MULTIVARIATE INJURY RISK CRITERIA FOR FRACTURES TO THE DISTAL RADIUS

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INTRODUCTION
• The number and severity of forward fall related distal radius fractures has remained high and consistent over the last 20 years [1].
• Previous attempts to develop distal radius injury criteria have not considered the dynamic multidirectional nature of forward fall initiated loading [2].
• Accurate failure probability models are needed to assess the effectiveness of injury prevention strategies (e.g. wrist guards, protective flooring and fall prevention training).

PURPOSE
• Develop a multivariate distal radius injury risk prediction model that incorporates dynamic loading variables in multiple directions.
• Utilize the Weibull distribution to interpret the failure data and establish distal radius injury probability thresholds.

METHODS: INJURY CRITERIA DEVELOPMENT
• A custom designed pneumatic impactor (Figure 1) [3,4] was used to impact eight cadaveric radius specimens, potted to match the impact surface/radius angle commonly reported.
• Impacts were applied at increasing energy levels, starting at 20 J (i.e., pre-fracture) and increasing in 10 J increments, until a crack (i.e., non-propagating damage) and fracture (i.e., specimen separated into at least two fragments) were recorded.

RESULTS
• The median (SD) fracture velocity was 3.4 (0.7) m/s resulting in a mean (SD) fracture force of 2142.1 (1228.7) N.
• The damage incurred by the distal radius was consistent and clinically relevant in terms of severity and location (Figure 4).
• Crack (R²=0.69) and fracture (R²=0.85) models were developed containing dynamic multidirectional variables (Table 1).
• In contrast, peak Fz alone accounted for only 55% and 29% of the variance in the crack and fracture outcomes, respectively.
• There is a 10% probability of crack and fracture at risk scores of 0.45 and 0.61, respectively (Figure 5).

CONCLUSION
• The current study highlights the importance of considering all impact force components and dynamic measures that predict distal radius fracture risk. An injury probability threshold of 10% has been presented and should assist researchers in the assessment and development of injury prevention interventions.

REFERENCES

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