Correspondence

Commentary on Tomczak PD, Buikstra JE. Analysis of blunt trauma injuries: Vertical deceleration versus horizontal deceleration injuries. J Forensic Sci 1999; 44(2):253–62.

Sir:

The recent article by Tomczak and Buikstra attributes the injuries in a decomposed body to impact by a truck or other vertical-front vehicle on a pedestrian. We are concerned about the interpretation of these results and the implications of this methodology, should it be adopted more widely.

Although it is difficult to determine the exact nature of the injuries from the article, they appear to consist of fractures at the vertebral ends of left ribs 1, 3–12 as well as sternal fractures of left ribs 5–9. Right ribs are also injured, including rib 1 and 9. Spinal injuries are limited to T4, and T7 to L1 and consist of spinous process, transverse process and articular facet fractures. Side of injury is not specified in the spine. Additional injuries included the right scapula and left clavicle. No injuries are noted on the cranium, pelvic ring, upper limb or lower limb.

This isolation of trauma to the upper torso appears incompatible with the usual pattern of vehicle-pedestrian accidents as reported in the article, even when these involve vans or trucks. The more typical pattern of the car to "run-under" the victim is altered with vertical-faced vehicles. Instead the victim is thrown forward where they will also suffer additional injuries upon impact with the road or other objects in their pathway. Head injuries are the most common cause of death in vehicle-pedestrian accidents. Neck injuries may result from the initial impact. Pelvic fractures are common in vehicle-pedestrian accidents. It is highly unusual for these circumstances not to result in lower limb fractures, especially as the bumper strikes the lower leg. "Boot-top" fractures of the tibia and fibula are common due to the bumper of the vehicle striking the legs. These may occur at remarkably slow speeds.

In the case under discussion, it seems difficult to reconstruct an impact which would strike the upper to mid back without inflicting damage to the head, pelvis or lower limbs. We are concerned that other possible mechanisms of injury were not sufficiently considered. Instead, it appeared that the only assessment was which of two mechanisms (vehicle-pedestrian impact or fall from a tree) was most probable.

In the article, a possible cause of death or incapacitation is presented. While such speculations are common within the archaeological literature, it is inappropriate for forensic anthropologists to include such interpretations in a forensic case. The cause and manner of death, including possible soft tissue injuries and the capability of the victim to move following injury should be left to the forensic pathologist.

Finally, avulsion fractures are small fragments of bone that are detached from the bony prominences by the tension produced by the attached ligaments or tendons (1). Tight bonds between the Sharpey's fibers and the adherent soft tissue prevent failure at the insertion point and failure is displaced to the surrounding bone. The illustrations of the scapula and of the two vertebrae are both described as being "avulsion" fractures. However, the massive scapula injuries seem much more likely to be caused by direct trauma. Similarly the vertebral fractures illustrated are not consistent with the definition of avulsion fractures and are more likely due to either impact, rotational or shearing injuries. While such fragments could be displaced by the attached muscles following fracture, this does qualify as an avulsion fracture.

While we applaud the efforts of Tomczak and Buikstra to explore more deeply into the trauma, we are cautious about the ability to make such detailed interpretations.

Reference

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Authors' Response

Sir:

In reply, we thank Dr. Galloway and Dr. Mason for their comments. As mentioned in the article, we agree that it is most common to find skull injuries and fractures of the pelvis and lower extremity associated with vehicular-pedestrian accidents. However, the presence of extensive and severe trauma to the thoracic region and the absence of such "characteristic" vehicular-pedestrian injuries suggest that the individual under study was not struck by a car or van, but most likely a larger vehicle, such as a truck. If the point of impact was higher than that associated with a car (i.e., thoracic area) one would not expect "boot-top" fractures of the tibia and fibula. For instance, the individual who was struck by a truck in the study (Case #2) did not display skull nor lower extremity fractures. Instead, injury was concentrated to the thoracic region. In contrast, all of the individuals who were struck by cars in this study suffered lower extremity injuries and 80% (4/5) suffered cranial fractures. While the number of cases studied in this investigation are limited, there appears to be a distinction in injuries suffered by individuals struck by cars versus a larger vehicle (i.e., truck).

Additionally, a comprehensive literature review suggested that extensive blunt trauma to the thoracic region was most likely due to vertical deceleration or horizontal deceleration trauma, thereby limiting the focus of our investigation. While Galloway and Mason suggest that we do not explore a sufficient number of possible mechanisms of injury, our research on extensive blunt trauma, as well as the context in which the body was found best support the scenarios put forth. We would certainly welcome any additional probable scenarios to explain the trauma observed.

The focus of this article was to examine the extensive injuries the individual sustained in order to ascertain the most probable manner of death. As we are aware that cause of death is a medical determination, there is no attempt in this article to ascertain cause of death. We are simply stating that the severe injuries sustained by this individual most likely seriously incapacitated him.

Finally, several of the injuries to the scapula and vertebrae have been attributed to contraction of particular muscles. However, our understanding of avulsion fractures as a result of forcible tearing or pulling suggested that these injuries could also be classified as avulsion fractures. For instance, fractures of the inferior and superior scapular angle, where there is muscle attachment, are often classified as avulsion fractures.

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Commentary on Introna F, Di Vella G, Campobasso CP. Determination of postmortem interval from old skeletal remains by image analysis of luminol test results. J Forensic Sci 1999; 44(3):535–8.

Sir:

I have a few questions for the authors followed by some comments on luminol. What was the history of the bones examined in the study? Were the bones from burials or were they from non-buried, relatively pristine bodies? Did the bones undergo any cleaning procedures prior to luminol treatment?

A forensic scientist must always be very careful when interpreting luminol results. In this study, the authors took appropriate steps to eliminate false positives that could result from plant peroxidases; however, other sources of contamination can cause false luminol positive reactions. Copper, copper salts, ferricyanide, iron ions, cobalt ions, and sodium hypochlorite (bleach) can cause luminol to fluoresce (1–3). Any of these substances could come in contact with bones, particularly bones that have been buried in mineral rich soil and bones that have been cleaned with tap water and/or bleach. I have seen luminol react with copper salts that have leached into the fabric surrounding the copper rivets of blue jeans. I have also seen luminol react with black fingerprint powder. When using the suggested method for aging bones, the scientist must be aware of other substances that can cause variation in the fluorescent intensity of luminol. Standards, such as known bone samples of varying PMI, and controls, such as a soil sample collected from the area surrounding the bone, clothing associated with the remains, and bone cleaning materials, should be used in conjunction with this type of analysis.

References

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Authors' Response

Sir:

Thank you very much for the comments regarding our article: "Determination of postmortem interval from old skeletal remains by image analysis of luminol test results." We do really appreciate them and certainly agree that forensic scientists must always be very careful when interpreting luminol results.

The goal of our study is testing a simple and easy distinction method between two broad groups of skeletal remains frequently examined during forensic investigations: "modern" (less than 50 years) and "ancient" (more than 50 years) bones. The paper is a preliminary effort to the evaluation of correlating the time since death with blood remnants in bone tissue. Luminol is very sensitive, reacting rapidly to the most minute traces of blood, but it is a presumptive test, capable of delivering both false positives and false negatives. For example it does not differentiate between human and animal blood (1).

Major sources of false positives are chemical oxidants, catalysts, and salts of heavy metals such as copper and nickel. To avoid the possible influence of the most common substances (such as iodine, rust, household bleach, formalin and plant peroxidases such as are found in horseradish, citrus fruits, bananas, watermelon and numerous vegetables), we washed in distilled water all the bone samples and heated them to 100°C for a period of 5 min prior to testing with luminol solution. This temperature does not appreciably affect the heme portion of the hemoglobin responsible for the luminescence reaction and destroys the plant peroxidases.

However, as you stated in your comments, metal surfaces such as copper, copper salts, ferricyanide, iron ions, cobalt ions and sodium hypochlorite (bleach) are particularly likely to yield false positives. To avoid the possible influence of these substances we followed procedures as reported in a previous paper on this topic (2) collecting bone powder from the inner compact tissue of the mid-shaft of each femur. Compact bone is, in fact, far less susceptible to physical and/or surface contamination than trabecular bone with its large surface area to volume ratio and multiple cavities that easily become filled with contaminating soil and clay particles. After removing the periosteal (outer) and endosteal (inner) surfaces and pulverizing the compact tissue samples into a fine bone powder using a grinder no other particular cleaning procedures were used except a second washing in distilled water.

Regarding the history of the bone samples examined, the femora belonging to the "ancient" group examined (fourth and fifth group with PMI ranging between 50 and over 80 years) were from human remains found in different ossuaries (crypts) of old Roman Catholic churches. For these latter bones the original burial conditions are still not well defined and for some skeletons completely unknown. However, based on the negative results of image analysis of luminol tests for this latter "ancient" group we can exclude manifest false positives since only one femur (PMI ranging between 50 and 60 years) revealed a very faint light-reaction (see the weaker luminance recorded from the powdered bone than the other groups). The most of femora (33 out of 60) belonging to the "modern" group (first, second and third group with PMI ranging between 1 month and 35 years) were from skeletal remains found outdoors, in open fields, during forensic investigations. The rest of femora belonging to "modern" group (27 out of 60) came from cemetery exhumations. These bodies were buried in wooden coffins embedded both beneath the soil and in cement niches for urns; actually, we do not know exactly which coffins were lined with metal (zinc) plate or which kind of clothing was associated with the remains. Consequently, it was not possible to standardize the variations caused by burial environments, since the examined material came from different sites such as