Indocyanine Laser Angiography Does Not Predict Early Muscle Injury Severity in a Porcine Open Tibia Fracture Model

Joseph Featherall, MD*; Tyler J. Thorne, MD; Dillon C. O'Neill, MD; Eleanor Sato, MD; Willie Dong, BS; Justin Haller, MD*

Purpose: Muscle injury and necrosis associated with open fractures is an unsolved need in orthopaedic trauma surgery. The degree to which surgeons are aggressive or conservative with debridement of open injuries is highly variable and there is limited evidence available to guide debridement technique. Indocyanine laser angiography (ILA) has been suggested as an imaging modality to aid in the precision of initial open fracture debridement. The purpose of this study was to correlate ILA imaging intensity with histologically proven muscle injury in a porcine open tibia fracture model.

Methods: Open tibia fractures were created in 12 porcine hindlimbs using a custom-designed pneumatic ram device. At 6 hours after injury, muscle biopsies were obtained from injured hindlimb muscle. ILA was used to identify live and dead muscle for comparative tissue samples. Histological assessment of muscle injury at 72 hours after injury was used as a positive control to ensure sufficient injury to generate muscle necrosis. Muscle biopsies were processed using standard hematoxylin and eosin staining. Histology was reviewed to identify severity of muscle injury, interstitial hemorrhage, muscle fiber loss, interstitial inflammation, and muscle necrosis.

Results: No ILA nonviable muscle biopsies obtained at 6 hours after injury, in either the open tibia fracture or open tibia fracture with blast injury group, demonstrated inflammation, muscle fiber loss, or necrosis. At 72 hours after injury, ILA identified nonviable muscle biopsies that demonstrated increased prevalence of interstitial inflammation (83% vs 0%, P = 0.019)

Conclusion: Indocyanine laser angiography is not predictive of histologic muscle injury at 6 hours after open tibia fracture in a porcine model. ILA assessment of muscle injury at 72 hours after fracture correlates with muscle structural disruption and inflammatory infiltrate. A conservative approach to initial debridement may minimize volumetric muscle as ILA is a poor predictor of histologic muscle injury.

OTA GRANT