

## CASE REPORT

# Injury interpretation and reconstruction of events in a victim of a 'hit-and-run' road traffic incident

Ariyaratna HTDW

*Department of Forensic Medicine, Faculty of Medical Sciences, University of Sri Jayewardenepura, Nugegoda, Sri Lanka*

## ABSTRACT

Forensic reconstruction of events is akin to assembling a jigsaw puzzle. Missing pieces of the jigsaw puzzle exacerbates the difficulties. Deductions or conclusions arrived should be supported by scientific evidence during the medico-legal investigation. A case where a man was found dead by the roadside with a damaged motorcycle is reported. The police investigation determined that the incident was a "hit-and-run" road traffic injury with no evidence of "run-over".

This case study reveals how meticulous injury interpretation and event reconstruction by the Forensic pathologist helped unravel an "atypical run over injury" in a hit-and-run traffic injury.

**Keywords:** Run-over-injury, hit-and-run accident, reconstruction of events, road traffic trauma

**Corresponding Author:** Ariyaratna HTDW  
ariyaratna@sjp.ac.lk  
 <https://orcid.org/0000-0002-4266-5508>

### ARTICLE HISTORY

Received: 18.01.2022

Received in revised form: 13.04.2022

Accepted: 27.05.2022

Available online: 13.06.2022



This article is licensed under the terms of the Creative Commons Attribution-Non Commercial 4.0 International License.

caution<sup>1</sup>. Due to the scarcity of biomechanics and its applications in Sri Lanka, scene investigation and scientific observations were used to reconstruct the events in this case.

It is not infrequent to sustain bizarre-patterned injuries during road traffic accidents. As result, it is possible that certain injuries are overlooked. This case report is an instance where reconstruction of each injury in a logical manner proved to be of major benefit in revealing an atypical run over injury that was not initially suspected by the investigating police officer.

## INTRODUCTION

A medico-legal expert (forensic pathologist) is obligated to address any medico-legal issues that arise following violent deaths. Investigation of a crime scene by investigating police officers and available post-mortem findings are often enough to reconstruct events during most routine medico-legal investigations. However, there are some instances in which extensive analysis and interest is required to address medico-legal issues. Incorrect reconstruction has grave consequences in the medico-legal field, as it may effectively exonerate the perpetrator while concluding an innocent person as guilty. Events occurring during a victim-vehicle collision can be complicated. Therefore such events should also be analysed and interpreted with

## CASE HISTORY

A 49-year-old male was discovered dead by the side of the road along with his damaged motorcycle. This was suspicious of a hit and run accident. There were no eyewitnesses or CCTV footage of the incident. However, a sudden moderately loud noise had made a neighbour visit the scene. He had noticed the unresponsive victim lying on the road. He was wearing a helmet with no other protective wear. The victim's severe damaged motorcycle was located by the side of the road with.

External examination of the upper back of the T-shirt revealed three tears, blackish dust/grease marks and dried 'saturated bloodstains'. The middle

tear showed a concavity towards the midline (**Fig. 1**). The other external injuries were lacerations to his left external ear and to the lower lip, as well as a contusion measuring 3x4 cm in size over the left side of his neck. All injuries were simple in nature. A roughly rectangular abraded contusion measuring 20x15 cm was observed, across the back of his upper chest, sparing the mid-chest with an oval shape (15x10 cm) (**Fig. 2**). There were no de-gloving or avulsion injuries. Grazed abrasions, injuries to genital region, long bone fractures and skull fractures that are typically expected in a motorcyclist following a collision with another vehicle were not evident in this case.

Internal examination revealed diffuse axonal injury (grade 3 level), diffuse vascular injury, and diffuse subarachnoid haemorrhage with no skull fractures (**Fig. 3**). (No histopathological studies were performed which is a drawback of this study). Bilateral rib fractures were observed posteriorly. There were bilateral lung contusions, lung lacerations and bilateral haemothorax (approximately 200 ml in total). The 2-8<sup>th</sup> ribs were posteriorly fractured in two locations, bilaterally. These fractures were stacked one on top of the other, resulting in the formation of two imaginary lines (**Fig. 4**). The most medial "fracture lines" were drawn parallel to the vertebral column, while the most outer "fracture lines" were drawn a few centimetres away and equidistant from those (**Fig. 4, 5, 6 & 7**). The most lateral fracture lines were "curvilinear" in shape, which corresponded to the oval-shaped skin marking and also to the middle tear on the T-shirt (**Fig. 1**). There was an undisplaced fracture of the vertebrae at the T1 and T2 levels, resulting in partial spinal cord damage.

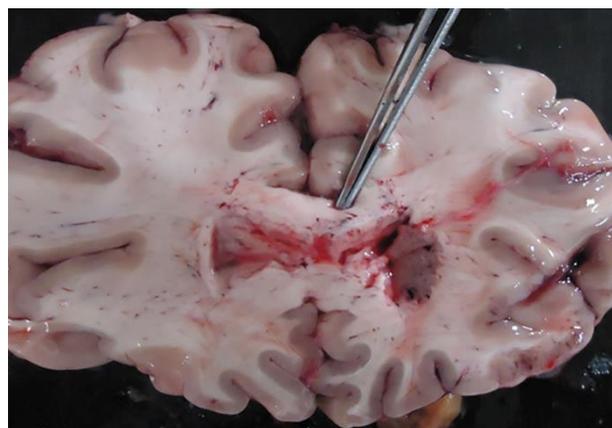
The cause of death was determined to be blunt force trauma to the head, chest, and spine sustained by a motorcyclist as a result of a vehicular collision. The incident was described as a run over injury by a heavy vehicle of which the driver had driven away without informing the police (hit-and-run road traffic injury). The injury pattern was consistent with those sustained due to acceleration and deceleration (head injury), and run-over (upper back of chest) by a heavy vehicle. The run-over injury was unequivocally diagnosed by considering the torn areas, faint grease/dust marks on the back of the T-shirt, and by the underlying injuries that were unexplained otherwise.



**Figure 1:** The arced-shaped tear in the back of the T-shirt (yellow arrow). Two other tears (black arrows). The blackish marks gradually decrease in density from left to right.



**Figure 2:** The roughly rectangular abraded contusion across the upper back of the chest, with an oval-shaped sparing of skin centrally. The injury is more pronounced towards the left side than the right side.



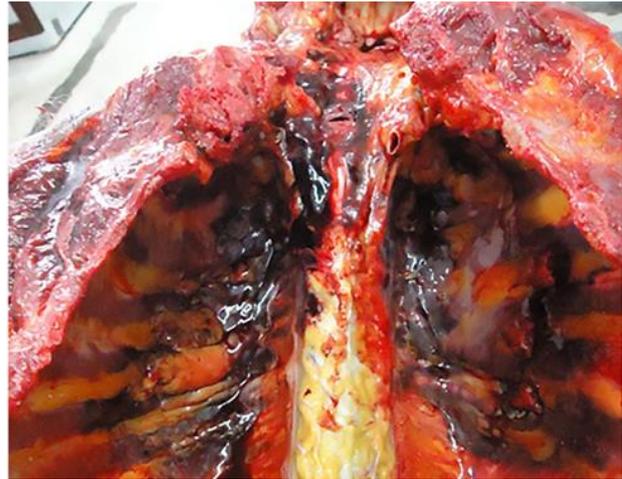
**Figure 3:** A coronal section of the frontal lobes of the brain with the typical haemorrhage in the corpus callosum that indicates severe diffuse axonal injury.



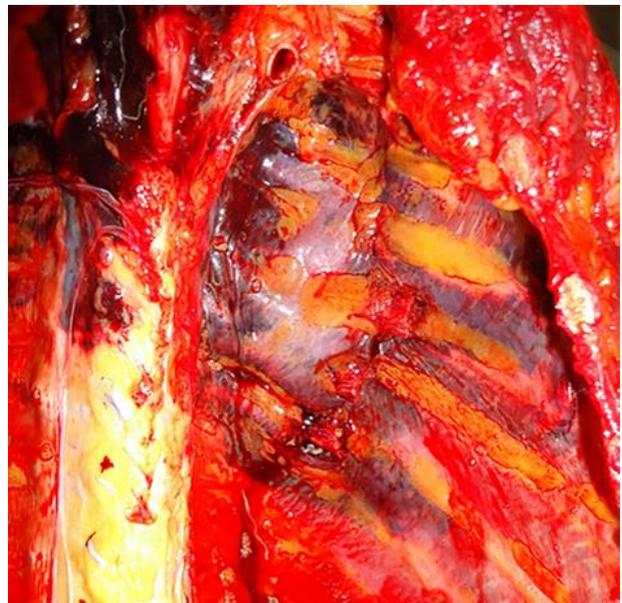
**Figure 4:** The schematic diagram depicts the locations of posterior rib fractures (note the curved pattern of the fracture lines situated on the ribs).



**Figure 5:** A schematic diagram of how a bony flap could have been formed as a result of a tyre being run over the back of the rib cage while victim was in a prone position.



**Figure 6:** The interior of the rib cage with “fracture lines” and vertebral fractures at T1 and T2.



**Figure 7:** The “curved fracture line” on the left hemithorax.

The large injury in the form of an abraded contusion that extended across the back of the upper chest was initially not explainable during the post-mortem examination. However, a degree of suspicion as to why the undamaged peculiar patterned injury was seen within the contused abrasion was the trigger to analyse injuries extensively. If the injury over the back of the chest was not analysed and interpreted as a whole, this deduction would have been impossible.

## DISCUSSION

A “hit-and-run” accident is where a driver of a vehicle who collides with another vehicle, property,

or human being leaves without providing the investigating party with his/her identity<sup>2,3</sup>. Because the case at hand involves a "hit-and-run" accident, it is necessary to reconstruct the dynamic events that occurred and to interpret the injuries in order to identify the implicated vehicle and the driver. Reconstruction essentially requires the correct identification of the mechanism of causation of injuries. It is easy when the injuries are typical in a given instance. When the injuries are atypical or not consistent with the usual appearance it is difficult to interpret. This may result in wrongful interpretation and lead to incorrect inferences that will lead to a miscarriage of justice.

The author was unable to interpret or provide an opinion on the injury situated on the upper back of the chest despite considerable efforts. It did not show features of a primary impact injury or secondary injury. However, subsequent to injury documentation the internal dissection was initiated without any interpretation of external injuries. The internal examination revealed multiple posterior rib fractures, lung lacerations and contusions, and vertebral column damage arousing suspicion of a run over injury. There was no other convincing explanation for the severity of the injuries that he had sustained on his chest.

An examination of the scene was conducted retrospectively by the author. This did not result in any convincing evidence to ascertain the reason for the spared skin in the upper mid-back of the chest. Given that those injuries were sustained as a result of being run over, the author was then compelled to look for possible tyre marks on his body and clothing. The mark observed on the back of the upper chest which did not have a viable explanation at the outset of the postmortem examination was then subjected to study in-depth. If the mark was caused as a result of a run-over accident, it was necessary to determine the reason for absence of typical tyre marks and the reason for sparing of an oval-shaped area of skin in the centre or either side of the midline. The absence of typical tyre tread marks on the alleged run-over injury may be attributed to the vehicle having wasted tyres. The T-shirt that the deceased was wearing may have also partly contributed to the absence of tyre-thread marks.

Absence of injuries over the upper mid-back of the chest should also be explained as the second query that was encountered during the medico-legal investigation. However, the reason for that was not clear and required further meticulous observations and reasoning.

As shown in Figures 4, 6 and 7, the 2-8<sup>th</sup> ribs had been bilaterally fractured in two locations, resulting in the formation of two vertical imaginary lines on each side. The symmetrical rib fractures in the 2-8<sup>th</sup> ribs allowed for the formation of 'a separate bony flap' that could be pressed into the posterior thoracic cavity while the tyre ran over the upper back of the chest in the prone position. The fractures at the first and second thoracic vertebrae may have facilitated indentation of the bony flap, thereby preventing skin contact with the running tyre (**Fig. 5**).

Another medico-legal issue that needed to be addressed was the vehicle's travel direction. The concentration of dust and grease marks on the victim's clothes, which decreased from left to right while the victim was prone, was used as evidence<sup>4,5</sup>. The severity of the skin injury was also gradually reduced from his left to right while he was in the prone position. By considering those two facts the author was able to provide an opinion that the offending vehicle was moving from left to right of the victim while he was in prone position.

Severe diffuse axonal injury (DAI) (grade 3) in conjunction with diffuse vascular injury (DVI) suggested the acceleration, deceleration, and rotating movements inflicted on his head<sup>6,7</sup>. The presence of unequivocal DAI and DVI indicates (**Fig. 3**) that his body was subjected to significant force as a result of the incident<sup>8</sup>.

It is the duty of the forensic pathologist to provide useful information after the post-mortem examination to the investigating police officer to continue his investigations. On this body, there were no primary or secondary impact injuries or secondary injuries. Instead, a run over injury was identified. At the end of the post-mortem investigation, the author informed the investigating Police officer that there has been a component of "run over" in addition to it being a hit and run incident. The estimated minimal width of the tyre from one sidewall to another of the offending vehicle and the direction of travel of the vehicle was also determined (The width was 15 cm and the vehicle moved from left to right of the victim while he was in the prone position at the scene). The police were further informed that no paint flakes or any other trace evidence was collected from the dead body.

On query by the Police, the possibility of being run over by two vehicles was ruled out due to the 'uncomplicated nature' of the injuries confirmed by the judicial medical officer and also by the direct

testimony from neighbour who rushed to the scene immediately upon hearing the moderately loud noise.

The technical examination of the motorcycle that was conducted by the Police investigators along with findings of run over injury, revealed that the offending vehicle had collided with the motorcycle, imparting significant kinetic energy to his body, causing him to be thrown off from his seating position resulting in run over by the same vehicle.

In this case, the dynamic events were reconstructed using knowledge from basic sciences and empirical studies. The width of the tyre mark injury provided information about the tyre's dimensions. As per the dimensions of the injury situated over the back of the chest, the width of the tyre from the sidewall to the opposite sidewall was around 15 cm (**Fig. 2**). It provided a clue or evidence to trace the offending vehicle. Furthermore, if sufficient research had been conducted on the force required to cause this level of damage and chest compression, the weight of the vehicle, whether it was loaded or not could have been reconstructed to a certain extent<sup>9</sup>. This case highlights the fact that forensic biomechanics needs to be incorporated into the Sri Lankan medico-legal investigations because such techniques will help the investigative process by providing reliable evidence<sup>10</sup>. Hence this case report highlights the importance of the application of biomechanics.

A medico-legal expert must suggest the dynamic actions that could have occurred during a road accident. The dynamic movements of the victim that could have occurred during the incident/impact should also be considered with great care while arriving at conclusions. However, there is no standard scientific procedure to cross-check or double-check the conclusions reached based on reconstruction of events in this case. Further there is no other convincing explanation for this case scenario within the limits of examination. As a result, it was concluded that the 'bony flap' supposedly created by the moving tyre on the upper back could have resulted in the atypical "run-over injury".

## CONCLUSION

Since extensive internal injuries along with bizarre external injuries are common in fatal incidents of road traffic accidents meticulous injury interpretation and event/injury reconstruction would be useful in determining the sequence of events.

## RECOMMENDATIONS

It is essential to develop the field of biomechanics in order to make more useful conclusions such as positive identification of the perpetrator and the offending vehicle.

## CONFLICTS OF INTEREST

There are no conflicts of interest.

## ETHICAL ISSUES

None

## REFERENCES

- Giorgetti A, Cecchetto G, Giraud C, et al. Reconstruction of the dynamic in a fatal traffic accident with prolonged dragging of the victim. *Legal Medicine*. 2021;53: 101963. <https://doi.org/10.1016/j.legalmed.2021.101963>.
- The Free Dictionary. *Hit and run*. Available from: <https://legal-dictionary.thefreedictionary.com/hit+and+run> [Accessed 14<sup>th</sup> Jan 2022].
- Sri Lanka Police. *Traffic Police - Action to be taken in the Eve of an Accident*. Available from: <https://www.police.lk/index.php/item/72-traffic-police-action-to-be-taken-in-the-eve-of-an-accident> [Accessed 14<sup>th</sup> Jan 2022].
- Dolinak D, Matshes E, Lew E. *Forensic Pathology*. 1<sup>st</sup> ed. Available from: <https://www.elsevier.com/books/forensic-pathology/dolinak/978-0-08-047066-5> [Accessed 14<sup>th</sup> Jan 2022].
- Beddoe HL. Hit-run murders: Examination of the body. *The Journal of Criminal Law, Criminology, and Police Science*. 1958;49(3): 280. <https://doi.org/10.2307/1141407>.
- Science Direct. *Diffuse axonal injury - an overview*. Available from: <https://www.sciencedirect.com/topics/psychology/diffuse-axonal-injury> [Accessed 14<sup>th</sup> Jan 2022].
- Adams JH, Doyle D, Graham DI, Lawrence AE, McLellan DR. Gliding contusions in nonmissile head injury in humans. *Archives of Pathology & Laboratory Medicine*. 1986 Jun;110(6): 485–8.
- Makino Y, Arai N, Hoshioka Y, et al. Traumatic axonal injury revealed by postmortem magnetic resonance imaging: A case report. *Legal Medicine*. 2019;36: 9–16. <https://doi.org/10.1016/j.legalmed.2018.09.019>.
- Arregui-Dalmases C, Teijeira R, Forman J. Injury biomechanics as a necessary tool in the field of forensic science: a pedestrian run-over case study. *Forensic Science International*. 2010;198(1–3): e5–9. <https://doi.org/10.1016/j.forsciint.2010.01.008>.
- Chen Y. Current state and progress of research on forensic biomechanics in China. *Forensic Sciences Research*. 2021;6(1): 1–12. <https://doi.org/10.1080/20961790.2021.1879365>.