

**Impact of Concussion, Playing Surface, and Sport Contact Status on Time to Lower  
Extremity Musculoskeletal Injury Among Collegiate Student-Athletes**

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**ABSTRACT**

**Background:** Post-concussion neuromuscular control deficits may persist beyond clinically measured recovery and predispose athletes to subsequent musculoskeletal injuries in the months-to-years after returning to sports. Previous investigations have demonstrated a relationship between concussion and risk of subsequent lower extremity musculoskeletal injury (LEMSKI) among diverse athletic populations, but the effect of sport- and patient-specific factors on time to injury after concussion has not been thoroughly described.

**Hypothesis/Purpose:** To explore the effect of concussion, biologic sex, playing surface, and sport contact status on time to LEMSKI among NCAA Division I student-athletes.

**Study Design:** Case-control, level of evidence III.

**Methods:** A 3-year retrospective observational investigation using archival data from the Pac-12 HAP, a deidentified injury database of injuries among Pac-12 NCAA Division I student-athletes, utilizing a mixed linear model analysis with contrasts.

**Results:** LE injuries accounted for 44.5% (14,873/33,432) of all database injuries. Among 1179 student-athletes included, student-athletes sustained a subsequent LEMSKI on synthetic surfaces a mean of 14.5 days sooner than on constructed surfaces (SE=5.255;  $p=0.045$ ) and 23.5 days sooner than on organic surfaces (SE=4.018;  $p<0.001$ ). On average contact sport student-athletes sustained a subsequent LEMSKI 52.1 days sooner compared to collision sport student-athletes

(SE=5.248;  $p<0.001$ ), and limited contact sport student-athletes sustained a subsequent LEMSKI 42.29 days sooner compared to collision sport student-athletes (SE=4.463;  $p<0.001$ ). There was no observed effect of either prior concussion ( $F=0.038$ ;  $p=0.846$ ) or biologic sex ( $F=0.602$ ;  $p=0.438$ ) on time to LEMSKI overall.

**Conclusion:** LEMSKI was not influenced by history of concussion in this observational study. Student-athletes who compete in contact and limited contact sports or play on synthetic surfaces may be at increased risk of earlier subsequent LEMSKI compared to student-athletes who compete in collision sports or play on other surfaces. Further investigations exploring the factors contributing to any protective effect of sport contact level and playing surface on time to subsequent LEMSKI may further elucidate injury risks, inform injury prevention strategies, and improve student-athlete health.