

GUNSHOT WOUNDS: MEDICO-LEGAL PERSPECTIVES

'There is a kind of medical knowledge which is not so much concerned with the cure of disease as the detection of error and the conviction of guilt.' – Samuel Farr (1788)

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In South Africa an estimated 127 000 people per year seek treatment for gunshot injuries at state hospitals and there are approximately 20 000 firearm-related fatalities annually – far exceeding the number of fatalities associated with motor vehicle accidents and resulting in enormous costs to the country.^{1,2} Sadly, almost 90% of these deaths are due to interpersonal violence. By comparison, there are approximately 30 000 gunshot fatalities annually in the USA, but only approximately one-third of these are due to homicide (with some 16 000 deaths due to suicide).³ Globally, some 500 000 people die annually as a result of gunshot injury – 300 000 in regional conflict and 200 000 due to interpersonal violence and suicide.⁴ The shocking conclusion is that South Africa probably contributes a greater number of homicidal deaths to this latter statistic than any other country in the world.

Clearly, medical practitioners in South Africa – at least those in the surgical and emergency medical care disciplines – will regularly deal with gunshot injuries. This article deals with the medico-legal perspectives of such cases, and stresses that the initial evaluation and description of these injuries may be vitally important in the police investigation and subsequent judicial proceedings. It is a sad indictment of our profession that many cases of violent and sexual assault that come before our courts are ultimately abandoned or dismissed purely due to lack of appropriately documented medical evidence. Remember too, that the vast majority of legal proceedings involving gunshot injuries will be decided on the evidence gathered and recorded by doctors other than forensic medical officers or pathologists.

Only some 20% of fatal cases are examined by specialist or experienced forensic practitioners, meaning that legal proceedings deriving from tens of thousands of fatal and non-fatal gunshot injuries will be dependent on the adequate initial medico-legal assessment and recording done by general medical and surgical practitioners. Knowledge of forensic medical perspectives regarding gunshot injuries is therefore certainly not only the domain of the forensic pathologist.

Doctors should understand that it is not sufficient simply to diagnose or record that the patient has suffered a gunshot injury: in most cases witnesses or the policeman attending the scene can adequately attest to that. The doctor must give important further objective and reliable information regarding *inter alia* the probable distance from which the shot(s) had been fired; the direction of fire; specific entrance and exit wound features; the calibre and kinetic energy of the projectile; whether the wounds represent probable self-inflicted, accidental or homicidal injury; what the victim's capacity to act may have been after sustaining the injury – and more. This can only be done if due attention is paid from the outset to the broader medico-legal perspective, without in any way detracting from the effective clinical management of the patient.

MANAGEMENT OF GUNSHOT WOUNDS

A detailed protocol for the medico-legal management of gunshot wounds in the clinical setting is not provided here.

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However, clinicians dealing with these injuries should ensure that a practical and accountable protocol is followed and that all staff (including emergency support staff and nursing professionals) are informed as to the medico-legal perspectives. Often, items of clothing worn by the victim are a vitally important source of information – where gunpowder or soot soiling is noticed on clothing, the latter should be carefully handled and retained (having perhaps been removed at the scene or in the casualty section), in order that these items may be handed to the South African Police Services (SAPS) for further analysis where necessary.

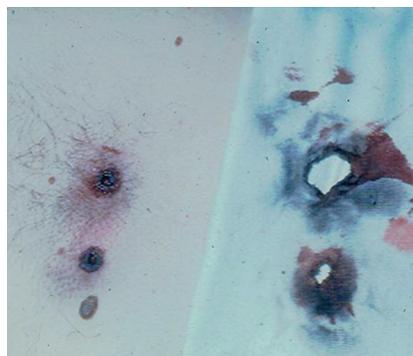


Fig. 1. Items of clothing may alter or mask important wound features and provide valuable additional information. Here, soot and powder soiling of the clothing indicate a close range discharge. Searing injury can also be seen on the surrounding skin.

Similarly, where uncertainty exists regarding the probable circumstance of injury (whether self-inflicted, accidental or homicidal), consideration should be given to timeously requesting the SAPS to perform gunshot residue tests on the hands of the victim at the earliest practical opportunity – this may contribute greatly to the subsequent investigation of the case. Where projectile(s) are removed from patients (either at surgery or, as is quite common, where found within the items of clothing of the victim), these precious evidentiary items should be carefully handled to prevent scratching or damage, sealed in a container or envelope and entrusted to a specific individual for safe custody, until they can be handed to a police officer. The SAPS are capable of sophisticated projectile analysis using the integrated ballistic identification system (IBIS), which may lead to successful matching of spent projectiles found at different crime scenes or from different bodies – and which may link various crimes to one weapon or person.



Fig. 2(a). Projectiles should be treated as valuable evidentiary items. The striations seen on the surface are unique and may serve as 'fingerprint' features to identify the gun that fired the projectile.

Furthermore, all cities and major towns in South Africa have local criminal record centres (LCRCs) of the SAPS, from where an official police photographer can be speedily despatched, in order to take good quality photographs of the injuries, as soon as is feasible after initial assessment and/or management. Photography may be invaluable in

facilitating subsequent investigation and legal proceedings, especially where unusual wound features or distribution of injuries are seen. The medical and surgical intervention provided (including wound cleaning or disinfecting procedures and suturing), together with early healing changes, may rapidly alter the appearance of the injury, to the extent that its primary nature may be impossible to assess. A good early assessment is a golden opportunity for clinicians to capture essential evidence, thereby contributing in a very material and often most objective manner to the huge burden of fighting crime in our country.



Fig. 2 (b). Unusual or highly characteristic wound features are often best documented by photography. Here, a typical contact gunshot injury is seen, with a muzzle imprint and adjacent injury caused by the recoil pin of the pistol.

BALLISTICS

In order to fulfil these medico-legal obligations, as well as their medical duty of care, it is essential that those who provide medical and surgical treatment to victims of gunshot

injuries be well informed of the basic principles of ballistics. Again, definitive review cannot be provided here, but an understanding of the three branches or subdivisions of ballistics and projectile injury is essential. These are:

- internal or weapon ballistics
- external or intermediary ballistics
- terminal or wound ballistics.

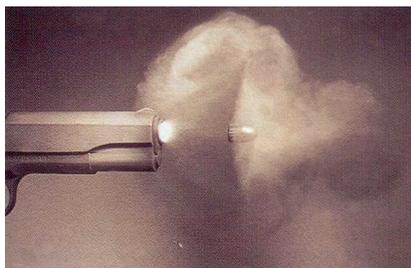


Fig. 3. With close range discharge of a firearm, heated gases (flame), smoke and soot, as well as unburned gunpowder particles may result in characteristic features on the target or victim.

Internal or weapon ballistics

A basic knowledge of internal or weapon ballistics will allow clinicians and medico-legal practitioners alike to understand the important differences between handguns and shoulder arms, revolvers and pistols, smooth bore and rifled weapons. In addition, they should know the difference in wounding patterns between projectiles of small and large calibre, with high and low kinetic injuries and with different structural composition, leading to huge variations in tissue penetration, projectile break-up and tissue destruction. Some understanding of the large spectrum of ammunition that is available on the open and covert market (including illegal projectile types which are not uncommonly encountered in South Africa) is required. Only a few of these can be referred to here, but remember that ammunition manufacturers make these projectiles for specific purposes: some are intended to provide high penetration capacity, while others are made to fragment or deform and stop upon impact. It is for these reasons that some projectiles have sharp points while others have rounded, flat or

even hollow tips; some have a full metal jacket (to protect the projectile in flight and to improve penetration), while others have only a relatively soft lead alloy composition, allowing them to be easily deformed – and leading to rapid stopping and indeed, energy transfer. X-rays of the injured body parts may aid greatly, even if the projectile is not removed (ballistics experts may well still be able to identify the type of projectile and/or calibre of the weapon used).



Fig 4(a). The Black Talon projectile, with exceedingly sharp edges that are folded open upon impact, may cause severe tissue destruction – and injure the unwitting surgeon!



Fig 4(b). The Eliminator projectile has a small plastic cap which covers a central pillar, and which may cause a second skin wound at close range. Note the flattened shape of the spent projectile, meaning more effective energy transfer to the tissues.

Terminal or wound ballistics

Terminal or wound ballistics involves some understanding of impact kinetics and mechanical properties of tissue. The fundamental determinant of the extent and type of tissue damage caused by a projectile is that of energy transfer to the tissues. Clearly, the higher the initial kinetic energy that a projectile has, the greater the potential for transfer of this energy to the target (victim). The most important single determinant of inherent kinetic energy

is, of course, velocity. However, a number of other factors will also influence the actual amount of energy transferred, including the calibre, 'front' and composition (including propensity to fragment upon impact) of the projectile, the nature of the tissue that is struck and the anatomical site involved. Where soft tissue (skin, muscle, etc.) is struck by a rapidly moving projectile, the effect is similar to that of a stone or pebble being cast into a pond, with the hydrodynamic effect resulting in a peripheral or radial displacement of energy – often resulting in substantial tissue damage (also to nerves and blood vessels) at some distance away from the primary tract or path of the projectile, without these areas actually having been struck by the projectile. Even fractures may be caused (including 'blow-out' fractures in the skull) at sites where no contact with the passing projectile took place. Understanding the nature of the temporary and permanent wound cavities will also enhance our ability to treat these injuries effectively.



Fig. 5. The kinetics of gunshot injuries are very similar to those of a pebble being cast into a pond, being a 'hydrodynamic' event with rapid – and repeated – radial displacement of energy waves in the tissues.

ENTRANCE AND EXIT WOUNDS

A good knowledge of the distinguishing features of entrance and exit gunshot wounds is required, as well as of the different types of entrance wounds. Entrance wounds can be divided into contact wounds, close range or intermediate range wounds and distant wounds. Further subdivisions are possible, where close

inspection and a good understanding or knowledge of wound features exist. From this, together with knowledge of the specific type of weapon and/or ammunition and with test shots fired with the relevant (or similar) weapon, it is often possible to reconstruct with reasonable accuracy what the probable distance of fire may have been.

heated gases (even erupting into flame upon leaving the barrel), smoke and soot as well as partially burnt gunpowder may therefore strike the target if the weapon is discharged at relatively close range (see Fig. 3). These features, which must be carefully sought and reliably documented, will provide invaluable evidence in corroborating or refuting versions

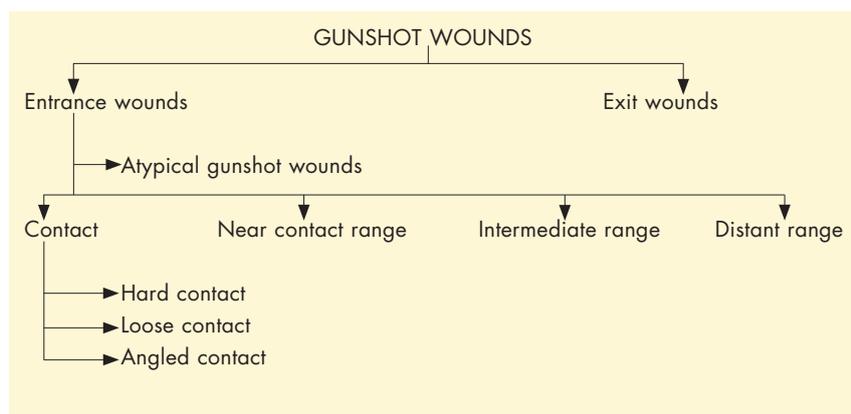


Fig. 6. Classification of gunshot wounds.

Contact gunshot wounds are of great significance in the forensic setting, most often implying intentional self-inflicted injury, although close physical struggle and execution-style shootings must also be considered. These wounds always require accurate description, and close attention to the size, shape and appearance of the base and periphery of the wound.

It should also be borne in mind that it is not only the projectile that exits the barrel of the weapon upon firing:



Fig. 7. Contact (entrance) gunshot wounds to the head often show large stellate defects, due to the explosive blast of the gases driven under the skin, with powder/soot blackening in the base of the wound.

of how the injury may have been sustained. Searing injury due to flame or heat, blackening due to smoke and tattooing due to impregnation of the skin by burning or unburnt particles of gunpowder, will often provide definitive proof that a weapon has been fired from close range – but it should be left to experts to comment on these probable ranges, as many factors may influence the latter.

Nursing professionals should be informed that where reasonably possible, the wounds should not be swabbed unduly or cleaned until the attending clinician has had an opportunity to assess and record the wound features. Handgun injuries from an intermediate range (usually between approximately 10 and 50 cm, where some powder may still be deposited on the target/victim) often require particularly close scrutiny, since tattooing may be difficult to see, especially in hairy parts of the body or in those with dark skin.



Fig. 8. Close range discharge results in powder and/or soot deposition on the skin or clothing, which may be very important evidence in reconstructing the circumstances of the injury – but which may be relatively easily wiped away during initial wound cleaning.



Fig. 9. Tattooing results from close range discharge, with gunpowder particles being impregnated into the skin. The dispersion pattern and width may greatly assist in assessing the direction and/or distance of fire.

Atypical entrance gunshot wounds may be seen in cases where the projectile has struck an intermediary target (quite commonly seen in shootings associated with hijackings, where the victim is shot through a glass panel or window), or where there has been a ricochet off another surface (important in instances where the assailant claims not to have fired directly at the victim). In these latter instances, the projectile may have fragmented or become deformed and/or unstable

in flight prior to striking the body, resulting in an irregular defect, perhaps associated with additional or surrounding penetrating lesions from secondary projectiles or fragments. Similarly, angled or oblique entrance wounds may have unusual shapes or configuration.



Fig. 10(a) and 10(b). In areas covered with hair, or individuals with dark skin, features such as tattooing or skin searing (heat injury) should be carefully sought, by shaving and/or close inspection of the wound surrounds.



Fig. 11. Atypical entrance wounds – in shape, size or number – may result from projectiles that have become unstable or fragmented in flight, due to striking intermediary targets, like vehicle windows.

Exit wounds tend to vary widely in their appearance and may be multiple (in the event of fragmentation of the projectile or secondary projectiles resulting from shattered bone), very irregular in shape (even mimicking incised wounds) and are usually



Fig. 12. Irregular or eccentric collars of abrasion around entrance wounds may suggest an angled or tangential projectile entry.

significantly larger than the entrance wounds. Care should be taken to differentiate contact entrance wounds from exit wounds, especially to the head. Examining the base of the wound for signs of blackening and searing will help.



Fig. 13. Exit gunshot wounds are usually irregular in shape and relatively large – and may be confused with contact entrance wounds.

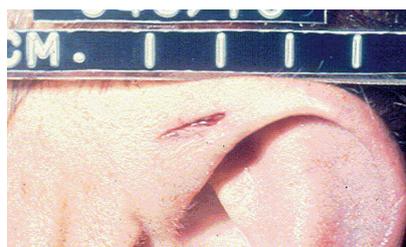


Fig. 14. Exit wounds are unpredictable in their appearance and may even look like incised wounds.

DESCRIPTION OF THE WOUND

Doctors should at all times describe the anatomical site, size and salient wound features accurately – and should certainly not simply state 'entrance wound right shoulder', without due recording of what the



Figs 15 (a) and (b). Exit wounds may be multiple, due to projectile break-up or formation of secondary projectiles (like bone fragments).

specific wound features were that merited such conclusion. It is almost certain that a good defence attorney (many of whom now have superb knowledge of gunshot wounds and ballistics) will query the clinician's conclusion – and may well create such uncertainty in the mind of the presiding judicial officer that the doctor's evidence is eventually questioned or even disregarded. Where more than one wound is present, it is even more imperative to describe wound features accurately, since justified distinction between entrance and exit wounds then becomes very relevant.

In particular, care should be taken also to describe the probable exit wound in detail. Where there are multiple gunshot wounds, it is best to number the wounds clearly and individually and to describe each injury accurately, without trying to correlate entrance with exit wounds. This is difficult enough even at autopsy, where there may be the benefit of dissection and exposure of the entire tract. It is advisable to describe the anatomical site of injuries with reference to fixed points, e.g. 'located on the left lower abdomen, 12 cm lateral to the midline, 46 cm below the left clavicle and 109 cm above the left heel'.

In addition, anatomical line sketches are invaluable.

Always assume that there are more than 1 or 2 wounds: do not neglect to carefully inspect body orifices, the scalp and particularly, the posterior aspect of the patient for further wounds. Small calibre weapons may leave very insignificant wounds with almost no external bleeding.



Fig. 16. Gunshot wounds involving body orifices and irregular surfaces (including the hands and face may be easily missed and difficult to assess – and should best be described accurately without making unwarranted conclusions as to entrances or exit nature.

CONCLUSION

Readers are strongly advised to consult appropriate texts for definitive information regarding the medico-legal features and appearances of the full spectrum of gunshot wounds. Nowhere in the world is this knowledge of greater importance than in our country. Only a selection and brief overview of some of the most important features that should be assessed and recorded has been provided here. Doctors should not disregard or underestimate the important role they can play in combating gun-related crime and injury in South Africa – our duties in

many of these cases certainly extend beyond only treating the patient. Ensuring that all members of the health care team are informed and appreciative of their responsibilities regarding preservation, recording and even verbal presentation of evidence when required, is vital.

References available on request.

Further reading

Di Maio VJM. *Gunshot Wounds*. 2nd ed. Boca Raton, Florida: CRC Press. 1999.
Firearms and gunshot injury (tutorial): <http://www-edlib.med.utah.edu/WebPath/TUTORIAL/GUNS/GUNINTRO.html>
Firearms and gunshot injury (tutorial): <http://www.forensicmed.co.uk/index.htm>

IN A NUTSHELL

Communicate with emergency medical staff about the alleged circumstances of the shooting and whether items of clothing have been removed, etc.

Ensure that nursing assistants do not unduly clean or wipe the wound(s) before the attending doctor has inspected the injuries.

Ensure that any projectile is carefully handled and safely kept by a designated individual, for personal handing over to the SAPS.

Number wounds carefully and make appropriate annotated anatomical sketches.

Describe individual wound features fully, and do not make unwarranted conclusions as to the primary nature of the wound

Examine body orifices, hair-covered regions and the posterior aspect of the body carefully for additional gunshot wounds.

Consider the involvement of the SAPS for purposes of photography, gunshot residue tests, etc.

Take X-rays of the injured body part(s) — even (especially!) if there is an exit wound.

Consider other relevant medico-legal perspectives, such as alcohol or drug intoxication.