Video Analysis of Multi-ligament Knee Injury in NFL Athletes

Ethan Ruh[1], Tyler Kallman MD[1], Elizabeth Lyden PhD, Justin Greiner MD[1]
[1]University of Nebraska Medical Center, Department of Orthopedic Surgery
Email of presenting author: eruh@unmc.edu

Disclosures: Ruh (N), Kallman (N), Lyden (N), Greiner (N)

INTRODUCTION: The multi-ligament knee injury (MLKI) is defined as a tear of more than one ligament in the knee. MLKIs have severe impacts on an athlete's career and longevity. A review of fifty NFL athletes that sustained a MLKI identified a return-to-play rate of 64%, though it was dependent upon which ligaments were involved.[1] Athletes who suffered MLKIs involving the ACL and MCL had a return-to-sport rate of 70.8% though only a 43.5% chance of returning to their original level of play. In contrast, athletes that sustained MLKIs involving the ACL and LCL or PCL had return-to-sport rates of 55.6%, with only an 18.5% chance of returning to their original level of play.[1] Previous studies have found that combined ACL/MCL injuries are more common and believed to be of lower severity than MLKIs involving different ligaments. [1,2,3] Previous research utilizing video analysis on ACL injuries in NFL players found over 70% occurred in non-contact or indirect contact mechanisms and identified patterns of knee, foot, and hip position at the time of injury.[4] Video analysis of MLKIs has been limited and MLKIs are far less understood than isolated ACL injury. We hypothesized that the mechanism of multi-ligament knee injury will vary based on its categorization and that there will be positional differences of the hip, foot and knee across different injury categories.

METHODS: A retrospective video analysis of official NFL game footage spanning 1997-2022 was performed. Players with MLKIs were identified from publicly available NFL injury surveillance data and confirmed via web search of team injury reports. Athletes were placed into categories based upon ligaments injury pattern: Group 1: ACL + MCL, Group 2: ACL + LCL and ACL + PCL, Group 3: ACL + MCL + PCL and ACL + LCL + PCL. Video analysis was performed to categorize injuries based on non-contact, indirect contact, or direct contact mechanisms while also determining the position of the hip, knee, and foot at the time of injury. Differences across MLKI groups were identified by Fisher Exact Test.

RESULTS: 35 MLKIs were identified and utilized in video analysis. MLKIs most often occurred from direct contact to the affected limb (80%), with the second most common injury mechanism being indirect contact (14.3%). Most players who suffered MLKI were starters (85.7%). Offensive skill positions, such as quarterbacks (17.5%) and wide receivers (17.5%), were most susceptible to suffering an MLKI. Running as the ball-carrier (57.1%) was the most common activity during MLKI. The most common MLKI was injury to the ACL and MCL (65%), the second most common was injury to the ACL and LCL (15%). Direct contact MLKI most often resulted in a valgus and external rotational force about a flexed knee (58%). There were statistically significant differences noted in location of contact, position of the hip and knee by injury category (Table 1). Combined ACL and MCL injury occurred with knee flexion (82.6%), valgus (100%), and external rotation (86.4%) of the tibia.

DISCUSSION: MLKI in the NFL most frequently occurs from direct contact forces, most often to ball-carrying offensive players. Across all categories, the most common knee position was flexion, valgus, and external rotation of the tibia. Combined ACL and MCL injury was the most common MLKI pattern, occurring with knee flexion, valgus and external rotation. Multi-ligament injuries involving three ligaments occurred only from direct contact mechanism.

CLINICAL RELEVANCE: Multi-ligament knee injury is a devastating, and often, career-altering event that can potentially be accompanied by neurovascular injury. Ongoing efforts to better characterize multi-ligament knee injuries are essential to improve surgical and rehabilitative protocols to improve return-to-play and return-to-performance in this population.

REFERENCES:
1. Bakshi NK, Khan M, Lee S, et al. Return to Play After Multiligament Knee Injuries in National Football League Athletes. *Sports Health*. 2018.
2. Dwyer T, Marx RG, Whelan D. Outcomes of treatment of multiple ligament knee injuries. J Knee Surg. 2012
3. Fanelli GC, Orcutt DR, Edson CJ. The multiple-ligament injured knee: evaluation, treatment, and results. Arthroscopy. 2005
4. Johnston JT, Mandelbaum BR, Schub D, et al. Video Analysis of Anterior Cruciate Ligament Tears in Professional American Football Athletes. *Am J Sports Med*. 2018

Table 1. Differences in Location of Contact, Knee Position and Hip Position in Video Analysis. Data presented as Count (Percentage of Category).

Parameter	Categorization	ACL + MCL	ACL + LCL ACL + PCL	ACL + LCL + PCL ACL + MCL + PCL	P value
Location of Contact	Anterior/Anteromedial	0 (0.0%)	2 (50.0%)	0 (0.0%)	0.009
	Lateral/Posterolateral	16 (84.2%)	2 (50.0%)	2 (40.0%)	
	Anterolateral	3 (15.8%)	0 (0.0%)	3 (60.0%)	
Knee Flexion/Extension	Flexion	19 (82.6%)	1 (16.7%)	4 (80.0%)	0.009
	Extension	4 (17.4%)	5 (83.3%)	1 (20.0%)	
Knee Valgus/Varus	Valgus	23 (100%)	2 (33.3%)	4 (80.0%)	<0.001
	Varus	0 (0.0%)	4 (66.7%)	1 (20.0%)	
Knee Rotation	Internal	3 (13.6%)	4 (66.7%)	3 (60.0%)	0.002
	External	19 (86.4%)	2 (33.3%)	2 (40.0%)	
Hip Rotation	Internal	21 (91.3%)	2 (33.3%)	5 (100%)	0.009
	External	2 (8.7%)	4 (66.7%)	0 (0.0%)	