Landing Error Scoring System (LESS) Items are Associated with the Incidence Rate of Lower Extremity Stress Fracture

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Objectives: Lower-extremity stress fracture injuries are a major cause of morbidity in physically active populations. The ability to efficiently screen for modifiable risk factors associated with injury is critical in developing and implementing effective injury prevention programs. The purpose of this study was to determine if baseline Landing Error Scoring System (LESS) scores were associated with the incidence rate of lower-extremity stress fracture during four years of follow-up.

Methods: To accomplish this objective we conducted a prospective cohort study at a US Service Academy. A total of 1772 eligible subjects with complete baseline data and no history of lower-extremity stress fracture were included in this study. At baseline we conducted motion analysis during a jump landing task using the LESS. Incident lower-extremity stress fracture cases were identified during the four year follow-up period using the injury surveillance systems at our institution. The primary outcome of interest was the incidence rate of lower-extremity stress fracture during follow-up. The electronic medical records of each potential incident case were reviewed and case status was determined by an adjudication committee consisting of two sports medicine fellowship-trained orthopaedic surgeons who were blinded to baseline LESS data. The association between baseline LESS scores and the incidence rate of lower-extremity stress fracture was examined for total LESS score and for each individual LESS item. Univariate and multivariable Poisson regression models were used to estimate the association between baseline LESS scores and the incidence rate of lower-extremity stress fracture during follow-up. Results: During the follow-up period, 94 incident lower-extremity stress fractures were documented in the study cohort and the cumulative incidence of stress fracture was 5.3% (95%CI: 4.3%, 6.5%). In univariate analyses total LESS score at baseline was associated with the incidence rate of lower-extremity stress fracture during follow-up. For every additional movement error documented at baseline there was a 15% increase in the incidence rate of lower-extremity stress fracture during follow-up (IRR=1.15; 95%CI: 1.02, 1.31, p=0.025). Based on univariate analyses, several individual LESS items at baseline were also associated with the incidence rate of stress fracture during follow-up. Ankle flexion at initial contact (p=0.055), stance width at initial contact (p=0.026), asymmetrical landing at initial contact (p=0.003), trunk flexion at initial contact (p=0.036), and overall impression (p=0.021) were significantly associated with the incidence rate of stress fracture. In multivariable analyses controlling for sex and year of entry into the cohort, subjects who consistently landed flat-footed or heel-to-toe were 2.33 times (IRR=2.33; 95%CI: 1.36, 3.97, p=0.002) more likely to
sustain a lower-extremity stress fracture during follow-up. Similarly, subjects who consistently demonstrated asymmetric landing at initial contact were 2.53 times (IRR=2.53; 95%CI: 1.34, 4.74, p=0.004) more likely to sustain a stress fracture during follow-up. **Conclusion:** These data suggest that specific LESS items may be predictive of lower-extremity stress fracture risk and may be helpful in injury screening and prevention.