DETERMINING LOSS OF CONSCIOUSNESS IN FIGHTERS AND DEVELOPMENT OF ASSOCIATED INJURY ASSESSMENT REFERENCE VALUES

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INTRODUCTION

Occupant protection standards found in FAR 2X.562 have proven to reduce the level of fatalities in survivable aircraft accidents. Comprehensive studies of airplane accidents have identified injury causing mechanisms that can impede rapid egress after an accident. One of the impediments to egress was head injury that results in loss of consciousness (LOC) or an inability to effectively navigate unfamiliar environments.

The purpose of this study is to monitor head impacts in boxing and in mixed martial arts hand-to-hand combat via an "Intelligent Mouthguard" (IMG), and develop Injury Assessment Reference Values (IARV) based on accurate and precise characterization of single head impacts to quantify risk of LOC. Preliminary results are presented here in n=12 boxers and American footballers.

METHODS

For low-error head impact measurements, IMG sensor output linearization, adequate coupling, user customization and non-trivial data processing algorithm were required. All IMGs were laboratory calibrated before field data collection. Athlete IMG data were collected under IRB 13-899.

RESULTS

Based on laboratory calibration data, IMG can measure head impact acceleration within +/-2g up to 113g. In athlete IMG data collection, 177 head impacts were characterized by trustworthy data since their parameters were within the laboratory calibration ranges. No athletes suffered LOC, or had signs or symptoms of concussion.

CONCLUSIONS

The "Intelligent Mouthguard" (IMG) meets the NFL Level I laboratory validity specification for accurate and precise characterization of head impacts. In tests with n=12 amateur boxers and American footballers, IMG recorded spatial and temporal characteristics of 177 head impacts. No athletes sustained LOC, concussion or any signs or symptoms.

When comparing IMG non-concussive impacts to published instrumented helmet concussion datasets, apparent overlap was found. Comparison by scalar peak acceleration values alone obscures spatial and temporal impact parameters. Differences in the individual tolerance to impact may also play a role. It may also be necessary to apply laboratory calibration correction factors when comparing datasets.

Future IMG analyses will investigate effects of accurately measured spatial and temporal head impact parameters on brain failure modes in male and female athletes for both helmeted and non-helmeted sports. Human IARV will be developed to quantify risk of LOC from these measurements.