%)

Figure 2. Patient demographics

	A	B	C	D	E	F	G	H
1	27 (77.1%)	1 (2.9%)	0 (0%)	14 (40%)	4	11 (31.4%)	2 (5.7%)	0 (0%)
2	22 (62.9%)	0 (0%)	0 (0%)	16 (45.7%)	5	9 (25.7%)	13 (37.1%)	0 (0%)
3	5 (14.3%)	0 (0%)	1 (2.9%)	10 (28.6%)	6	2 (5.7%)	4 (11.4%)	0 (0%)

Figure 3. Frequency of HO by grid location