



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

By

**Jo-Mari Visser**

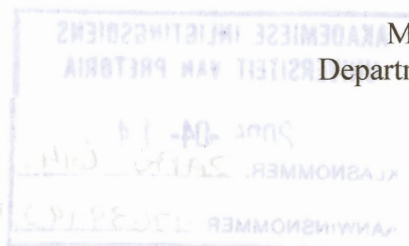
Student NR: 2210142

MSc Medical Criminalistics

Department of Forensic Medicine

University of Pretoria

September 2003





UNIVERSITEIT VAN PRETORIA  
UNIVERSITY OF PRETORIA  
YUNIBESITHI YA PRETORIA

DISSERTATION

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

By

**Jo-Mari Visser**

Student NR: 2210142

**September 2003**

**Supervisor: Prof. G. Saayman  
Department of Forensic Medicine  
University of Pretoria**

**Co-supervisor: Senior Superintendent Leonie Ras  
Forensic Science Laboratory  
South African Police Service**



Submitted to the Faculty of Health Sciences  
Department of Forensic Medicine  
University of Pretoria

Submitted in partial fulfilment of the requirements for the degree  
**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.

A handwritten signature in black ink, appearing to read 'J. Visser', written over a horizontal line.

**Jo-Mari Visser**

**Date:** 17 Maart 2004



## TABLE OF CONTENTS

Acknowledgements.....	p. i
Abstract.....	p. iii
Opsomming.....	p. iv
Abbreviations.....	p. v
List of Tables.....	p. vi
List of Figures.....	p. vii

### **CHAPTER 1: Background and Study Objectives**

1.1 Introduction.....	p. 1
1.2 Literature Review.....	p. 5
1.3 Aims of Study.....	p. 18

### **CHAPTER 2: Methodology**

2.1 Study Design.....	p. 19
2.2 Study Setting.....	p. 19
2.3 Subject Selection.....	p. 19
2.4 Study Population.....	p. 20
2.5 Sampling Frame.....	p. 20
2.6 Research Procedures.....	p. 21
2.7 Ethical Considerations.....	p. 23
2.8 Data and Documentation.....	p. 24
2.9 Funding.....	p. 25
2.10 Time Frame.....	p. 25
2.11 Reporting.....	p. 26

### **CHAPTER 3: Results**

3. Results.....	p. 27
-----------------	-------



## **CHAPTER 4: Discussion**

4.1 Identification of Contact Gunshot Entrance Wounds.....	p. 42
4.2 Detection of Weapons: The Dilemma.....	p. 47
4.3 Analysis and results.....	p. 53
4.4 Recommendations.....	p. 58

## **CHAPTER 5: Conclusions**

5. Conclusions.....	p. 60
5. Samevatting.....	p. 62

<b>References.....</b>	<b>p. 64</b>
------------------------	--------------

---

## ACKNOWLEDGEMENTS

**I wish to express my sincere gratitude towards the following persons and institutions for assistance and support during this research project:**

*Prof. G. Saayman* (Department of Forensic Medicine, University of Pretoria) – my study supervisor, for his inestimable contribution to this study and for being a patient and generous source of knowledge and wisdom.

*Senior Superintendent Leonie Ras* (Biology Unit, Forensic Science Laboratory of the South African Police Service) – co-supervisor to this study, for assistance in protocol and project development and to whom I am greatly indebted for shared knowledge and endless support.

*Sergeant André Massyn* (Biology Unit, Forensic Science Laboratory of the South African Police Service) – for the video recording, photography, and scientific analysis of the firearms.

All the forensic pathologists at the Forensic Medicine Department of the University of Pretoria for assistance in the identification of the gunshot wounds.

The photographers of the Photography Unit of the Forensic Science Laboratory for their care in the photography of the firearms.

Captain P.A. Dreyer and the members of the South African Police Service at the Medico-Legal Laboratory in Pretoria.

The investigative officers of each of the cases who made all the applicable information available and who conveyed the weapons to the Forensic Science Laboratory.

*Prof. P. Rheeder* (Department of Epidemiology, University of Pretoria) – for valuable contributions to protocol development.

*Dr. Bekker* (MRC-Building, Pretoria) – for assistance in the analysis of the data yielded during the study.

To *my parents* for the immense opportunity of fulltime post-graduate study and for being a source of great support and love.

*My Creator* without whom nothing is possible.

---

## 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 forensic 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 forensic 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 ondersoek.

Bepaling van die loop-teiken afstand kan die bepaling van die oorsaak van dood fasiliteer, aangesien kontak skietwonde selde in moord- of ongeluksterftes teëgekomp 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 internasionale studies nie.

Die baie lae opsporingsyfer van vuurwapens vir analise sluit die gebruik van 'n belangrike forensiometriese instrument in regsgeneeskundige ondersoek 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



## LIST OF TABLES

<i>Table 1.1: The variables used in Karlsson’s forensiometric model.....</i>	<i>p. 8</i>
<i>Table 1.2: Muzzle-target distances on the basis of different modes of death.....</i>	<i>p. 16</i>
<i>Table 3.1: Anatomical locations of entrance wounds.....</i>	<i>p. 29</i>
<i>Table 3.2: Type and caliber of weapons used in contact gunshot occurrences.....</i>	<i>p. 31</i>
<i>Table 3.3: Locations of suicidal gunshot events.....</i>	<i>p. 33</i>
<i>Table 3.4: Results of weapon analysis for the presence of blood on the outside and inside of barrels.....</i>	<i>p. 39</i>

---



## LIST OF FIGURES

<i>Figure 3.1: Age distributions by 10-year age group.....</i>	<i>p. 28</i>
<i>Figure 3.2: Distribution of race according to suspected manner of death.....</i>	<i>p. 28</i>
<i>Figure 3.3: Typical suicidal entrance wound to the right temple (a), and central forehead (b).....</i>	<i>p. 30</i>
<i>Figure 3.4: Number of suicides by type of weapon used.....</i>	<i>p. 31</i>
<i>Figure 3.5: The .22 caliber target pistol.....</i>	<i>p. 32</i>
<i>Figure 3.6: Number of weapons analyzed, "lost" for analysis, and still outstanding.....</i>	<i>p. 35</i>
<i>Figure 3.7: A firearm showing macroscopic back spatter on the outside.....</i>	<i>p. 36</i>
<i>Figure 3.8: External aspects of firearms covered in blood.....</i>	<i>p. 37</i>
<i>Figure 3.9: A photograph showing the interior surface of a barrel.....</i>	<i>p. 38</i>
<i>Figure 3.10: Note the presence of blood droplets.....</i>	<i>p. 38</i>
<i>Figure 3.11: Summary of blood positive weapons.....</i>	<i>p. 40</i>
<i>Figure 3.12: A graph correlating an entry wound with the number of blood positive weapons.....</i>	<i>p. 40</i>
<i>Figure 4.1: A picture of a contact entrance wound exhibiting seared edges and soot deposition around the defect.....</i>	<i>p. 42</i>
<i>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 large, round defect.....</i>	<i>p. 43</i>
<i>Figure 4.3: The Chemical structure of Benzidine.....</i>	<i>p. 56</i>