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Editorial Open Access

Bridging the Gap between the "How" and the "Why" in Forensic Biomechanics

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Editorial

In spite of the vast and constant advancements in the field of Biomechanics in the past few decades, many court decisions continue to question its applicability in forensic settings. This may partly be attributed to the realization that the biomechanical data collected in experimental and/or computational frameworks could significantly vary from real life traumatic settings, as well as the complexity inherent to devising standardized reliable quantitative metrics for forensic biomechanical assessment. Specifically, while forensic biomechanics tools and methodologies may at present adequately explain the "how" aspect of an injury, there continues to be considerable limitations regarding the "whether" or causation aspect.

The main challenge in establishing the causation stems from the inherent dependence of the outcome/conclusions on risk and probability considerations, which poses various constraints.

In 1965, English epidemiologist Sir Austin Bradford Hill devised what became known as The Bradford Hill criteria or Hill's criteria for causation. These primarily consist of 9 minimal conditions necessary to provide adequate evidence of a causal relationship between an incidence and a possible consequence. Hill's criteria provided the foundation for all subsequent approaches to causation. The field of Forensic epidemiology consequently emerged providing systematic means for quantifying causal determinations in legal and forensic settings. Two main types of causal assessment are typically identified: population-based or general causation and individual based or specific causation. Metrics such as Bayes law were proposed for quantifying the potential error involved in establishing biomechanical plausibility and causal determination.

In their paper entitled "Applications and Limitations of Forensic Biomechanics:A Bayesian perspective", Freeman et al. presented an Error Odds (OE) analysis of seven previously published case studies in forensic biomechanics as means to validate OE as a quantitative metric that can be used to enhance court admissibility. Their results showed that based on OE, only 1 out of the 7 presented cases exceeded the threshold of 10 for admissible testimony, hence emphasizing the large potential of error. When these results were combined with pre-test probability, they improved substantially. On the other hand, the adoption of standard quantitative methods that could be used to reliably determine causation resulting from a traumatic event remains a challenge.

Since it is well established that forensic biomechanics assessment is most accurate and reliable in explaining the "how" aspect of an injury as compared to the "whether" aspect, perhaps the forensic biomechanics community needs to dedicate more time and creativity focusing on the latter. Researchers in the field already realize the value of matching injury mechanisms with expected/observed injuries as means of causal determination. Leveraging recent advances from other fields may be one step in the right direction. The recent significant computational advancements in data mining, predictive analytics and cloud computing should enable the large-scale integration of biomechanics with epidemiology in forensic settings. The development and sharing of various epidemiological databases and banks spanning different populations that may be used in alignment with biomechanical approaches and tools could provide means for improving the current outcomes.

Finally, in a field where one not only needs to identify the pieces of the puzzle but also to align them properly, it is critical to have multidisciplinary teams working together. A team composed of various experts such as a forensic medical doctor, epidemiologist, biomechanician, biostatistician, and geneticist, among others has much better chances at identifying and linking the "how" with the "whether" and bridging the gap between the two. The forensic biomechanics community only stands to benefit when such a team integrates the methods and tools from their perspective fields towards devising new innovative tools and metrics for quantitative biomechanical assessment that could be reliably used in court

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