

PROCESS FOR ACCURATE INJURY RECONSTRUCTION IN FORENSIC INVESTIGATIONS

BY GEOFFREY THOR DESMOULIN

ON THE SHOULDERS OF GIANTS

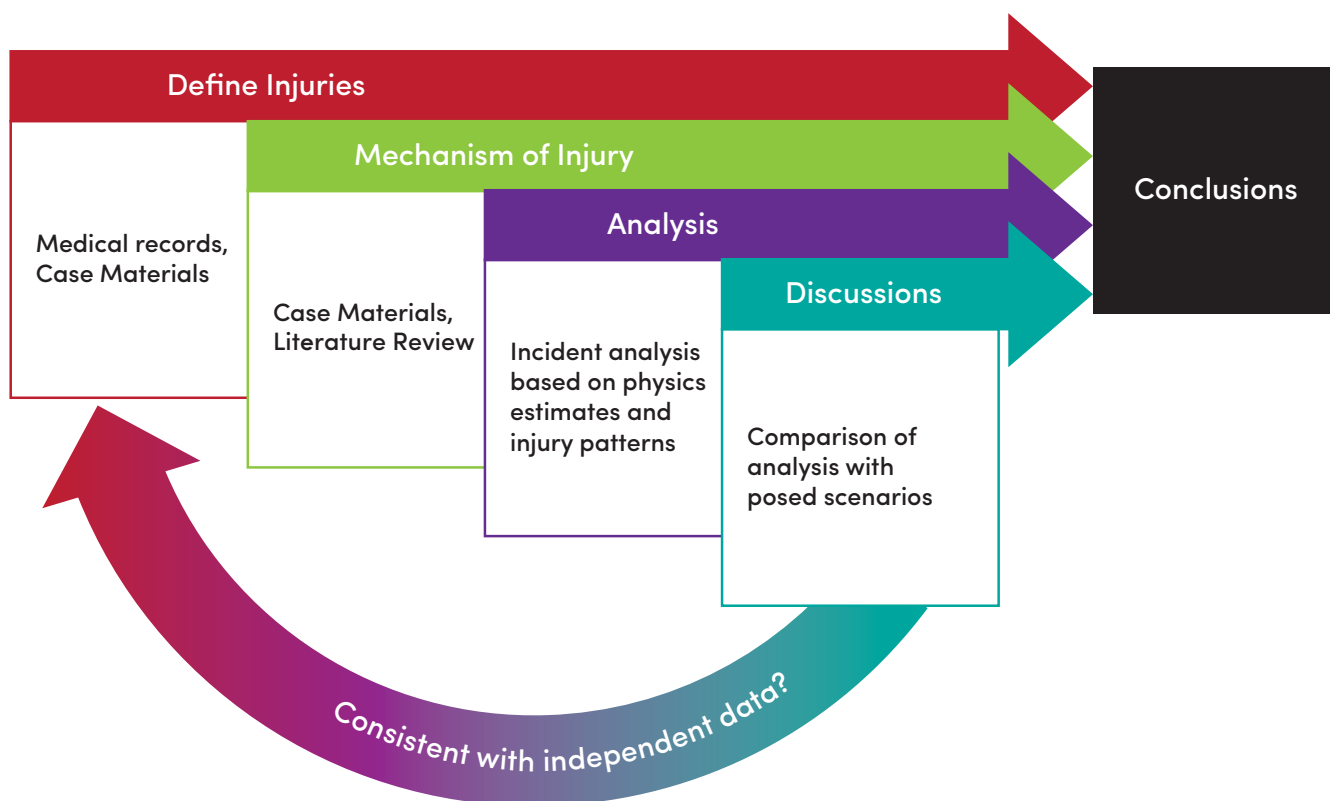
Forensic analysis that attempts to determine the cause of injury must frequently be performed with incomplete data.

Consequently, a well-defined process for determining the approach, including methodology and workflow is essential to achieve the best results. Nahum and Gomez (1994) described the process of injury reconstruction as “a method of analyzing an accident and resulting injuries to produce a comprehensive description of the injuries in both medical and engineering terms which reflect the injury and associated causative factors.” Once the injury has been defined, there are frequently many possibilities as to the mechanism which caused the injuries. The challenge is to determine which mechanism is consistent with available data. Nahum and Gomez (1994) presented a workflow for injury reconstruction in the case of vehicle accidents. Their process consists of adjusting body and vehicle motions within parameters established by the available data until a result is achieved that provides a

plausible explanation for the injuries. Their focus is primarily on the location of injury and the force that would be necessary to produce a given type of injury. Evidence from the vehicle can establish points of contact with the body and analysis of vehicle motion can be used to estimate the forces applied to the body.

FRAMEWORK SPECIFIC TO ANY INJURY

A framework for injury reconstruction which can be applied to any injury, has been developed by GTD Scientific (GTD). A distinguishing feature of this framework is the requirement that conclusions are consistent with independent objective data (Fig. 1). Lawsuits frequently involve disputes centered on conflicting accounts of an incident. Accounts of witnesses and involved parties provide a narrative that can set the scene. However, these accounts cannot be accepted as reliable without supporting evidence. Therefore, it is necessary to determine the consistency of testimony with independent objective data. The analysis can begin



with a set of presumptions based on testimony, but ultimately it must be supported by independent objective data.

CRITICAL FIRST STEPS – DEFINE THE INJURY

The process consists of first defining the injury based on medical records and then accounting for the injuries based on plausible mechanisms consistent with a review of relevant published literature on the injury biomechanics. Issues that need to be considered when defining the injury include physical tolerance, timing of the injury and the mechanism of the injury. Physical tolerance is a determination of the magnitude of the force necessary to cause the injury, which is frequently expressed as a range about a mean value from which probability of injury can be calculated. Timing of the injury is important for determining when the injury occurred in the sequence of events and may be established through analysis. The mechanism of injury may be known, e.g., from video evidence or by agreement. In some situations, there may not be proof of the mechanism but its etiology may have been established in published research, i.e., the mechanism can be inferred from prior knowledge. However, it is also possible that the mechanism of injury is unknown, in which case analysis is likely required to determine the mechanism of injury.

WHAT YOU HAVE VS. WHAT YOU NEED

The initial injury reconstruction is based on accounts of witnesses, medical records or autopsy reports and knowledge of the mechanism of injury obtained from a review of relevant literature.

Videos and photos of the location of bodies, objects, damage, blood stains, etc. relevant to the incident can provide independent objective data to corroborate witness accounts as well as input for quantitative analysis.

The analysis is planned based on the investigative questions and available or missing information required to address these questions. Analysis is necessary to establish causal relationships between the injuries and the dynamics of the incident. This analysis may involve methods such as photogrammetry, impact tests, computer models and mechanical calculations. In some cases, ergonomic analysis may be necessary to determine the cause of the injury.

ARE YOU SURE? – REACHING A CONCLUSION

In general, a single line of reasoning does not conclusively answer all of the questions addressed by the investigation. Therefore, a discussion of the evidence, results of the analysis and independent objective data is required to draw conclusions. The discussion includes elements such as a review of standards relevant to the incident and whether the standards were observed, results of tests which were performed as part of the analysis and the probability

of risk of injury under the conditions which existed at the time of incident, as determined by the analysis. However, before any conclusions can be drawn, agreement must be established between the different lines of reasoning.

Critically, any conclusions drawn from witness accounts or evidence recovered from the scene must be consistent with independent objective data.

Generally, the independent objective data are derived from the analysis, although they may also come from outside sources such as published validated studies.

If the results from different lines of investigation are inconsistent or there is inconsistency with the independent objective data, the analysis must be revisited as there may be an error or assumptions may be invalid. In addition to repeating the analysis, it may also be necessary to review the injury literature again to ensure that the referenced studies are appropriate for the specific mechanism of injury and demographics of the case. The final conclusions should represent a harmony of the data gathered from the case material and independent objective data derived from the analysis and referenced literature.

NEED MORE DETAIL?

A more detailed version of this paper will be available at www.gtdscientific.com soon, where two case studies are presented to illustrate the workflow developed by GTD with a particular focus on how consistency with the independent objective data was incorporated in determining the final conclusions. 