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# Gravitational bullet injuries. Unique insights for further investigations

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## ABSTRACT

Gravitational bullet injuries, prevalent in the Middle East, particularly in Iraq, are a critical public health concern, often resulting from celebratory gunfire. In our Neurosurgery Teaching Hospital in Baghdad, we've observed that these injuries differ significantly from high-velocity gunshot wounds, characterized by lower velocity and energy due to air resistance and gravity. Unlike high-velocity bullets, gravitational bullets cause less bone fragmentation and radial brain damage. These bullets often end up on the tentorium or within the skull base, rarely transgressing the cerebellar tentorium on a vertical trajectory. We've also noticed that the pediatric population, particularly younger children, are more susceptible to these injuries due to their thinner cranial vertex, leading to more penetrating injuries and aggressive brain bleeding. Our observations underline the need for focused studies, awareness, regulation, and tailored management strategies to combat this overlooked issue.

We are writing to share our experience and observations with gravitational bullet injuries, an overlooked yet pressing public health issue, particularly prevalent in the Middle East and notably in Iraq. Over the years, celebratory gunfire, a culturally ingrained phenomenon usually associated with joyous occasions such as weddings and national team football victories or sorrowful events such as the death of a head of a tribe. Nonetheless, it has inadvertently led to a significant number of such injuries [3].

From our extensive experience treating these victims In the Neurosurgery Teaching Hospital in Baghdad; we have gleaned some unique insights. The nature of gravitational bullet injuries differs greatly from that of high-velocity gunshot wounds due to the distinct ballistic characteristics of the projectiles. Gravitational bullets are typically characterized by a lower velocity, attributable to air resistance and the force of gravity, as they descend from their peak altitude. Despite the reduced speed, their mass and shape still have the potential to inflict

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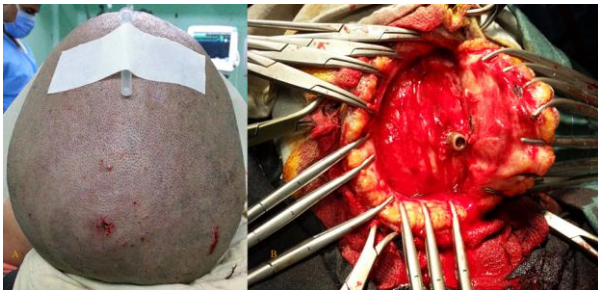


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significant damage upon impact. In contrast to high-velocity bullets, these falling bullets deposit less kinetic energy into the skull, which decreases the likelihood of extensive bone fragmentation and secondary projectiles [2]. This lower energy transfer also leads to a lesser cavitation effect, a phenomenon of temporary cavity formation seen prominently in high-velocity gunshot wounds, which causes extensive radial damage to the surrounding brain tissue [1].



A 23-year-old male presented to our emergency department with an acute onset of scalp bleeding. His initial head computed tomography (CT) scans (Axial and coronal views) show (A, B respectively) intraparenchymal hemorrhage near the superior sagittal sinus. (C) is sagittal bone window CT scan exhibits the metallic object (bullet) penetrating the calvarium near the vertex and reaching the parenchyma of the brain.



Our experience has consistently shown that gravitational bullets, upon entering the cranium, invariably end up either on the tentorium or within the skull base. In the cases that we encountered, gravitational bullets can rarely transgress the cerebellar tentorium if they have a vertical trajectory. This uniform pattern provides us with valuable information about the behavior of these projectiles after cranial entry and may inform surgical approaches, enabling more precise predictions about injury patterns, and improving patient outcomes. Such a phenomenon could be explained by the fact that gravitational bullets are low-velocity projectiles with low kinetic energy.

Furthermore, a particular observation from our clinical experience that warrants further

investigation concerns the pediatric population's vulnerability to gravitational bullet injuries. A study conducted by Smith et al. [4] demonstrated that both bone thickness and density increase with age from birth to 18 years, which suggests that the pediatric population, particularly younger children, have a significantly thinner cranial vertex than adults.

The reduced cranial thickness may render this age group more susceptible to severe injury from gravitational bullets. Further, we have noticed that following a gravitational bullet wound, brain injury, and bleeding tend to be more aggressive than adults as the protective vertex bone is thinner resulting in more penetrating injury.

Understanding the reasons behind this more severe presentation in the pediatric population is crucial. Contributing factors could be multifactorial, encompassing the relative vascularity of the pediatric brain, differing responses to trauma, and even elements relating to the gravitational bullet's trajectory or velocity. These observations underscore the importance of tailoring management strategies to this age group, with a focus on prompt surgical intervention and rigorous hemodynamic stabilization.

These observations highlight the urgent need for comprehensive studies on the unique characteristics and outcomes of gravitational bullet injuries. Given the specific cultural context driving the prevalence of these injuries, it is imperative to understand the unique dynamics of gravitational bullet wounds. Greater awareness, stricter regulation of celebratory gunfire, and enhanced understanding of these injuries can collectively contribute to reducing their incidence and improving care for those affected.

## REFERENCES

1. Abdali HA, Hoz SS, Moscote-Salazar LR. Cranial Gravitational (Falling) Bullet Injuries: Point of View. *J Neurosci Rural Pract*. 2018 Apr-Jun;9(2):278-280.
2. Alvis-Miranda HR, Rubiano AM, Agrawal A, Rojas A, Moscote-Salazar LR, Satyarthee GD, Calderon-Miranda WG, Hernandez NE, Zabaleta-Churio N. Craniocerebral gunshot injuries; a review of the current literature. *Bulletin of Emergency & Trauma*. 2016 Apr;4(2):65.
3. Shuker ST, Satta R. Craniomaxillofacial falling bullet injuries and management. *J Oral Maxillofac Surg* 2010;68:1593-601.
4. Smith K, Politte D, Reiker G, Nolan TS, Hildebolt C, Mattson C, Tucker D, Prior F, Turovets S, Larson-Prior LJ.

Automated measurement of pediatric cranial bone thickness and density from clinical computed tomography. In 2012 Annual International Conference of

the IEEE Engineering in Medicine and Biology Society 2012 Aug 28 (pp. 4462-4465). IEEE.