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Forensic Biomechanics Analyses in Criminal Forensics

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Biomechanics and Other Experts

Cases involving blunt force trauma to include physical assaults of infants, children and adults will benefit from a forensic biomechanics analysis. Many times this is a team effort involving the expertise of a crime scene investigator, a forensic biomechanist, a blood spatter expert and sometimes a forensic anthropologist. Medical experts will certainly include a medical pathologist in the case of a fatality and other medical experts based upon the nature of the trauma loading and other factors relevant to the case matter. One critical issue for the biomechanist is the magnitude of the force required to produce bone and soft tissue trauma. In one of my most recent cases, an emergency room physician testified that the extent of brain damage to the young infant as the result of non-accidental trauma was equal to the trauma that would have occurred if the infant's head had fallen seven stories and impacted the concrete pavement. Note this seven story displacement is about 76 feet. This physician statement was made in spite of the fact that there was no evidence of any external blunt trauma to head. Unfortunately, some physician clinicians rely heavily on the anecdotal examples they once heard in medical school or over the course of their early years of practice. Furthermore, they have forgotten their Newtonian physics. Running the vertical velocity equation coupled with a linear momentum analysis clearly shows the error of such an absurd illustration and yet, a jury will many times simply take such statements as fact. This is a gross disservice to justice.

This brings up another point; that being knowing the limits of our own areas of expertise and the value of fully understanding the other experts. I have found that in a team approach when opinions can be shared (with the court's permission) in the form of written reports or better yet in the form of conference calls with the expert parties, everyone including the attorneys get a much understanding of the key elements and opinions of the case. I have personally found that my background in biomechanics and in functional musculoskeletal anatomy is well received by physician experts and I certainly have great respect for the physician experts. Everyone learns and comes to a better comprehensive understanding of the case.

Advanced Technology

This is another example of what a biomechanics expert can bring to the table in criminal forensics. A careful examination of the crime scene is usually accomplished first by the criminal investigator along with follow-up laboratory work. However, the examination of the crime scene and detailed measurements with the new automated laser scanning equipment is cost and time effective and will enable the biomechanist to generate three dimensional coordinates of thousands (or millions) of points which can be used via software algorithms to fully develop the detail of the crime scene. Comparison of competing witness scenarios from a biomechanics perspective can then be made and can be compared with the findings of the other experts (e.g. a blood spatter or ballistics expert).

Case Study Example of the Roles of a Biomechanist -Suicide vs. Homicide

One brief case study serves to illustrate. This was a complex murder vs. suicide case involving an adult male victim[1] which was widely publicized in the media. This case involved several investigative agencies including the Federal Bureau of Investigation in the USA. In order to maintain appropriate confidentially in this matter, only an outline of the biomechanical questions are presented with no discussion of the outcome. This matter required crime scene investigators, forensic pathology experts, ballistics experts and a blood spatter analysis as well as forensic biomechanics experts. The questions posed to me included:

- Did the shooting take place when the victim was standing up or lying down in a supine position?
- Did a component of the recovered projectile best match a standing or supine position of the victim at the time of the shooting?
- Did the absence of a blunt scalp contusion help determine whether this shooting took place with the victim standing or laying down in a supine position?
- The fired weapon was in close approximation to the neck/head link with undisputed evidence of gunshot residue (GSR). Was there evidence of a struggle? In view of the angle of entry-exit wounds of the neck/head, could such a body position be accomplished by the victim if this was a suicide?
- The weapon was found at the scene. Was the final resting position of this weapon consistent with a suicide or with a homicide staged to look like a suicide from a biomechanics/functional anatomy perspective?
- What would have been the effect of weapon recoil upon the final resting point of the weapon in relation to the victim's body in a suicide scenario?
- What was the role of active and passive muscle elements in resisting the weapon recoil in a suicide scenario?
- What tissue damage due to the weapon recoil force would one expect upon the trigger hand of the victim in a suicide scenario?

The team approach in examining all of the physical evidence as well as human body positions during-after the shooting and the muscle force capabilities of the victim certainly played an important role in these analyses.

[1]The term "victim" refers the deceased regardless of a suicide or a homicide scenario.

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