DETECTION AND SIGNIFICANCE OF BLOOD IN FIREARMS USED IN CONTACT GUNSHOT WOUNDS

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DISSERTATION

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MAGISTER SCIENTIAE in **Medical Criminalistics.**

DECLARATION

I hereby declare that this dissertation is my own work. It is being submitted for the degree **Magister Scientiae** in **Medical Criminalistics** at the Department of Forensic Medicine at the University of Pretoria.

It has not been submitted before for any degree or examination at this or any other university.

Opinions or statements expressed in this dissertation do not necessarily reflect that of the University of Pretoria, the supervisor or co-supervisor of the dissertation, or that of the external examiners.

Jo-Marí Visser

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ABSTRACT

Firearm fatalities in South Africa are responsible for a very large number of fatalities. For purposes of judicial administration, determination of manner of death, in particular, differentiating between homicidal, accidental and suicidal death, is one of the primary objectives in fatal shooting investigations.

Determining the muzzle-target distance can assist in establishing the manner of death, since contact gunshot wounds are seldom seen in cases of homicidal or accidental death. It has been reported that muzzle-target distance can be confirmed by detection of blood back spatter on the inner and outer surfaces of the weapons.

To determine whether this phenomenon was being used to assist the forensiometric analysis of fatalities, a study was undertaken whereby weapons used to inflict fatal contact gunshot wounds in victims presenting at the Pretoria MLL, were requested for biological analysis during the period June 2002 to June 2003. Of the 123 cases identified, only 30 firearms were delivered to the FSL for analysis. Blood was found on the inside of barrels in 70% of cases, and the outer surface in 40%. These figures do not correlate well with international studies.

The very low retrieval rate of weapons for analysis precludes the use of an important forensiometric tool in medico-legal investigation of firearm related fatalities in Pretoria. The urgent need to develop adequate protocols with respect to police handling of weapons is hereby confirmed.

OPSOMMING

Skietwond sterftes in Suid Afrika is verantwoordelik vir 'n groot hoeveelheid van alle sterftes. Vir geregtelike administrasie, is bepaling van oorsaak van dood, en in besonder differensiasie tussen moord-, ongeluk- en selfmoord sterftes, een van die primêre doeleindes in noodlottige skietgeval ondersoeke.

Bepaling van die loop-teiken afstand kan die bepaling van die oorsaak van dood fasiliteer, aangesien kontak skietwonde selde in moord- of ongeluksterftes teëgekom word. Dit is aangeteken dat loop-teiken afstand bevestig kan word deur die opsporing van bloed spatsels aan die binne- en buitekantste oppervlakke van die vuurwapens.

Om te bepaal of hierdie verskynsel gebruik is om die forensiometriese analise van sterftes te assisteer, is 'n studie onderneem waarvolgens wapens, gebruik in die toediening van noodlottige kontak skietwonde in slagoffers wat presenteer by die Pretoria RGL, aangevra is vir biologiese analise tydens die periode Junie 2002 tot Junie 2003. Van die 123 sake geïdentifiseer, was slegs 30 vuurwapens na die FWL geneem vir analise. Bloed was sigbaar aan die binnekant van wapens in 64%, en aan die buitekantste oppervlak in 40% van alle sake. Hierdie syfers korreleer nie goed met internationale studies nie.

Die baie lae opsporingsyfer van vuurwapens vir analise sluit die gebruik van 'n belangrike forensiometriese instrument in regsgeneeskundige ondersoeke van vuurwapen-verwante sterftes in Pretoria, uit. The dringende noodsaaklikheid vir geskikte protokol met betrekking tot polisie hantering van wapens is hierdeur bevestig.

ABBREVIATIONS

FSL: Forensic Science Laboratory

FWL: Forensiese Wetenskap Laboratorium

MLL: Medico-legal Laboratory

RGL: Regsgeneeskudige Laboratorium

CRC: Criminal Record Centre

SAPS: South African Police Service

SAP13: Abbreviation employed to describe the register at police stations where all items of physical evidence (for example, firearms) are registered and stored.

GSR: Gunshot residue

IBIS: Integrated Ballistics Identification System

AFIS: Automated Fingerprint Identification System

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Chapter 1

BACKGROUND AND STUDY OBJECTIVES

1.1 Introduction

In South Africa, firearm fatalities accounted for the greatest number of homicidal deaths in the year 2000, as well as in 2001, constituting 52 percent and 54 percent of all homicidal deaths, respectively (n = 8 395 [2000] and n = 11 254 [2001]). Suicidal gunshot events accounted for 34 percent of all suicidal deaths in 2000 (n = 1 782) and 29 percent of those in 2001 (n = 2 500), being one of the greatest causes of suicidal death, second only to death by hanging.[1, 2]

When law enforcement agents are called to a scene of a fatal shooting, one of the most important aspects to be addressed is mode of death (that is, whether death was suicidal, homicidal or accidental). Misjudgement of manner of death may cause severe problems and can have far-reaching effects on payments of insurance money, research, and justice. The underreporting of suicides and homicides have already been reported, for example, in cases where suicides were classified as accidents to "make things easier" for the family and oftentimes to prevent an in-depth investigation that requires much input from already overburdened officers.[3, 4]

In South Africa, formal classification of mode of death is *not* the responsibility of the investigating officer, forensic pathologist, or forensic scientist, but rather that of the Court. The investigating authorities are responsible for supplying the Court with evidence, information, and opinions to assist the Court in making its decision.

Every piece of physical evidence must be collected from the scene, however insignificant it may seem. Unfortunately, the opinions of the investigating officers

regarding the manner of death may lead to subjectivity in detecting and collecting evidence. Crucial evidence may be then be overlooked.

The extremely high rate of unnatural deaths in South Africa inevitably leads to a heavily burdened police force. In South Africa – depending on the jurisdiction – detectives are expected to investigate up to one hundred new cases per month, which is an extremely elevated rate of new casework. This, together with the urgency of solving as many cases as quickly as possible, may cause crucial evidence to be overlooked if – at first glance – the manner of death seems obvious. In an effort to save time, or in misjudgement of the evidence at the scene of a shooting, erroneous interpretations may cause misjudgement of the manner of death.

In homicidal shootings deaths where the firearm were neatly placed in to the hand of the deceased, it would be easy for the inexperienced officer to conclude homicide as manner of death, when it was in fact suicide. Here, all other evidence must be analysed and interpreted.

Manner of death in fatal shooting incidences may also be *disguised*.

Suicides disguised as either homicide or accident will allow the family members of the victim to collect insurance money, and to escape the stigma attached to suicide (which may cause family embarrassment).[6] It may even be disguised by the deceased self to gain notoriety as a victim or to lay blame elsewhere.[6] Various other personal, religious, and social reasons may cause the concealment of firearm suicides.

Some homicidal firearm deaths may be concealed to suggest suicide or accident in an attempt to prevent the subsequent investigation into the identification of the perpetrator. It is therefore essential that *all* fatal shootings be investigated with objectivity and thoroughness to prevent wrongful classification of mode of death.

The *multivariate (forensiometric) model* has been developed in the late 1990's by Thor Karlsson[7], to be used as an expert aid in the discrimination between homicidal and suicidal firearm deaths. This model functions by assigning a value to each of fifteen aspects (variables) of a specific case. The variables are then ranked in falling order of correlation with either homicide or suicide.[7]

Some of the variables used in this model include the following:

- Muzzle-target distance (that is, the distance between the muzzle end of the barrel of a gun and the surface of the target).
- Anatomical location of entrance wounds.
- Location of the weapon after the fact.
- Age and gender of the victim.
- The presence of a suicide note.
- Bullet path through clothing.
- Location of body on the scene, etc.[7]

These variables should never be considered to possess evidential value as separate entities, but should always be used *in conjunction with one another*.

Assessment of shooting distance is perhaps one of the most significant components in the process of establishing the manner of death in a fatal shooting. Suicides are committed within contact or near contact range (approximately 97%), while 50% of homicides occur at distant ranges and approximately 75% of all firearm accidents occur at intermediate distances.[8, 9, 10] Determining the muzzle-target distance is therefore a vital tool used to facilitate the forensiometric process of excluding or proving homicide or suicide.

Confirmation of the muzzle-target distance being within contact range may be found in the medical and/or scientific arenas of forensic investigation.

The appearance of *gunshot wounds* can yield important information concerning the muzzle-target distance. However, in some cases it may be impossible to interpret muzzle-target distance based on the appearance of a particular wound. It then becomes imperative to evaluate additional physical evidence to identify the range of weapon discharge.

Examining the bloodstains and spatter at a scene, on or inside the barrel of a weapon or on the clothing of the victim and/or perpetrator can be instrumental in determining the distance of discharge[11, 12, 13], as well as in reconstructing the event.

Bloodstains and spatter from gunshot wounds are produced from both forward spatter (blood spatter laterally ejected from the exit wound) and back spatter (blood and other biological matter ejected in the contrasting direction as movement of the projectile).[14]

When a firearm is *discharged at close range* of the target surface, back spatter may be found on the shooting hand and/or weapon.[4] At intermediate and distant gunshot ranges, the shooting hand and weapon will be beyond back spatter range and will therefore be clear of blood droplets. (It is important to bear in mind that the absence of blood droplets on a firearm does not necessarily imply intermediate or distant firearm discharge. It is the *presence* of blood droplets that serve as confirmatory evidence.)

The *drawback effect* (or blowback effect) is a phenomenon seen mainly in contact and close-range gunshot wounds.[12] It refers to the process in which blood droplets are deposited *inside* the barrel of a weapon after discharge. The cause of this phenomenon has not yet been agreed to, but current theories include the increased pressure in the gunshot wound and the near vacuum in the barrel (created by the discharged gases escaping along with the projectile), which then creates a sucking effect that sucks blood and other biological tissue into the barrel.[15]

The distance that blood droplets and other biological tissue penetrate a barrel of a gun may assist the determination of the *precise distance* (down to one centimetre) between the wound and weapon at the time of discharge[15], but the real relevance of this information is debated[12], as the close proximity of discharge is already confirmed by the mere presence of blood.

A firearm discovered on the scene of a fatal shooting (especially where discharge distance is disputed) should therefore be carefully examined for the presence of blood spatter on the outside and on the inside thereof.

The importance of this information lies in the statistical fact that suicide acts seldom occur at distances greater than a few centimeters.[10] If the muzzle-target distance can be calculated within a certain range, it assists the reconstruction of the event and might facilitate the process of excluding homicide and accident as mode of death by forming part of the forensiometric analysis process.

The aim of this prospective analytical study was to determine the frequency of blood back spatter on the inside of barrels of firearms used in contact gunshot wound events in the Pretoria metropolitan area. In addition, any contributing factors that may have influenced the phenomenon of drawn back blood in the barrels, are discussed.

Problems encountered and some surprising results are also described

1.2 Literature Review

In South Africa, more people are killed with guns each year than by any other means. Suicide by firearm is the second most popular mode of suicide among South Africans.[1, 2] In the United States of America, the incidence of firearm suicides are much greater than all the other methods combined.[16]

Conversely, firearm-related deaths in Europe and Canada, for instance, are much more infrequent than in South Africa or the United States.[17]

A possible explanation for the extremely high rate of firearm deaths in America and South Africa may be the rate of gun ownership in these countries. In Europe and Canada, laws governing the possession of weapons are much more severe than in America, and consequently, there are only a few European families in possession of a firearm.[18, 19] The majority of gun owners in these countries are hunters who generally purchase long guns (that is, rifles and shotguns). As a result of this, the vast majority of suicidal firearm deaths in Europe and Canada are committed with rifles or shotguns.[7] In Sweden, for instance, the majority (35 percent) of all suicides are committed with shotguns. In Canada, 61 percent of suicides are committed with shotguns, and a mere 8 percent with handguns.[7, 18] In the United States, however, 75 percent of all suicides are committed with handguns, and only 25 percent with long guns.[10]

The United States of America has one of the highest rates of firearm suicide and homicide, as well as one of the highest rates of gun ownership in the world. Kaplan and Gering[20] performed a study during the late nineties on the differential impact of gun availability on firearm homicides and suicides in America. They discovered that elevated availability of weapons, and subsequent increased gun ownership, has a stronger impact on suicidal than on homicidal firearm deaths. The study suggested that ready availability of weapons in homes can be associated with increased risk of *suicide* by firearm. This suggestion is supported by separately performed studies[21, 22].

In the early eighties, Markush and Bartolucci[23] researched the statistical increase of suicide with increased gun availability and found a 3.0 per 100 000 population increase in the suicide rate per 10 percent increase in the household prevalence of firearms.

On account of the equally lenient gun laws in South Africa, combined with the notable number of stolen weapons circulating the streets of this country, it may be accepted that the high rates of firearm suicide and homicide in South Africa can be attributed to the high rate of gun ownership – whether legal or illegal.

To combat the increased level of firearm deaths, one may suggest reduction of the aggregate levels of gun availability, which may decrease the risk of gun-related deaths, and especially suicidal firearm fatalities.[20] However, this may have little impact on the vast number of fatal shootings in this country if the investigation of firearm-related deaths is not of highest quality.

When arriving at a scene of a shooting fatality, it becomes essential to detect and examine all aspects that will later clarify manner of death as suicide, homicide, or accident. Many cases of suicide are indisputable and obvious to both law enforcement and the victim's family. In a considerable number of cases, however, manner of death is not as apparent and requires scrupulous examination of all aspects of the case.[24]

The official number of firearm accidents that occur annually in any given country may not always reflect the true statistics, as some accidental shooting deaths are all too freely classified as being suicidal in nature, or vice versa. Lack of knowledge concerning the circumstances of the death, weapons, or a sincere attempt to ease the suffering of family and friends, may result in the wrongful classification of manner of death as an accident.[4]

The accurate classification of manner of death in all firearm-related deaths is of crucial importance. As previously mentioned, insurance companies, family members, and ultimately members of the general community will suffer if these deaths are falsely classified.

Bennett and Collins[24] performed an analytical study of all variables in alleged suicide cases to assist the forensic investigator, pathologist, and the court in accurately assigning cause and manner of death to a suicidal gunshot death. These variables included mutual histories, scenarios, demographics, risk factors, and methods of suicide. They examined age, sex, race of the victims, presence of a farewell letter, time of year, etc.

This study produced interesting statistics and pointed to definite tendencies in suicide by firearm. (In fact, a significant part of their findings correlated with those data produced by Thore Karlsson[7] in his development of the *forensiometric model*, as discussed in the following paragraph).

Earlier, in the late nineties, Thore Karlsson developed the distinguished multivariate "forensiometric" system of analysis.[7, 25] The objective of this *forensiometric model* was to aid the predictions regarding whether a certain fatality exhibits similarities to homicide or suicide. The model was created by complex multivariate projective statistical methods (PCA, PLS-DA) and logistic regression analyses.[25] It employs all available variables from an investigation in a mathematical formula to categorise the specific case as being either homicide or suicide. In this model, the variables are identified and ranked in falling order of correlation with homicide or suicide by firearm.[7]

The variables usually employed in the forensiometric model can be seen in ***Table 1.1***. The variables are arranged in falling order of correlation to homicide or suicide.

Table 1.1: The variables used in Karlsson's forensiometric model.[7]

HOMICIDE	SUICIDE
Other injuries than gunshot injuries	Firearm found close to the body
Entrance wounds in anterior aspect of the chest EXCEPT the precordium	Suicidal ideation
Bullet path through clothing	Victim's age
Entrance wound in the upper extremities	Contact entrance wounds
Female victim	Male victim
Entrance wounds in the abdomen	Suicide note
Entrance wounds in the head EXCEPT in the temples, mouth, and central forehead	Entrance wounds in the mouth, temples, and central forehead

*Entrance wounds in the back	

Continue*

It is clear that the main factors used in forensiometrics to determine manner of death include:

- *Muzzle-target distance* (that is, the distance between the muzzle end of the barrel of a gun and the surface of the target) – the vast majority of suicides are committed within contact range, accidents within close to intermediate range, and homicides within intermediate to distant ranges.[9]

- *Anatomical location of entrance wound* – sites of preferred suicide usually include the temples, mouth, and central forehead.[7]

- *Location of the weapon after the fact* – weapons are usually within reach of the body in cases of suicide and "weapon cleaning" accidents.[4, 7]

- *Age and gender of the victim* – males are more likely to commit firearm suicide, and – dependent on the country – the age range of individuals committing suicide with firearms also fall into a specific group.[7]

- *The presence of a suicide note* – though the absence of a farewell letter does *not* necessarily preclude suicide, the presence of a suicide note is strong indication of suicide.

- *Bullet path through clothing* – it has been found that a bullet path through clothing is more prevalent in homicides and accidents than in suicides.

- *Location of body, etc.* – the majority of individuals who commit suicide do so in the privacy of their homes, while the majority of homicides are committed outdoors.[7]

- *Bullet trajectory in the body* – research has found that the trajectory of the bullet can be valuable evidence in a shooting fatality. Suwanjutha[8] (1988) found that direction of a bullet's path in suicides are in an angle of elevation 77 percent of the time, while in homicides they are at a horizontal level 53 percent of the time.

It should again be emphasised that these variables should never be considered to possess evidential value as separate entities, but should always be used *in conjunction with one another*.[7]

The forensiometric model was formulated by compiling data from several police records, autopsies, and toxicology reports and the coherent information from these cases were defined using the projective multivariate analysis system. Consequently, when a new case of firearm-related death is investigated, each variable in the case is ranked according to the model and a mathematical value is assigned to each variable. If – after use of the model's formulae – the total value in the case exceeds 0.5, it is considered to be a homicide.[7]

Karlsson validated the model by employing forensiometric analysis in assigning mode of death classifications to a set of cases that were already classed as homicide or suicide following thorough police and medical examinations. All suicides were classified accordingly by the model and all the homicides, save two, were classified as such. Therefore, Karlsson deducted that his model exhibited 89 percent sensitivity and 100 percent specificity in classifying homicides.[7]

Even though the model may be highly advantageous in the investigation of homicide or suicide, a fixed model for accidental shooting fatalities has not been included in the study. Such a model would be of great assistance, as accidental firearm fatalities are likely to be under- or overreported.[4]

Estimating the *muzzle-target distance* is perhaps one of the most significant elements in the forensiometric model. Careful examination of gunshot wounds may yield important information regarding the range of weapon discharge. Suicidal gunshot wounds, for example, customarily exhibit features characteristic of contact or near contact weapon discharge, unless some device was present to reach the trigger from a greater distance.[10, 19]

However, differentiating between contact and distant gunshot wounds on the basis of examining features of entrance wounds may be hampered by the following factors:

- Decomposition of the body – blackish discoloration of the skin surrounding the defect may simulate or conceal soot deposition. Powder tattooing and soot may be lost if slippage of the skin occurs and dried blood around the edges of the entrance defect may also simulate partly burnt powder particles.[4]

- When a weapon is discharged within soot and smoke range and the projectile moves through clothing, the clothing usually filters out soot and gunpowder. The clothing may then not be available for examination or it may be blood soaked to such an extent that examination for soot and gunpowder becomes impossible.

- Drying of the edges of contact wounds with small calibre weapons may simulate soot deposition[26].

If conclusive information concerning the muzzle-target distance cannot be obtained from the entrance wound, special attention should be given to the *weapon* employed in the act, as it may also yield information pertaining to the range of fire. (It is suggested that such attention be given to the weapon regardless of the appearance of the wounds, seeing as though suicidal deaths are of the most disputed cases and all evidence should be collected for ensuing legal purposes.[27])

The weapon at the scene of a fatal shooting may be a great source of information. It may offer fingerprints or ballistic evidence indicating that the weapon was utilised in a previous crime. The location of the firearm with respect to the body, may also serve as further confirmation of suicide or exclusion of homicide. In addition to this, weapons may possess macro- or microscopic evidence of blood, either on the exterior aspect of the weapon, or on the inside.

Blood on the outside or on the interior of the barrel of firearms is positive evidence that the firearm in question was employed in a contact gunshot event.[10, 11, 12, 28] However, the forensic investigator should keep in mind that the absence of blood on or inside a firearm is *not* exclusive evidence that the weapon was not employed in a contact gunshot event, but is merely *confirmatory evidence* of a contact range discharge.

The question of how blood droplets reach the weapon situated in retrograde position of the entrance wound can be answered with considerable ease if one were to study blood droplets in flight.

Gunshot wounds are frequently associated with high-velocity blood spatter. This implies a high-velocity force (the projectile in flight) striking a source of blood (the body). High-velocity blood spatter generally presents as a mist-like spray of minute droplets, although droplets of greater diameter usually accompany the mist-like dispersion of blood. With the dynamic creation of entry and exit wounds, tiny high-velocity droplets (usually less than 0,1 mm in diameter) are transferred onto the surroundings.[29]

Blood spatter (including other biological material, such as bone and tissue) originating from an exit wound is known as *forward spatter* and generally travels in the same direction as the source of energy (exiting projectile).[29]

Similarly, ejection of biological matter from a gunshot *entrance wound* can also be observed. This ejection of blood, bone, and other tissue, occur in the opposite direction of projectile movement and is known *back spatter*. This back spatter is propelled towards the weapon and the shooter, and the presence of biological matter on a weapon is especially associated with close-range discharge of a firearm.[29] Factors creating no or diminished back spatter include gunshot wounds to the chest or abdomen, distant muzzle-target ranges, and clothing.[15]

The phenomenon of back spatter – consisting of both micro- and macro-back spatter – were extensively researched by Karger et al.[30, 31] in the mid-nineties. Macro-back spatter describes blood back spatter droplets with diameter of greater than 0,5 mm and micro-back spatter droplets with diameter smaller than 0,5 mm.

In their research they attempted to measure the distances of back spatter by shooting into the heads of nine live calves at distances ranging between 0 and 10 cm. They performed this experiment in duplicate. It was discovered that macro-back spatter could be detected at distances of 72 to 119 cm from the entrance wounds. Micro-back spatter occurred approximately 69 cm from the wounds. Both experiments were conducted with 9 mm Parabellum ammunition[30, 31].

Macro-back spatter is known to travel at greater distances than micro-spatter due to the former's greater mass[15].

It was also reported that, the greater the muzzle-target distance, the fewer the blood droplets and the shorter the distance that the back spatter droplets will travel in retrograde direction of the movement of the bullet. This confirms the close-range weapon discharge needed to produce significant back spatter.[30]

Type and calibre of weapon employed in a shooting also influence the presence of back spatter. Large calibre weapons and ammunition are more likely to produce large quantities of back spatter than smaller calibre firearms. [10, 11, 30, 31]

Karger et al. reported that possible *causes* of back spatter in especially gunshot wounds to the head, include the following:

- A rapid expansion of gas trapped between the elastic skin and the skull with resulting backwards stream of escaping gas.[28, 30]
- Increased intracranial pressures created by the temporary cavitation.[30]
- Tail splashing (blood retrogradely ejected when the projectile enters the body).[30]

Back spatter due to the gas effect will correspond to the maximum range of hot expansion in front of the muzzle, but that back spatter from the remaining two factors are independent of the shooting distance.[30]

The quantity of back spatter depends on a variety of ballistic and anatomical considerations. Some of these considerations include:

- Close range – back spatter occurs in greater quantities when the projectile enters the body within close range.[28]
- A gunshot into a liquid-filled cavity inside the body. [30, 31]
- A gunshot by large-calibre weapons and ammunition. [30, 31]
- The presence of a bony structure immediately beneath the skin (as found in the head with underlying skull), assisting the development of a pocket-like subcutaneous space.[32]

Karger et al.[30, 31] (1996) believed that back spatter is *not* – as previously believed – caused by the spin of the bullet or a momentary suction effect of the barrel aspiring material into the barrel of the weapon.

Although the research of Karger et al. elucidated the properties and significance of back spatter, it must be taken into consideration that certain anatomical differences

between the heads of calves and humans exist. Calves have a much smaller brain volume and a wider subcutaneous space than humans do and this might affect the ability to extrapolate the results on humans.

Stone[11] tested 397 firearms (discharged at contact or near contact range) for the presence of blood on and inside the barrels. He found that several variables influenced the positive finding of blood on or inside weapons. He noted that – as in the case of Karger et al.[30, 31] – the type and calibre of the weapon affected the outcome of the tests accordingly. For example, it was found that shotguns (a much more powerful firearm than a 9mm pistol, for instance) were more likely to have blood both on and inside the barrel and that the incidence of such blood being found increased as the calibre increased.

In later studies Stone[33] reported that other factors might significantly affect detection of blood on or inside the barrel of firearms. These factors include the presence of clothing or hair and the anatomical site of entry wounds[10].

In 1992 Stone[10] performed another study in which he recorded the presence of blood inside the barrels of weapons according to their type and calibre. It was again found that blood detection increased as calibre increased and that 53% of revolvers yielded positive tests for blood in the muzzles, compared to the 57% of pistols. He found that 85% of shotguns had blood inside the barrels and that 85% of rifles displayed positive tests for the presence of blood in the barrels, again proving the heightened probability of shotguns retaining blood.

Stone[10] confirmed the valid point first made by MacDonnell and Brooks[12] that presence of "drawn back" blood in the barrel of a handgun places that weapon within close range of the intended target.

In his research Stone also noted that the absence of blood inside the barrel is not necessarily an indication that an intermediate or distant shot were fired. Approximately half of the weapons used in close-range shots were "negative" for the presence of blood. Therefore, the absence of blood inside barrels possesses no evidential value, while the

presence of blood serve as confirmatory evidence that discharge occurred at close range.[10]

Results from experiments done by Suwanjutha[8], indicated that suicides are mostly committed at tight contact ranges (54%) compared to the rare occasion that tight contact discharge of weapons occur in homicides (7%). In 2001 Kohlmeier et al.[34] noted that of 1704 cases of suicide 97,9% were contact wounds and merely about 2% were intermediate range shots. Cina et al.[9] also reported the ranges of firearm discharge in different modes of death. His results are summarised in ***Table 1.2***[9].

Table 1.2: Muzzle-target distances on the basis of different modes of death.[9]

	Suicide (n = 86)	**Homicide (n = 30)**	**Accident (n =4)**
Contact Shots	97%	10%	25%
Intermediate Shots	3%	75%	3%
Distant Shots	0	50%	0

Research on the subject of drawback blood spatter in determining the *exact* muzzle-target distance was performed by Herbert MacDonnell and Brian Brooks[12] in 1977. By carefully analysing the depth of back spatter penetration into the barrels of the weapons, they concluded that a correlation exists between the depth of blood droplet penetration into the barrel and the distance of discharge. They also noted the higher penetration depth of higher calibre and higher energy load weapons (e.g. magnum weapons) compared to those of smaller calibre and energy load.

Results obtained from the research of MacDonnell and Brooks revealed that penetration depth of small calibre weapons like .22 calibre revolvers, ranged from 1 to 1,5 inches (2,53 to 3,8 cm). The depth of detectable blood droplets in higher calibre guns such as 12-, 16-, or 20-gauge shotguns reached up to 5 inches (12,65 cm) and for handguns approximately 3 inches (7,6 cm) [12].

Although their research contributed greatly to the literature of forensic science, contrasting opinions exist to the practical application of their research. Detection of blood inside a firearm already places that weapon within close range of the target. Is there really distinction in calculating the exact distance in centimetres if presence of blood already testifies close range discharge?

As Yen et al.[33] so rightfully stated, one should be very careful in analysing any blood spatter evidence, whether it is on hands, weapons, or blood covered adjacent objects. Seepage, dripping, secondary traces, and ricocheting blood spatter should all be taken into consideration when scrutinising bloody evidence.

The importance of the present study therefore lies therein that accurate estimations of muzzle-target distances may be possible and might assist in the precise reconstruction of a fatal shooting. This study will aim to determine the frequency of drawn back blood in weapons used in contact firearm fatalities. The relative influences of certain variables such as the type and calibre of weapon is also discussed.

Determining the precise depth of penetration of blood droplets into the barrels falls beyond the scope of this study. The mere presence of blood is to be detected and correlated with different variables.

The results of this study will hopefully add to forensic literature and might assist the forensic scientists in South Africa in evaluating whether a case of a firearm fatality is homicidal, suicidal or accidental in nature, by indicating muzzle-target distance, and employing this in a forensiometric model. Since suicides are most likely to be committed within a near-contact or contact range, it would be another useful tool in the forensiometric analysis of gunshot events to prove suicide.[9, 10]

1. 3 Aims of Study

1. To determine the frequency of blood back spatter on the inside of barrels of firearms used in events of contact gunshot wounds in the Pretoria metropolitan area.

2. To indicate any possible influences that the following variables might have on the phenomenon of "drawn back" blood:

- Type and calibre of weapon
- Anatomic location of entrance wounds
- Clothing, hair, etc.

Chapter 2

METHODOLOGY

2.1 Study Design

This was a prospective analytical study.

Since no biological examinations on weapons have ever been performed at the Forensic Science Laboratory (FSL) of the South African Police Service (SAPS), the study could not be analysed from a retrospective perspective.

2.2 Study Setting

Analysis of the discharged weapons was performed in the laboratories of the Biology Unit of the FSL in Pretoria.

All photographs were taken in the laboratories of the Photographic Unit at the FSL. The photographic and video material is secured in a safe at the FSL.

Additional relevant information to be included in this report, such as the presence or absence of a suicide note, was obtained from the dockets on each of the cases and/or from interviews with the relevant investigating officers. Collection of information from the scene of a contact gunshot incident will be done in conjunction with Crime Scene Management, Investigative Support and the FSL in Pretoria.

2.3 Subject Selection

All *available* weapons employed in suspected contact gunshot events in the city of Pretoria were analysed for draw back blood spatter.

Exclusion criteria:

- Weapons found lying in a pool of blood were excluded from the study – in these cases, it would be impossible to prove that any blood present on or inside the weapon originated from back spatter and not from secondary contact with blood.

- Weapons returned to family members or institutions were also excluded, because of the possibility that these weapons might have been wiped or cleaned prior to analysis.

2.4 Study Population

Weapons used to inflict contact gunshot wounds in victims presenting from the greater Pretoria area to the Pretoria Medico-Legal Laboratory (MLL) were requested to be made available for analysis by the appropriate investigating officer during the period of June 2002 to June 2003.

Pretoria was selected as the ideal frame for assembling the study population as it suffers an extremely high incidence of firearm related suicides[36] and will therefore facilitate obtaining adequate data for inclusion in this proposed study.

2.5 Sampling Frame

All information concerning blood within the weapons (as well as the additional information to be included in this report) was collected from experimental procedures in the biology and photography laboratories of the FSL in Pretoria.

Pathology reports and dockets compiled by the relevant investigating officers were utilised to obtain information regarding location of weapons on the scene, anatomical site of the entrance wounds, clothing, and location of the body.

Where pathology reports were not effective in providing such information, the relevant investigating officers were contacted and the information obtained via interview.

2.6 Research Procedures

Weapons employed in contact gunshot events were submitted to the laboratories of the Photography and Biology Units for analysis of drawn back blood spatter inside the barrels and on the outside of those weapons.

Contact gunshot events were detected by way of distinguishing contact gunshot wounds from intermediate and distant wounds at the Medico-Legal Laboratory in Pretoria. The relevant dockets of each case were examined for information pertaining to the specific police station involved and appropriate data on the victim, for example, the gender, age, and race.

The investigating officer of each case was contacted and requested to deliver the related weapons to the FSL. During the interviews with investigating officers, additional information was obtained regarding the type and calibre of weapon and the location of the weapon at the scene.

Unofficial protocol regarding the collection of weapons from a crime scene includes appropriate packaging and transport to the appropriate division of the Criminal Record Centre (CRC) in Pretoria (where photographing and fingerprinting are performed) and/or to the Ballistics Unit at the Forensic Science Laboratory.[37] Subsequent to photographing and fingerprinting at the CRC, and ballistic testing at the FSL, it is

expected that the weapons be returned to the appropriate police station for safe keeping in the station's SAP13.

Once at the Biology Unit of the FSL, the external aspects of the weapons were photographed. Subsequent to this, the barrels of the firearms were probed internally for visible blood droplets by employment of a baroscope (a thin, elongated tube with a light and minute video camera at the tip).

The dislodged barrel of each weapon was mounted on a vice to stabilise it for inspection. The long, thin probe of the baroscope was manually manoeuvred inside the barrel without touching the internal walls of the barrel. This was done with the objective of visualising any blood droplets drawn back into the barrel. The probing process was recorded and stored on videotape.

Chemical analysis of weapons for blood was done by wiping the inside of the barrel with moist pipe cleaners and staining the pipe cleaners with benzidine. This substance utilises the peroxidase-like activity of heme to produce a blue/purple colour as end product.[38]

Benzidine is used as a presumptive test for blood and exhibits identical sensitivity and specificity to tetra-methylbenzidine.[38] The sensitivity and specificity of the latter have been compared with that of other agents used as presumptive tests for blood, such as phenolphthalein, orthotolidine solutions and leucomalachite green.[38]

The phenolphthalein has been found to be the best single test for blood, having both the greatest sensitivity and specificity, but this agent is not currently being used in the Police Forensic service.[37]

The tetra-methylbenzidine (together with orthotolidine) was the most sensitive test of the group. Bearing in mind that tetra-methylbenzidine and benzidine are

indistinguishable in relation to the produced results, it can be assumed that benzidine will also have a sensitivity of one part in 10,000 to 200,000.[38]

To obtain reliable sensitivity, a maximum of 10 seconds should be allowed for the colour reaction to occur.[38] In high blood concentrations the development of the colour will occur within 5 seconds. If the colour develops after 20 seconds, interference colour might have been produced or a false-positive result might have been obtained. The interpretation of the results of this test is dependent on the expertise and experience of the scientist performing the experiment, method of preparation and the blood concentrations on the surface being tested.

However, the employment of this stain must be done with great care as benzidine has been known to be a carcinogenic agent, especially in long-term occupational exposure.[36] It is suggested that analysis using benzidine as dye must preferably be done in a well ventilated area using latex gloves for skin protection.

Examination of mortuary dockets of each case will be done and any variables able to influence draw back of blood into the muzzle of the weapon (like clothing or the presence of hair) will be noted. These dockets will be handed back to the investigating officer.

2.7 Ethical Considerations

Consent to use information from the relevant dockets was obtained from the head of the Detective Services in Pretoria. Consent for employing the statistics acquired from the biology laboratory after analysis of the discharged weapons, was obtained from the officer commanding the Biology Unit of the Forensic Science Laboratory of the SAPS in Pretoria.

Complete anonymity of all victims was maintained throughout the study. Use of case reference numbers deprecated the risk of disclosing personal information and all reports and findings are stored on the researcher's personal computer, protected by a password.

2.8 Data and Documentation

Confidentiality

Data obtained from the dockets and investigative officers of each case was handled with care as to protect the confidentiality thereof. All reports are stored on the researcher's personal computer protected, by a password.

Use was made of case reference numbers only, thereby minimising the risk of disclosing personal information.

Collection of Data:

Data was collected on grounds of the presence of blood penetration into the firearm. If the appropriate laboratories could verify the presence of blood droplets, the weapon was considered "positive for drawn back blood" and the type and calibre of the weapon recorded. The latter recordings were also done in the case of "negative tests".

Additional forensiometric markers of suicide such as location of weapon on the scene, anatomical site of entry wounds, bloodspatter on the outside of the weapon, presence of a suicide note, gender, age, race, etc., will also be entered in the final report.

All problems and additional information stumbled upon during the course of the study was also recorded and entered into this final report.

Processing of Data:

All the numerical data was captured onto a data capture sheet. A printout of the results on all firearms tested by the Forensic Science Laboratory was forwarded to me by the FSL. Data pertaining to the study will be handed over to a statistician.

These analyses will involve the use of standard mathematical formulas to calculate the percentage of weapons that tested positively for drawn back blood in the barrels.

The type and calibre of weapon and the anatomical sites of entry will be correlated with the presence or absence of back spatter.

2.9 Funding

No additional funding was necessary for any laboratory tests performed on the firearms themselves. The investigations and analyses constituted an integral part of the investigative protocol for individual fatalities.

2.10 Time Frame

The collection of weapons used in contact gunshot incidents was done over the period of June 2002 to June 2003. This represented the time frame available to the researcher to fulfil the requirements for the M.Sc. degree.

The suicide caseload of the Medico-Legal Laboratory in Pretoria is calculated to be approximately 15, 3 percent of the 1 748 cases handled annually. Of these 268 suicide

cases, 41 percent is due to gunshot wounds.[39] This means that the Laboratory supervises roughly 107 suicidal gunshot fatalities annually and almost nine cases a month. All of these cases are generally contact gunshot wounds.

This means that the presented time frame will allow for approximately 108 cases of suicide, which will be sufficient to yield legitimate statistics. The number of contact homicidal or accidental gunshot fatalities was – as expected – minimal, but was also added to the study.

2.11 Reporting

The final results will be submitted to a peer-reviewed scientific journal with intent to publish.

Chapter 3

RESULTS

During the period afforded to complete the study, a total of 123 cases of contact gunshot wounds were identified at the Medico-Legal Laboratory in Pretoria. Of these cases, the vast majority was being investigated as suicidal events (n = 114), with only 8 cases being of definite homicidal nature. One case was considered to be an accidental firearm death.

Cases in which gunshot wounds could not be positively identified as being within contact range were not included in the research. Also excluded were weapons found in a pool of blood, and weapons returned to family members or institutions after the fact.

Age, Sex, and Race

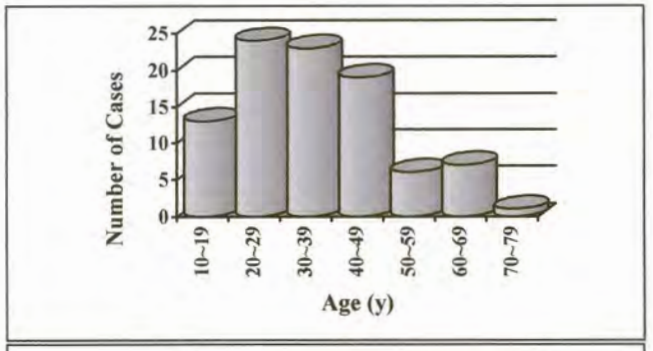
In 23 cases of strongly suspected suicide the ages of the victims were unknown, in three cases the victims were simply described as being "adult", and in one case the victim was characterise as being an "adolescent". The mean age of the remainder of victims strongly suspected of having committed suicide (n = 87) is 36,1 years (range: 15 to 77 years).

The mean age of the homicidal gunshot victims (n = 5) was calculated to be 30,8 years of age, and ranged from 17 to 43 years. In three of the homicidal firearm deaths, the ages were unknown.

The victim of the known accidental shooting was 26 years of age.

The precise age distribution of *all* the victims can be seen in ***Figure 3.1.***

a



b

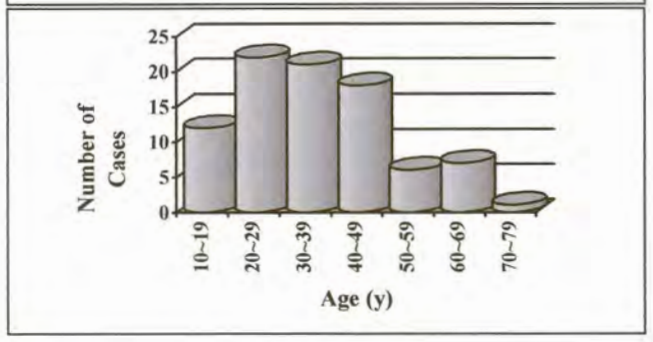


***Figure 3.1**: a) Age distribution by 10-year age group (n = 93), and b) similar distribution in suicidal gunshot deaths (n = 87).*

The ratio of male to female victims was approximately 4:1 – 98 male (79,7 %) and 25 female (20,3 %) victims. The suspected suicidal cases (n = 114) were comprised of 92 (80,7 %) males and 22 (19,3 %) females.

The majority of the victims were white, constituting 72 (58,5 %) of the 123 cases. The remainder of the victims was black (36,6 %), Asian (3,3 %), and Coloured (1,6 %). ***Figure 3.2*** reveals the distribution of race according to suspected manner of death.

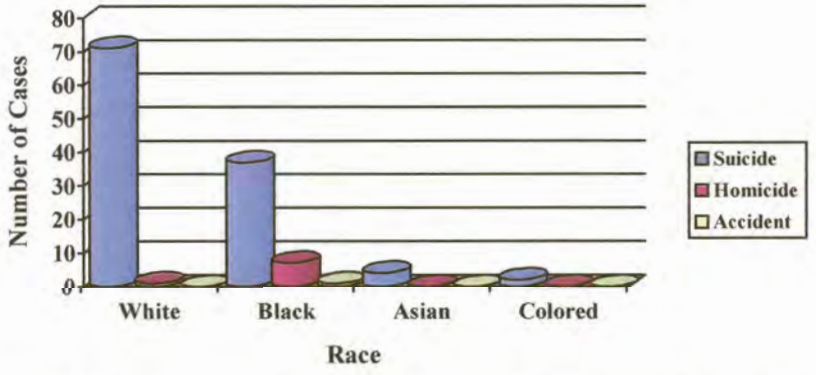


***Figure 3.2**: Distribution of race according to suspected manner of death.*

Anatomical Location of Entrance Wounds

The anatomical location of each entrance wound was recorded. The preferred site of entry was found to be the head in 89,2 % of cases, the chest in 6,7 %, the neck in 2,5 %, and the abdomen in 1,6 % of *all cases*. Not included in the data are the three cases in which multiple contact gunshot entries were found. These cases had strong indication of suicide. In ***Table 3.1*** summarises the precise sites of entry in the single gunshot cases.

Table 3.1: Anatomical locations of entrance wounds.

SITE OF ENTRY	FREQUENCY	% (n = 120)
Head		
- Right temporal	55	45,8
- Mouth	23	19,2
- Frontal Area	14	11,7
- Left temporal	5	4,2
- Inferior jaw	4	3,3
- Other	6	5
Chest	8	6,7
Neck		
- Anterior aspect	1	0,8
- Right lateral	1	0,8
- Posterior aspect	1	0,8
Abdomen	2	1,7

The three cases involving multiple contact gunshot wounds were all highly suggestive of suicidal events. All three cases involved the inferior aspect of the jaw as the primary site of entry, followed by entries in the right temporal region, the chest, and the right tempero-parietal region. It appeared as though the primary shot under the chin did

not cause immediate incapacitation and that the victims could therefore manage the discharge of secondary shots.

The preferred sites of entry in cases known to be homicide were the precordium (n = 2) and left temporal region of the head (n = 2).

Figure 3.3 exhibits two gunshot entrance wounds to two of the most popular anatomical sites: The right temple and the central forehead. Note the black soot deposition around the edges of both wounds, as well as the stellate-shaped wound on the central forehead ***(b)***. These features are both indicative of contact range gunshot discharges.

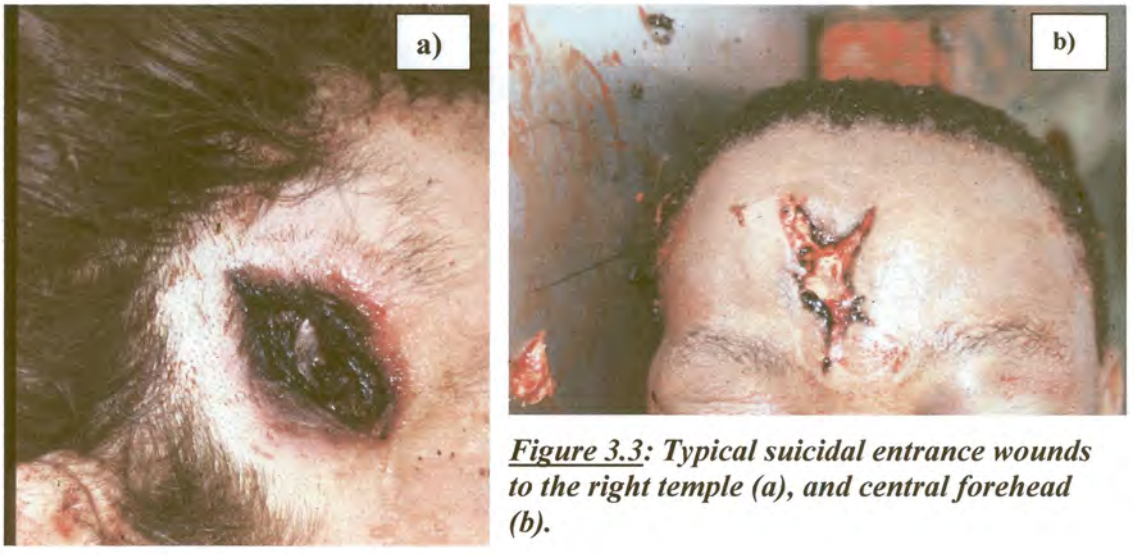


Figure 3.3: Typical suicidal entrance wounds to the right temple (a), and central forehead (b).

Weapons

Although 123 cases of contact gunshot wounds were reported during the course of the study, the type and calibre of only 92 firearms were identified. These weapons include:

- Pistols – 59 (64,1 %)
- Revolvers – 24 (26,1 %)
- Rifles – 5 (5,4 %)
- Shotguns – 4 (4,4 %)

The 9mm calibre pistol was the firearm of choice, followed by .38 Special revolvers, with 43 (46,7 %) and 17 (18,4 %) reported cases, respectively. Other firearms employed in suicidal acts include .32 calibre pistols, shotguns, rimfire ammunition weapons, etc. In ***Figure 3.4*** and ***Table 3.2*** the weapons used are summarised.

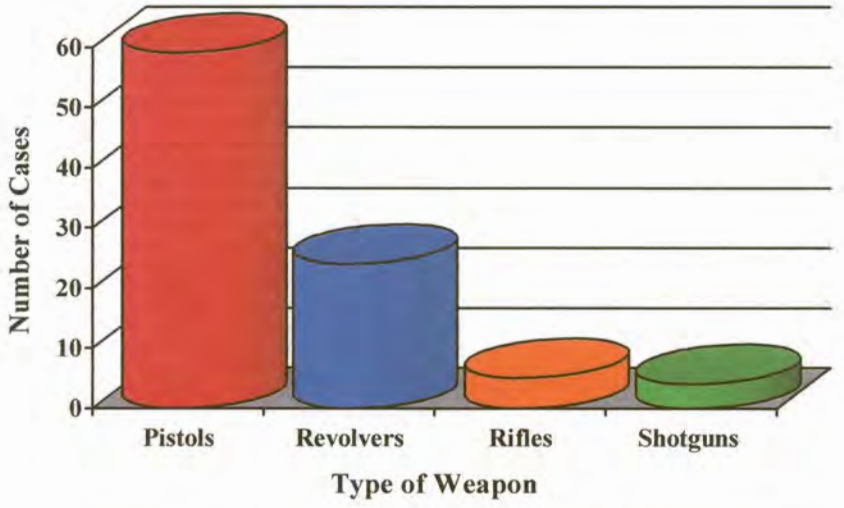


Figure 3.4: Number of suicides by type of weapon used.

Table 3.2: Type and calibre of weapons used in contact gunshot events.

WEAPON & CALIBER	NUMBER OF CASES	% (n = 92)
Pistols		
- 9 mm	43	46,7
- .32 (7.65 mm)	7	7,6
- .25 (6.35 mm)	2	2,2
- .22	2	2,2

- .357 Magnum*	2	2,2
- .38	1	1,1
- .45	1	1,1
- 7.62	1	1,1
Revolvers		
- .38 Special	17	18,4
- .357 Magnum	4	4,3
- .22	2	2,2
- .32	1	1,1
Shotguns	4	4,3
Rifles		
- 7,62 mm	1	1,1
- .303	2	2,2
- .243	1	1,1
- .22	1	1,1

*Continue

Some uncommon firearms were encountered during the study. A .22 calibre target pistol ***(Figure 3.5)***, as well as a 7.62 calibre pistol (a calibre usually found in military rifles), formed part of the recovered firearms.

Figure 3.5: The .22 calibre target pistol.

Suicide Notes

In 45 cases of possible suicide no information regarding a farewell letter could be obtained, either from incomplete docket entries or from an inability to come into contact with the relevant investigating officers. In the remaining 69 cases of strongly suspected suicide, information had been obtained and it was found that in only 13 (18,8 %) cases a suicide note was indeed left behind by the deceased. This is not surprising, as it corresponds with data from previous studies.[18, 34, 40]

Location of the Body

The location of the body was unknown in 48 of the cases. In the remaining 75 cases, the preferred site for a contact shooting to occur (suicidal or homicidal) was the decedent's home, and more precisely, the victim's bedroom, where 34 (45,3 %) cases of contact gunshot wounds occurred ***(Table 3.3)***.

These numbers correlate well with previous studies.[18, 34] Alternative, unexpected locations were encountered as preferred sites of suicide. A bar, church, zoo, and a shooting range were some of the unusual locations of these deaths ***(Table 3.3)***.

Table 3.3: Locations of suicidal gunshot events.

LOCATION	NUMBER OF CASES	% (n = 75)
Indoors		
- Bedroom	34	45,3
- Lounge	6	8
- One room shack	3	4
- Other	4	5,3
Outdoors		
- Garden	6	8

- Roadside*	5	6,7
- Just outside a building	3	4
- Field	2	2,7
- Park	1	1,3
- Cemetery	1	1,3
Public Areas		
- Shooting range	1	1,3
- Zoo	1	1,3
- Nature Reserve	1	1,3
- Public restroom	1	1,3
- Church	1	1,3
- Bar	1	1,3
Other		
- Motor vehicle	3	4
- "Wendy House"	1	1,3

*Continue

The single accidental gunshot event occurred as the deceased was sitting at his security guard post directly outside a building.

The other suicides that occurred directly outside buildings include a homicide-suicide that transpired outside a one-room shack, and a suicide just outside an unknown house in the process of being built.

Locations of other homicide-suicides include a "Wendy house" and a one-room shack.

Blood on and in Firearms

Perhaps the most disturbing of all results is the extremely low quantity of weapons obtained for analysis. Of the 123 cases that formed the study population, *only 30 weapons* were transferred to the Biology Unit at the Forensic Science Laboratory in

Pretoria. This means that *only approximately 24 percent of all weapons discovered on scenes of shootings in South Africa were made available for analysis of biological matter on the weapons during the course of the study.*

Another disquieting discovery made during the study was the number of firearms immediately "lost", thereby being unavailable for analyses – either ballistic or biological. In 18 cases (15 %) the weapons were immediately unavailable for scientific examination. In two of these cases the shooting was considered to be homicide and the weapon was not present at the scene of the crime. In another three cases, the shooting was considered to be of suicidal nature, but the weapon was "thought to be stolen from the scene" prior to police arrival.

Approximately 10 firearms were returned to the victims' family immediately after investigating the crime scene, two firearms were service weapons belonging to police officers who committed suicide and were returned to the relevant police station immediately without entering it for analysis. In another case, it was discovered during an interview that the officer in charge of that specific suicidal shooting, cleaned the weapon himself prior to entering it into SAP13.

Of the 123 cases, approximately 75 weapons are still outstanding for biological analysis. ***Figure 3.6*** displays the number of weapons analysed, "lost" for analysis, and still outstanding.

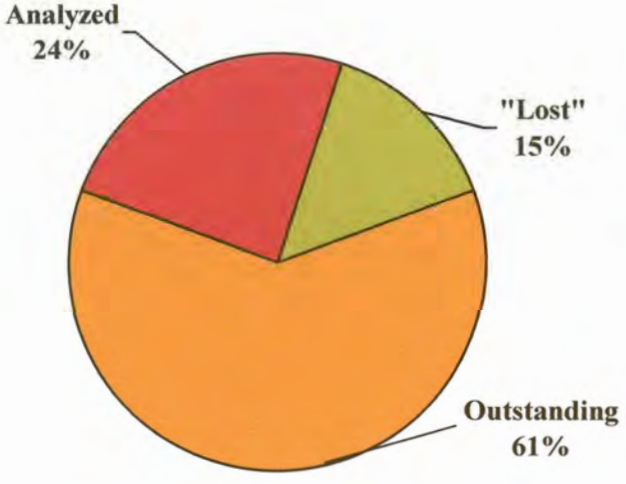


***Figure 3.6:** Number of weapons analysed, "lost" for analysis, and still outstanding.*

The external aspects of the available weapons were carefully inspected for the presence of back spatter. Of the 30 weapons inspected, only 12 firearms (40%) were found to contain blood on the exterior aspects. These figures do *not* correspond with those from experiments performed by Stone[10, 11]. In ***Figure 3.7*** a 9mm pistol can be seen with blood on the external surface.

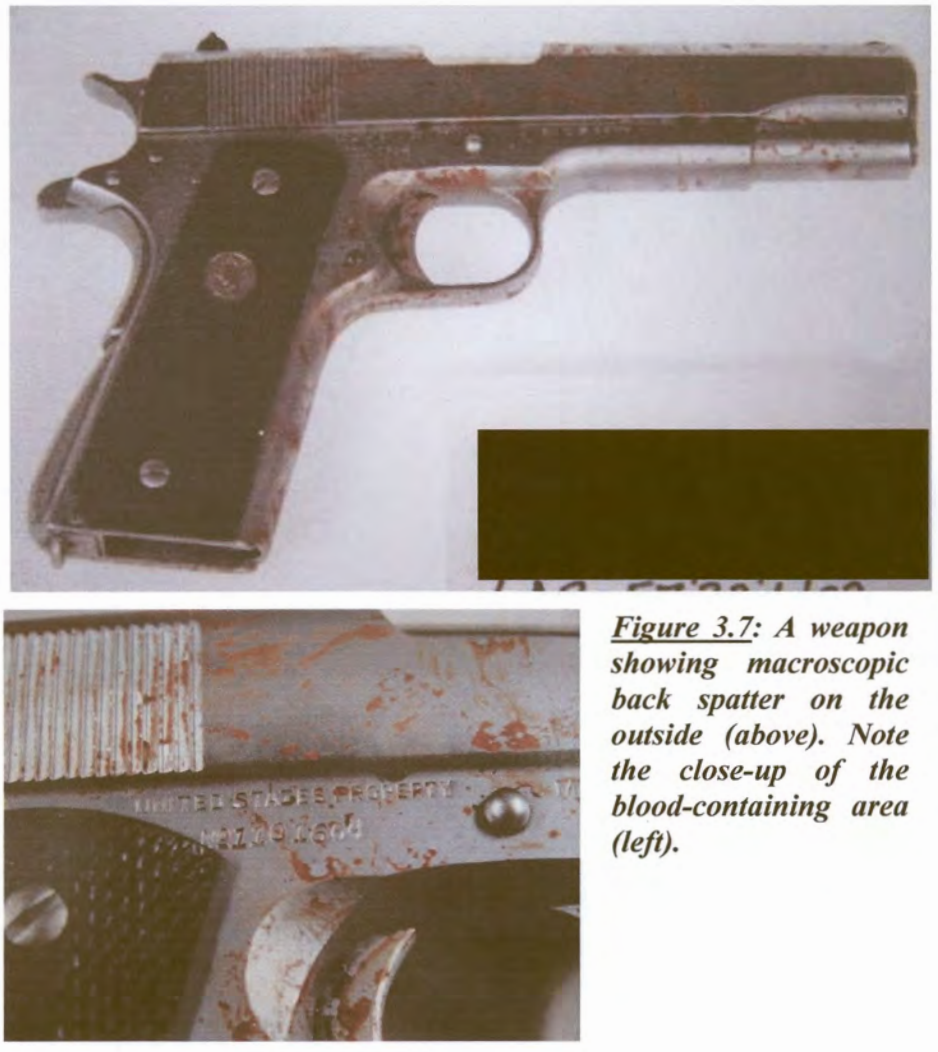


***Figure 3.7**: A weapon showing macroscopic back spatter on the outside (above). Note the close-up of the blood-containing area (left).*

In the majority of instances where firearms were analysed for blood on the external surfaces, it was the superior aspects of the guns that were covered with the greatest amount of blood. This equates well with previous studies[33], as the inferior part of

the weapon, especially the handle, is usually shielded by the shooter's hand. Other weapons with blood on the external superior surface are exhibited in ***Figure 3.8***.

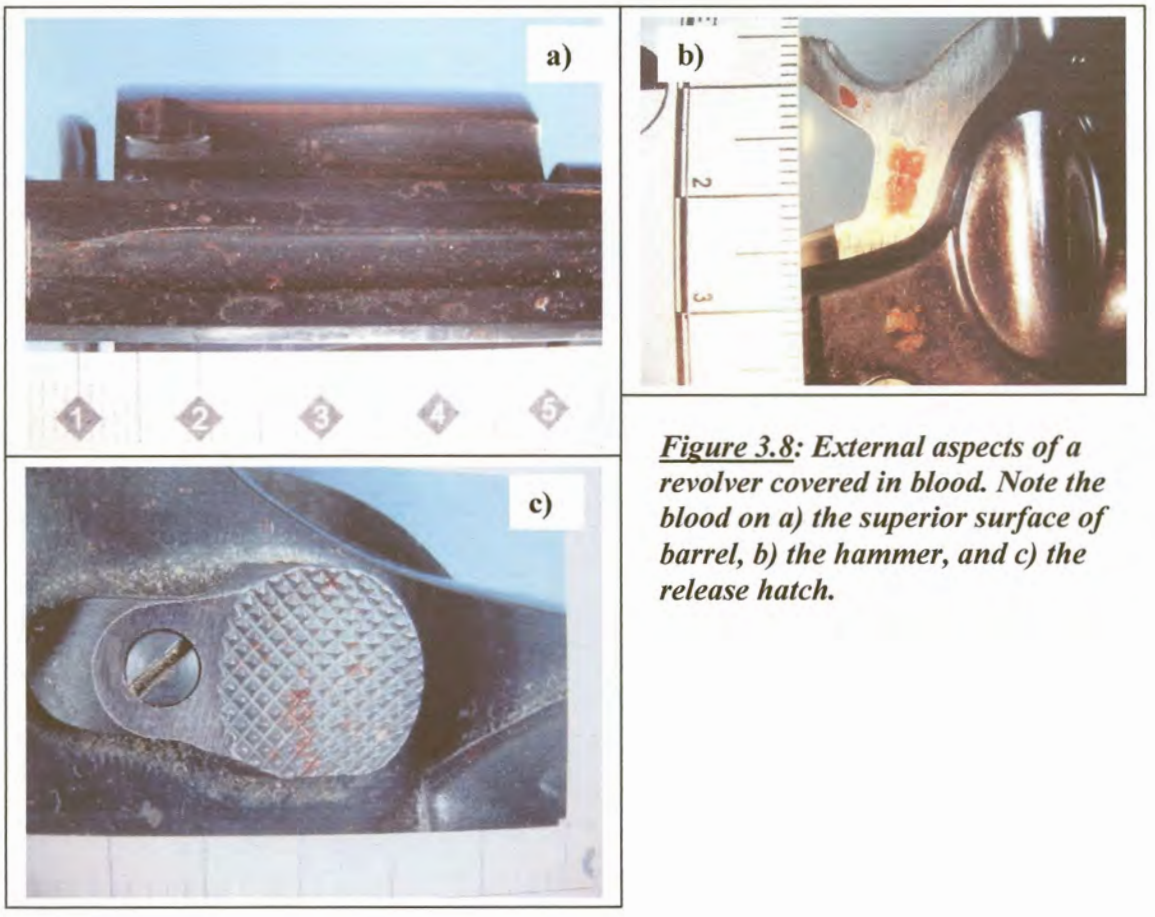


Figure 3.8: External aspects of a revolver covered in blood. Note the blood on a) the superior surface of barrel, b) the hammer, and c) the release hatch.

Subsequent to examination of the exterior surface of the weapons, the inside of the barrels was investigated by utilising a baroscope. This instrument allowed for the magnified probing of the very inside of the barrels and the presence of any foreign biological material could be visualised. The appearance of the inside of a barrel can be seen in ***Figure 3.9.***

Twenty-one (70%) of the available firearms tested positive for blood droplets inside the barrels. In ***Figure 3.10*** the blood droplets can be seen on the interior surface of one of the barrels.

Figure 3.9: A photograph showing the interior surface of a barrel.

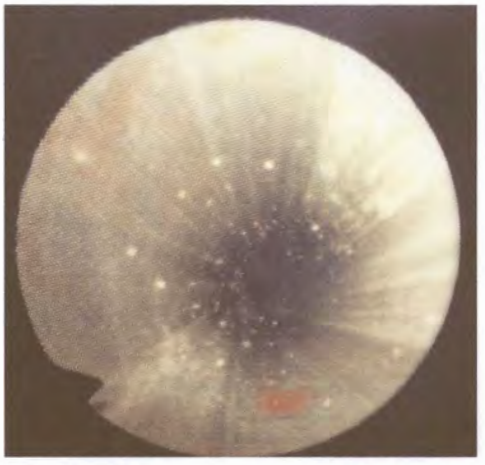


Figure 3.10: Note the presence of blood droplets.

Positive tests for blood were obtained by employing the chemical, benzidine. The treatment of the inside of the barrels with this chemical revealed that 21 firearms (70 %) yielded positive results for the presence of blood in the barrels. ***Table 3.4*** gives a summary of the type and calibre of weapons with the number of positive and negative tests for blood.

Table 3.4: Results of weapon analysis for the presence of blood on the outside and inside of barrels.

WEAPON	BLOOD VISIBLE OUTSIDE	BLOOD VISIBLE INSIDE (Baroscope)	POSITIVE BENZIDINE TEST INSIDE
9 mm Pistols (n = 11)	3	6	6
.38 Special Revolver (n = 5)	2	4	4
.38 Revolver (n = 1)	1	1	1
.45 Pistol (n = 1)	1	1	1
.357 Mag Revolver (n = 2)	2	2	2
7.65 mm Pistols (n = 2)	0	1	1
.25 Pistol (n =1)	0	0	0
.22 Revolver (n = 1)	0	1	1
.22 Target Pistol (n = 1)	0	1	1
7.62 Pistol (n = 1)	0	1	1
Shotgun (n = 1)	0	0	0
Rifles (n = 3)	3	3	3
TOTAL	**12 (40 %)**	**21 (70%)**	**21 (70%)**

Figure 3.11 provides a summary of the number of blood positive weapons.

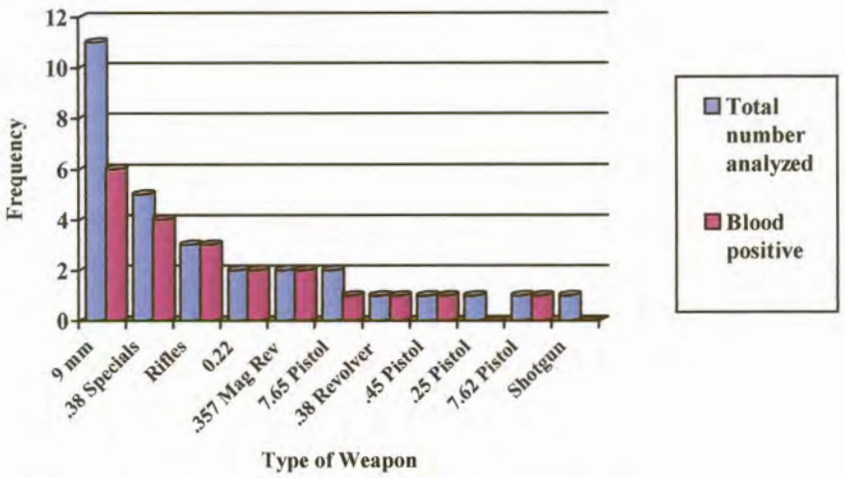


Figure 3.11: Summary of blood positive weapons.

Of the cases where the weapon was made available for analysis, the anatomical site of entry was examined and – as can be seen in ***Figure 3.12*** – firearms used to create entrance gunshot wounds in the right temporal area retained a higher percentage of blood than those employed to create alternative entries.

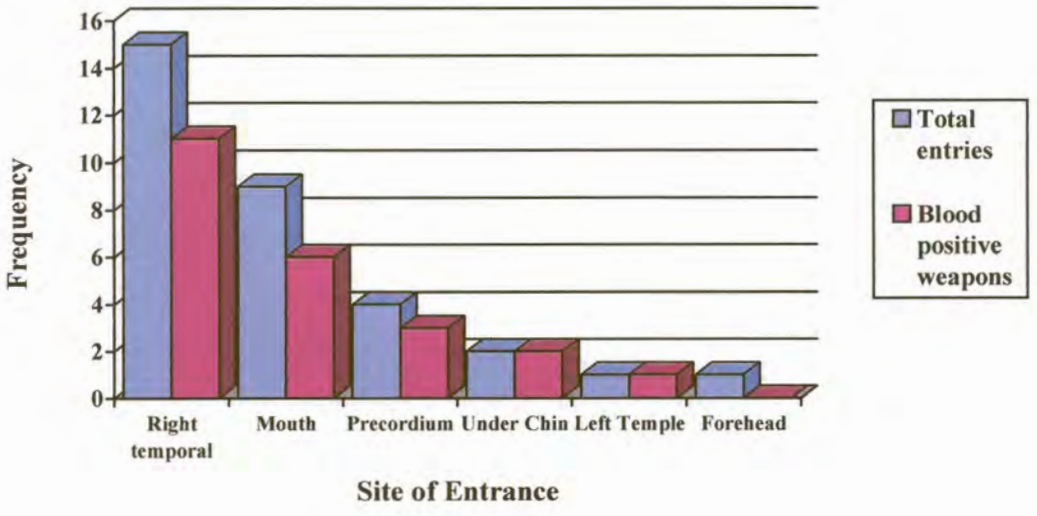


Figure 3.12: A graph correlating an entry wound with the number of blood positive weapons.

Two of the firearms that tested positive for the presence of blood inside the barrels were employed in multiple gunshot suicides. Both consist of double entry wounds. One of these cases had gunshot wounds to the inferior aspect of the jaw and to the right temporal area, while the other had wounds to the precordium, as well as the inferior aspect of the jaw. In the latter case, no blood could be detected on the external surface of the weapon (9mm pistol), while in the former blood was detected on the outside of the gun (.22 rifle).

Chapter 4

DISCUSSION

4.1 Identification of Contact Gunshot Entrance Wounds

In contact gunshot wounds, the face of the muzzle of the weapon is held against the surface of the target at the time of discharge. The muzzle may be held in such a way that it merely touches the surface, or it may be pressed hard against it. In the latter case, the surface may be indented by the muzzle, thus creating a seal between the muzzle and skin at the time of discharge. These types of wounds are known as *hard contact wounds*.

In hard contact wounds, the material exiting from the muzzle when the weapon is fired (that is, flames, gas from the burning propellant, soot, primer residue, metallic particles stripped form the bullet, and vaporised metal from the bullet and cartridge case[4]), is propelled into the wound and the edges of skin around the defect become seared by the flame and hot gases, as well as blackened by the soot deposition ***(Figure 4.1***, as well as ***Figure 3.3 a))***.

Figure 4.1: *A picture of a contact entrance wound exhibiting seared edges and soot deposition around the defect.*

Sometimes the entire bulk of matter escaping from the muzzle is driven underneath the skin, so that no evidence of a contact entry can be detected macroscopically. Here, contact entry can usually be identified during autopsy by observing soot and unburned powder particles in the underlying wound tract or deposited on the underlying structures.

Muzzle imprints ***(Figure 4.2)*** are oftentimes seen in hard contact wounds. When a seal is created between the muzzle and the skin, the gaseous matter is injected under the skin and this causes the skin to bulge outward toward the muzzle. The skin is forcibly pressed against the face of the muzzle and an impression of the muzzle is left in the skin in the form of abrasions and bruising, revealing the size and shape of the anterior aspect of the weapon.[41] This serves as unmistakable evidence of a contact gunshot wound.

Figure 4.2: A muzzle imprint left by a handgun pressed against the skin. Note the impression of the recoil guide rod at the inferior aspect of the wound.

Thali et al.[41] (2002) recorded the importance of these muzzle imprints. Despite being valuable proof of a contact gunshot entry, it can also facilitate the reconstruction of the event by providing information as to which type of weapon was used and how it was held at the time of discharge. They added that – in addition to the skin pressing against

the muzzle – the following factors (alone or combined) are responsible for the creation of a muzzle imprint:

- Direct pressure from the weapon pressed against the skin
- Reflexive, compensative muscular reaction by the shooter which forces the muzzle into the wound
- The effect of mobile firearm parts
- The suction effect of the muzzle after discharge[41]

Where a weapon is discharged over an area where skin overlies bone (as can be seen in the head, where skin overlies the skull), an entrance wound with a stellate or cruciform appearance can oftentimes be seen (Refer to ***Figure 3.3***). This is created by the emerging gasses becoming trapped between the skin and the underlying bony structure and causing the skin to bulge or balloon outward. When the stretching during this time exceeds the elasticity of the skin, it will tear and the tears will run outward from the defect, producing the star-shaped or cruciform appearance.

In addition to the fact that contact entries may not always exhibit a muzzle imprint or a stellate-shaped wound, entrance wounds may also not always be perfectly round, regular defects. Depending on various factors, such as the type and calibre of weapon, the position of the weapon against the surface, and other circumstances surrounding the event, defects may be large and irregular without soot deposition or searing of the wound edges. In these cases, the pathologist performing the autopsy may employ alternative methods of distinguishing the wound as one created at contact range.

Histologically, the entrance wound will exhibit the presence of black gunpowder in the wound tract or on and within the adjacent skin cells. Chemically, the presence of carbon monoxide from the muzzle gas can be detected in the wounds. However, this should be executed and interpreted with care, as carbon monoxide has been detected in wounds at a muzzle-target distance of 30 cm^4, which renders its ability to distinguish contact wounds uncertain.

In a singular incident, an autopsy was performed on a gunshot victim with strong suspicion of suicide, but the case was excluded from the study. The entrance wound was located in the right temporal area (entrance wound located by examination of the inward bevelling of the skull at point of entry), but *no* soot deposition, blackening or searing could be detected in the skin, the underlying bony structures, or tissues along the wound tract. The victim had been admitted to hospital and the wounds treated, but absolutely *no description of the wounds was entered into the victim's hospital files.* Although entries were made pertaining to which wound was the entry, no description of the wounds' appearance, the presence of soot or smoke, the size, etc., were given.

Any potential wound features characteristic of contact entrances were destroyed in the process of cleansing and medical treatment, and therefore, no deduction regarding the range of discharge could be done based on the appearance of the entry wound. Although contact discharge was suspected, no official mention of this could be made in the autopsy report and the case was consequently excluded from the present study.

This example highlights the importance of meticulous observation and documentation of gunshot wounds in hospital emergency units. Apfelbaum et al.[42] (1998) found that this is a neglected area in emergency medicine which could potentially have significant medico-legal and forensic implications.

In South Africa, subpoenas may take up to two years to be issued. If an emergency physician is called upon to act as factual witness in describing gunshot wounds after a lengthy period, thorough and comprehensive medical files may be the only source of recall for the physician.

The head was found to be the preferred site of entry in suicidal gunshot deaths, comprising 89,2 percent of the entire caseload. The right temporal area was found to be the site of choice in 45,8 percent of all suspected suicide cases, followed by the mouth with 19,2 percent of the cases ***(Table 3.1)***. These results correlate well with previously published research.[8, 9, 34, 43] The 8 cases of known or strongly suspected homicide, showed

5 cases with entrance wounds to the head (2 in the left temporal region, and one each in the vertex, forehead, and left fronto-parietal area), two with entries in the area of the precordium, and one in the abdomen. This arrangement of homicidal entrance sites also correlates well with forensic literature.[9]

In the accidental shooting death, the victim (security guard) placed his weapon underneath his jacket, which he used as a pillow. He fell asleep and the firearm discharged accidentally, creating a contact gunshot wound medially in the posterior aspect of the neck.

Three case of multiple gunshot wounds strongly suspected of being suicide, were identified. The weapons (a .22 calibre rifle and two 9mm pistols) were held against the inferior aspect of the mandible at initial discharge. Immediate incapacitation did not occur after the first shots, and the victims remained in a state of alertness where the firearms could be redirected and second shots fired into the right temporal regions (two cases) and the precordium, which then proved fatal.

Multiple suicidal gunshot wounds are not an infrequent occurrence and may cause problems in distinguishing manner of death. The inexperienced and ignorant believe that a gunshot wound to the head must cause immediate death, and therefore, if a victim is found with more than one firearm wound, manner of death *must* be homicide. This is an inaccurate notion.

Incidents of multiple suicidal gunshot wounds have been reported in forensic literature.[44, 45, 46] In fact, Karger et al.[44] (1997) reported that of 138 firearm suicides, 11 people who committed the act, fired two or more shots to the body. This means that of all the cases he studied, approximately 8 percent of cases exhibited multiple gunshot wounds.

Immediate incapacitation in such cases depends on some physiological effects, which basically involves tissue disruption, which reduces the functioning ability of the

central nervous system. The two main mechanisms to achieve this include direct disruption of brain tissue or indirect elimination of the central nervous system by cerebral hypoxemia from hemorrhage.[44] The instances where the initial shot was fired into the inferior aspect of the jaw, seemed to have only affected the facial structures. This enabled subsequent physical activity to bring about a second, fatal shot.

4.2 Detection of Weapons: The Dilemma

The detection and acquisition of firearms employed in contact gunshot events proved to be a great challenge. Standard operating procedure in most parts of the United States of America provides that all weapons and apparent suicides notes are taken into custody at the death scenes which appear to be suicide.[11] These firearms are then submitted to the relevant forensic science laboratory of the area. The same holds true for weapons discovered on scenes of homicidal and accidental shootings.

The author has found that – in South Africa – *no official protocol exists for the correct handling of weapons* discovered on scenes of firearm fatalities. This creates immense problems for those involved in the analysis of firearms.[47, 48] *Unofficial* protocol dictates that weapons be confiscated by members of the Criminal Record Centre (CRC) for gunshot residue testing (GSR-testing), photography, and fingerprinting. When these duties have been completed, the weapons are then to be securely conveyed to the ballistics laboratory of the FSL in Pretoria where it is then entered into the ballistics register before the relevant ballistic examinations and tests are to be performed. Due to the immense caseload of firearm-related crimes in this country, the ballistics laboratory may suffer a certain degree of backlogged cases. However, even in these circumstances, entrance into the laboratory's system may take no more than approximately four days.[47]

The most important of the evaluations performed in the ballistic laboratory is said to be the Integrated Ballistics Identification System (IBIS).

IBIS is a computerised system much like its fingerprinting counterpart, AFIS (Automated Fingerprint Identification System). All images obtained from microscopic examinations of bullets and cartridges (fired from a particular gun) are stored on the system's database and immediately compared to that of all other ammunition in the system. This enables the forensic scientist to determine whether that particular firearm had been employed in other crimes.

When all ballistic tests have been completed, the firearms are scheduled to be returned to the appropriate branch of the SAPS. No biological analyses of any kind are routinely performed on these weapons. (In fact, upon interviewing most of the investigating officers, the author came across some serious scepticism concerning the Biology Unit's "business" with firearms.)

Admittance of firearms into the register (SAP13) at the appropriate police stations requires entry of relevant information regarding the weapon into a logbook and storage of the weapon in a secure chamber under lock and key. The steps taken to release the firearms depend largely on the type of crime it was associated with at the time of seizure. In the case of weapons employed in suicidal and some accidental deaths, the relevant family members and insurance companies are contacted to retrieve the guns from the police station directly. Where a service pistol was employed in a suicide act, it is usually assigned to the relevant commanding officer of the station, who then generally orders the weapon to be cleaned.

Unfortunately, as discovered through the course of the present study, this *proposed* standard operating procedure is not only disregarded in a very high rate of firearm fatalities (creating a highly inadequate chain of evidence), but is also not nearly sufficient enough to procure thorough and comprehensive analyses of the weapons in different laboratories.

Of the 123 cases of contact gunshot wounds identified at the medico-legal laboratory in Pretoria, only 92 of the weapons utilised in these cases could be identified by the relevant investigating officers.

When the police are called to a scene of a firearm fatality, the officers processing the scene are those on call for that period in time. These officers, however, are rarely assigned as investigating officers to the cases of those death scenes they examined. Instead, the dockets regarding each case are accumulated and evenly distributed among the police officers of that specific station, who will then act as investigating officers to the assigned cases.

These investigators rely heavily on the documentation of the police officer who examined that particular crime scene. Notes, photographs, affidavits, and an array of additional information are present in the case files and serve as platform for the successful investigation of the death. *All* necessary data must be entered into the files in a clear and meticulous manner. However, case files are not always thorough and vital information is sometimes omitted. This could have disastrous consequences on an investigation. Consider, for instance, the case of suspected suicide where the investigating officer was contacted to obtain vital information concerning the circumstances of the case, but was unable to attest to the presence or absence of a suicide note, as this information was not mentioned in the docket.

Inadequate chains of evidence may cause the evidence to be deemed inadmissible by the Court, as its integrity cannot be proven. Incomplete documentation may create an insufficient chain of evidence.

Perhaps one of the greatest problems in a shooting death investigation and maintenance of chain of evidence, is the miscommunication between officers from the different agencies on death scenes, which may lead to *unfamiliarity with the location of the particular firearm.* The path of the firearm should be clearly stated in the case files and chain of custody closely monitored. However, this is not done and the consequences thereof can be potentially disastrous if exposed in Court.

In approximately 29 cases, the investigating officers informed the author that the relevant weapons had been conveyed to the ballistics laboratory at the FSL, whether via the CRC photographers, or by members of the SAPS on the scene. However, on contacting the ballistics laboratory to confirm the location of the weapons, it was discovered that none of the firearms had been entered into the ballistics register. In other words, according to the ballistic laboratory, the firearms were not in their possession. Contacting the CRC also yielded no information as to their locality. Approximately 5 of these weapons have been discovered as having been entered into SAP13, but never delivered to the FSL for analyses. By the time that this study came to an end, these weapons were yet to be delivered to the FSL, despite insistence that they be delivered immediately.

Case Study

In one particular case of an apparent suicidal shooting, the investigating officer delivered the relevant firearm to the FSL, but the gun was never located within the Forensic Laboratory itself. Packaged in an envelope, addressed to Sergeant Massyn at the Biology Unit, the weapon was supposed to reach the appropriate station for biological analysis, but Sergeant Massyn never received the package and it is believed that the handlers of this envelope *supposed* erroneous addressing and delivered the weapon to its "rightful" place: ballistics.[49] However, the weapons were still missing by the end of this study and it can only be hoped that the firearm will turn up eventually.

In 5 cases (with one mutual investigating officer), the author was informed by the relevant officer that the firearms in question were transported to the ballistic laboratory. However, the weapons were not entered into the ballistic system. After extensive researching, the firearms were "discovered" in the SAP13 register of the particular police station. The investigating officer was never informed that the members of the CRC obtained GSR test samples *on the scenes* and never confiscated the firearms for

photographing and fingerprinting. The weapons were therefore also not *en route* to the ballistic laboratory. During the course of the study, the investigating officer in charge of the cases quit the Police Service and it seemed to be unclear as to whom the substituting investigator was. Weapon transport could therefore not be organised.

Another 15 firearms to be analysed during the study were stationed at the specific SAP13, but were never delivered to the biology unit at the FSL. Some cases were identified at the very start of the research, but the firearms used are still outstanding. Scientifically, this creates immense problems, since time delay between detection and analysis of the firearms may influence the rate of detection of blood spatter on the outside and on the inside of the weapons. Backspatter on firearms undergo drying and may dislodge from the interior or exterior surface of the firearm during transportation or manipulation[50], which may then influence scientific authenticity of results. By the termination of the study, these firearms were still outstanding.

The author could not locate the remaining 24 weapons by the end of this study. The apparent absence of these weapons at any of the three sites included in the unofficial protocol of weapon handling raises some serious questions as to the validity of this proposed "protocol". If the firearms could not be found in these localities (CRC, FSL, and SAP13), where are they?

The lack of proper protocol on the handling of weapons causes great confusion among law enforcement personnel, forensic investigators, and researchers alike. When interviewing different members of the police service as well as forensic laboratory staff, it becomes painfully clear that very little consistency exists in the idea of proper firearm-related crime scene protocol in South Africa.

In the South African legal system, it is the duty of the Court to determine the manner of death with the aid of the investigating officer, the forensic pathologist, and any additional forensic investigators. However, it is oftentimes found that police officials on a scene (especially in suicidal gunshot deaths) unofficially decide manner of death and

investigate the scene as such. Whether this is done out of a desire to lessen the burden of the investigator, or to ease the suffering of the family and friends, this is utterly erroneous procedure. Investigation of a scene, and ultimately the entire case, should not be performed with the objective of proving a specific manner of death, but rather the pursuit of truth.

Case Study

In one case of suspected suicide, a young woman and her husband was sitting in the lounge of their home, watching television. According to the husband, he left the house to purchase take-away dinner, and – on his return – found his wife still seated in front of the television, but with a gunshot entrance wound to her head and a firearm lying on the floor next to her chair. The woman had indeed presented with a contact gunshot wound to the right temporal area. On contacting the relevant investigating officer (who ironically was also present on the scene), suicide was immediately accepted as mode of death (as it was "quite obvious that it was a suicide") and the weapon was returned to the husband on the scene.

Disturbingly, no previous history of suicidal ideation, depression, marital problems, financial difficulty and other problems frequently encountered in suicide victims, were known to have been present in the victim's life. Forensiometric analysis would have questioned the position and location of the woman's body on the scene, as suicide in a chair and in front of the television is quite rare. The only indications of suicide were the presence of the weapon on the scene, the entrance wound and the husband's testimony. Though manner of death may quite possibly be one of suicide, it will be extremely dangerous to create a president where all such cases are handled with a complete lack of meticulous investigation. How easy would it be to kill and get away with it just by staging a suicide!

In the South African criminal legal system the State prosecutes the accused/defendant for an alleged crime. Here - as opposed to civil law suites - the *burden of proof* rests upon the State to prove the defendant's guilt "beyond any reasonable doubt". In other words, the judge must be completely sure of every aspect of the case against the defendant.[50]

Considering the questionable decorum of weapon handling in this country and the resultant inability to prove the path and precise localities of a firearm throughout an investigation, would one not expect some shadow of doubt concerning the chain of evidence? What affect would the exposure of the inadequate chain of custody in shooting incidences have on the justice system? If an experienced defence attorney would come to know of the lack of thorough analyses on *all firearms*, together with the poor protocols, we might see many cases thrown out of Court on technical errors. This would cause endless frustration, which could have been prevented if formal protocols and training had been involved from the start of investigations.

When comparing the number of weapons obtained for analysis with those in previous international research, it becomes doubtful whether the results possess any statistical value. Furthermore, with such doubtful circumstances surrounding the analyses, one should consider if scientific examination and subsequent interpretation are at all conceivable.

4.3 Analysis and Results

Age, sex and race

The mean age of the suicide victims in the present study (36,1 years) is slightly lower than in studies performed by Kohlmeier et al.[34] (42,6 years) and Burnett and Collins[24] (39 years).

White South Africans constituted 58,5% of all shooting victims, while Black South Africans constituted only 36,6% of victims. In this country, the Black ethnic group form by far the greatest part of South Africa's racial composition with 78% of all citizens being Black and 10% being White (Reference: www.statssa.gov.za). Considering this, it is clear that those from the White ethnic group exhibit an exceptionally high frequency of firearm-related suicides when compared to those from the Black ethnic group. Blacks, however, show the greatest number of overall suicides (that is, suicide by any method.)[1, 2]

The male to female ratio of victims also correlate well with previous research.[24, 34]

Anatomical Site of Entrance Wounds

The head was the preferred site of entrance, with 89,2% of entries occurring in this area. This correlates well with previous studies.[8, 18, 43]

Weapon Analysis

Since *no* biological examinations of weapons have been done at the Forensic Science Laboratory prior to this study, novel investigative methods had to be employed by scientists at the Biology Unit. Experimental procedures employed by MacDonnell and Brooks[12] (1977) were chosen as suitable methodology to fulfil the objectives of this study. (However, precise measurements of blood penetration into the barrels – as was done by MacDonnell and Brooks – fell beyond the scope of this study.)

Although Benzidine was not the initial choice of presumptive test-substance for detecting blood inside the barrels of the weapons, it was at last accepted as medium because of the high incidence of false positives obtained by the alternative, luminol.

In the United States of America, as well as in the United Kingdom, the use of other presumptive tests for blood, like phenolphthalein and leucomalachite green (LMG) is well documented.[11, 38] However, these substances are not utilised in South Africa.[47] Luminol, a liquid that - when in contact with minute quantities of blood - induces chemical luminescence when viewed in darkness or near darkness, is the primary

substance used for presumptive blood tests in the South African forensic investigation system.[47] However, due to the great time delay between identification of cases and the delivery of weapons to the Biology Unit, the risk of false positive reactions obtained when luminol reacts with rust and other material in the barrels of the weapons, was too great and the decision was made to employ *benzidine* instead.[49]

The substance Benzidine, utilises the peroxidase-like activity of heme to produce a blue/purple colour as end product.[38]

Benzidine is used as a *presumptive test* for blood and exhibits identical sensitivity and specificity to tetra-methylbenzidine (a homologous substance most often mentioned in forensic literature as presumptive blood test).[38] Milton[38] (1991) compared the sensitivity and specificity of the latter with that of other agents used as presumptive tests for blood, such as phenolphthalein (the most frequently used chemical in blood detection in the United States of America), orthotolidine solutions and leucomalachite green.[38]

He found the phenolphthalein to be the best single test for blood, having both the greatest sensitivity and specificity, but – as already mentioned – this agent is not currently being used in the Police Forensic service.[47]

The tetra-methylbenzidine (together with orthotolidine) was the most sensitive test of the group analysed in the study. Bearing in mind that tetra-methylbenzidine and benzidine are indistinguishable with respect to the produced results, it can be assumed that benzidine will possess a sensitivity similar to that of tetra-methylbenzidine, namely one part in 10,000 to 200,000.[38]

The increased need for a high level of specificity and sensitivity of the presumptive tests are clear and for many years benzidine was the substance of choice. It is one of the most sensitive presumptive tests for blood[38] and – since its discovery – has been considered reliable for the generic diagnosis of bloodstains.[52] That is, until its carcinogenic effects were realised.

Benzidine ***(Figure 4.3)*** and its salts are considered dangerous carcinogens in man (especially in long-term occupational exposure) causing an increased incidence of especially bladder cancer.[52] Consequently, it has been declared a hazardous substance and its utilisation in the forensic domain has suffered since the late seventies. However, in South Africa it is only recently that the use of benzidine has been prohibited. It is therefore highly advisable that analysis employing the benzidine dye be done in a well-ventilated area, using latex gloves for skin protection.

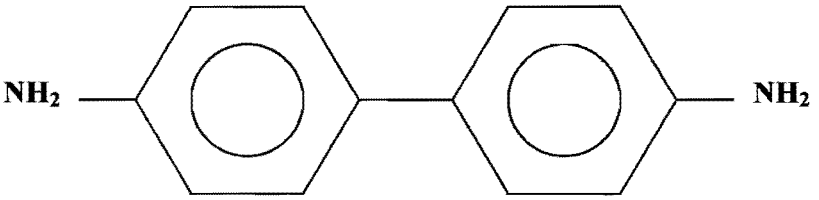


Figure 4.3: The chemical structure of benzidine.[52]

The existence of substances able to induce false positive results when using benzidine as presumptive test for blood is well known and documented.[38, 52] Plant peroxidases are known to create false positive reactions.

To obtain reliable sensitivity, a maximum of 10 seconds should be allowed for the colour reaction to occur.[38] In high blood concentrations the development of the colour will occur within 5 seconds. If the colour develops after 20 seconds, interference colour might have been produced or a false-positive result might have been obtained. The interpretation of the results of this test was highly dependent on the expertise and experience of the scientist performing the experiment, method of preparation and the blood concentrations on the surface being tested.

Of the 24 percent of weapons actually received and analysed, only 40 percent (12 firearms) possessed blood on the external surface of the weapon. This *does not correlate* with previous research.[10, 11, 35] Reports on the drawn back effect have documented blood on the outside of the same weapons in 64 to 90 percent of all firearms, independent of

type and calibre of the weapons. These numbers are significantly higher than that of the present study. Such a low rate of blood persistence on the exterior surface of a firearm used in a contact gunshot event is rare. Of special note is the low rate of blood persistence (27 %) on the outside of 9 mm pistols as compared to those in previous international studies (83 %).[10, 11, 35]

Unfortunately, due to the extremely low number of firearms delivered for analysis, statistical interpretations should be done with caution.

The low frequency of blood found on the outside of the weapons is symptomatic of a highly troublesome occurrence in the handling of weapons in this country. Handguns found on the scenes of fatal shootings are oftentimes found with a relatively large amount of blood on the external surface. It has been known to occur that – after photographing the weapons on scenes – they are sometimes picked up and wiped, to rid the weapon of the majority of blood.[47] The general fear of HIV / AIDS and other blood borne diseases so common in South Africa seem to warrant this action, but unfortunately it destroys any chance of successful scientific analysis of the weapons.

The frequency of blood back spatter on the inside of the barrels (70%) in this study seems to correlate with those of previous studies.[10, 11] Stone[35] (1992) recorded a persistence of blood on the inside of firearms in 47 to 74 percent of all weapons, dependent on the type and calibre. Once more, statistical interpretations of the results generated by the present study should be done with caution.

Weapons of greater calibre, for instance .38 Special revolvers and rifles, seem to possess greater blood retaining ability. This correlates well with previous research.[10, 11] No correlation of significance seems to exist between the anatomical location of entrance wounds and the number of weapons with positive tests for blood on the inside of the barrels. (All entrance sites occurring more than twice exhibited a statistical chance of retaining blood between 66 to 75 percent of the time.) In addition, no significant correlation seems to exist between the presence of hair or clothing as intermediate targets,

and the frequency of blood in and on the firearms. However, the small number of firearms analysed precludes proper determination of correlation between the above-mentioned factors and back spatter.

The conditions in some of the SAP13 registers are also cause for concern as to the validity of results produced during the study. It has been reported that some weapons – especially those of large calibre, like rifles and shotguns – are not placed in protective covering, such as paper or plastic envelopes or bags when entered into SAP13.[47, 48] Consequently, an extremely high risk of contamination exists in some of these registers, adding to decreased scientific validity of the study.

It is important to keep in mind that the above-mentioned practices are not born from laziness or ignorance on the part of the police officers. No proper protocol is in place to support the actions of those investigating shooting fatalities. No laws exist dictating the delivery of the firearms to the FSL for biological analysis. In fact, the advantages of biological analysis are unknown to most investigating officers. The burden should perhaps fall on those of us that understand and appreciate its significance, to push for the formation of novel criteria for the collection and analysis of weapons.

4.4 Recommendations

In a country where the incidence of unnatural deaths are of the highest in the world, it becomes essential to establish highly effective protocol for all aspects of an investigation, so that it will enhance the competency level of our police force and not take away from it. It should start at the very top.

The Court should be adamant about admission of evidence produced by strict adherence to scientific procedures and a completely intact chain of custody. It should insist on only allowing evidence that was detected, collected, analysed and interpreted by experts in the field without confounding factors.

The creation of standard operating procedure for fatal shooting incidents should be implemented as soon as possible and it should be strictly adhered to. Deciding on the manner of death on the scene should be avoided and all physical evidence collected according to the standard operating procedure.

Laboratory procedures regarding the biological assessment of firearms must be implemented and upgraded to international standards and novel chemicals, such as phenolphthalein, should be incorporated into the array of investigative tools. Proper systems, whether computer or manual, should be upgraded and adhered to so as to prevent the creation of great backlog.

Crime scene management must involve the primary entrance of forensic scientists. This will allow for detection and collection of evidence before it is contaminated or destroyed. The scientific handling of firearms on the scene is of great concern and a much greater respect for the scientific and biological value must be given to the weapons. Since the biological analysis of weapons do not pose a major risk for destruction of evidence such as fingerprints, it is perhaps essential that biological analysis occur prior to fingerprinting, and certainly prior to ballistic tests.

Chapter 5

CONCLUSIONS

Firearm fatalities in South Africa are responsible for a very large number of fatalities. For purposes of judicial administration, determination of manner of death, in particular, differentiating between homicidal, accidental and suicidal death, is one of the primary objectives in fatal shooting investigations.

Determining the muzzle-target distance can assist in establishing the manner of death, since contact gunshot wounds are seldom seen in cases of homicidal or accidental death. It has been reported that muzzle-target distance can be confirmed by detection of blood back spatter on the inner and outer surfaces of the weapons.

To determine whether this phenomenon was being used to assist the forensiometric analysis of fatalities, a study was undertaken whereby weapons used to inflict fatal contact gunshot wounds in victims presenting at the Pretoria MLL, were requested for biological analysis during the period June 2002 to June 2003.

Of the 123 cases identified, only 30 firearms were delivered to the Forensic Science Laboratory for analysis. Blood was found on the inside of barrels in 64% of cases, and the outer surface in 40%. These figures do not correlate well with international studies.

This study serves as proof that the current management of firearm-related fatalities and protocol pertaining to the handling of weapons after the fact prohibit proper and accurate scientific analysis of the weapons without risk of contamination or interference. In addition to this, great time delays between shootings and firearm analysis and rough and improper handling of weapons add some to doubt to the scientific validity of weapon analysis.

SAMEVATTINGS

Skietwond sterftes in Suid Afrika is verantwoordelik vir 'n groot hoeveelheid van alle sterftes. Vir die doel van geregtelike administrasie, is bepaling van oorsaak van dood, en in besonder die differensiasie tussen moord-, ongeluk- en selfmoord sterftes, een van die primêre doeleindes in noodlottige skietgeval ondersoeke.

Bepaling van die loop-teiken afstand kan die bepaling van die tipe sterfte fasiliteer, aangesien kontak skietwonde selde in moord- of ongeluksterftes teëgekom word. Dit is reeds aangeteken dat loop-teiken afstand bevestig kan word deur die waarneming van bloed spatsels aan die binne- en buitekantste oppervlakke van die vuurwapens.

Om te bepaal of hierdie verskynsel gebruik word om die forensiometriese analise van sterftes te fasiliteer, is 'n studie onderneem waarvolgens wapens, gebruik in die toediening van noodlottige kontak skietwonde in slagoffers wat presenteer by die Pretoria RGL, aangevra is vir biologiese analise tydens die periode Junie 2002 tot Junie 2003.

Van die 123 sake geïdentifiseer, was slegs 30 vuurwapens na die FWL geneem vir analise. Bloed was sigbaar aan die binnekant van wapens in 64%, en aan die buitekantste oppervlak in 40% van alle gevalle. Hierdie syfers korreleer nie goed met internationale studies nie.

Hierdie studie dien as bewys dat die huidige bestuur van vuurwapen-verwante sterftes en protokol met betrekking tot die hantering van vuurwapens na 'n skietvoorval, deeglike en akkurate wetenskaplike analise van wapens sonder die risiko van kontaminasie of inmenging, belemmer. Die aansienlike vertraging tussen skietvoorvalle en vuurwapen analises, asook die rowwe en onbehoorlike hantering van wapens dra by tot twyfelagtigheid ten opsigte van die wetenskaplike geldigheid van wapen analises.

Dit beklemtoon ook die noodsaaklikheid van die daarstelling van geskikte standaard werksprosedure op sulke tonele, asook die noodsaaklikheid van streng navolging van wetenskaplike protokol in die laboratorium.

In 'n land met so 'n uitsonderlike hoë syfer van vuurwapen-verwante sterftes, is dit steurend hoe ver verwyderd die areas van polisiëring en wetenskap funksioneer. Dit kan bevraagteken word of wetenskap enigsins 'n rol speel 'n polisiëring in Suid Afrika. Dit is daarom duidelik dat 'n studie wat so swaar staatmaak op akkurate wetenskaplik prosedure en beginsels, nie in die huidige sisteem uitgevoer kan word nie.

It also emphasises the need for the establishment of appropriate standard operating procedure on these scenes and the need for strict adherence to scientific protocol in the laboratory.

In a country with such an elevated rate of death by firearm, it is quite disturbing how greatly divided the domains of policing and sciences are functioning. In fact, it is questionable whether science is at all involved in policing in South Africa. It is therefore clear that a study heavily depending on accurate scientific procedures and principles cannot be performed in the current system.

Key Words: forensiometric analysis, firearms, suicide, suicidal gunshot wounds, back spatter, blood on firearms, suicide weapons, drawback effect, blood, crime scene protocol.

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