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CANADIAN POLICE RESEARCH CENTRE

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CENTRE CANADIEN DE RECHERCHES POLICIERES

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BAREFOOT COMPARISON AND IDENTIFICATION RESEARCH

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TECHNICAL MEMORANDUM

Submitted by
RCMP Forensic Identification
Research & Review Section

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NOTE: Further information about this report can be obtained by calling the CPRC information number (613) 998-6343

Executive Summary

The purpose of this project is to establish a database of barefoot impressions. This database would be used to show the uniqueness of barefeet and would eventually enable the forensic expert to compare scene of crime impressions found inside footwear, in blood, mud, or some other medium with the bare footprint of a suspect, to establish identity.

The entire sole of the foot contains sweat pores that cause the foot to sweat when confined to a pair of shoes. This, combined with thousands of footsteps taken each day, causes the shoe to bend and conform to size, shape and function of the foot. Also, the shoe may cause damage to the foot, eg., callus buildup, bunions, etc. All of these characteristics are accidental characteristics and when combined with the details in the stained impressions may lend themselves to a positive physical match of the foot to the shoe.

Résumé

Le but de ce projet est de constituer une base de données d'empreintes plantaires montrant l'individualité des pieds et permettant aux experts de comparer les empreintes laissées sur les lieux d'un crime dans des chaussures, du sang, de la boue ou toute autre matière avec celles d'un suspect, en vue de les identifier.

La plante du pied contient des pores qui donnent passage à la sueur lorsque le pied est dans une chaussure. La sueur, combinée aux milliers de pas effectués chaque jour, contribue à façonner la chaussure selon la taille, la forme et le mouvement du pied. La chaussure peut également endommager le pied et provoquer la formation de durillons ou d'oignons, entre autres. Il s'agit dans ce cas de caractéristiques accidentelles qui, lorsque combinées aux details d'une empreinte colorée, peuvent permettre l'établissement d'une correspondance entre la chaussure et le pied.

1) INTRODUCTION

The barefoot research described in this report was conducted on a full time basis from April 1994 to March 1995. It entails the gathering, comparison and physical matching of barefoot impressions inside shoes/footwear, or in any other substance at a crime scene, eg., blood, mud, when ridge detail is not present.

2) SUMMARY

The purpose behind this research is to establish a database of barefoot impressions that can be used with other information gathered throughout this study to show the uniqueness of barefeet. This will enable the forensic expert to compare scene of crime impressions found inside footwear, in mud, blood or some other medium with the bare footprint of a suspect to establish identity. Not only would this be useful for crime scene impressions, but it could prove very useful at times of mass disasters where identity is difficult to establish at best, if not impossible through other means. The comparison of the shoes found on a body part may be compared with shoes found at the victims home. It would also lend some form of identity when missing children are found, where the age of the child would limit the possibility of fingerprints or dental records being kept, and decomposition might make identification by other means impossible.

To date, this study has shown that feet, as with everything in nature, are unique. The foot is a rigid structure with the entire sole of the foot being covered with papillary ridges that contain sweat pores which cause the foot to sweat when confined to a pair of shoes. Heat from the foot and the sweat secreted by these pores in combination with the thousands of footsteps taken each day, cause the shoe to bend and stretch to conform to the size, shape and function of the foot. The pressure, heat and perspiration darken the pressure areas on the insole of the shoe while the sides of the shoe conform to the toes, sides and heel of the foot. The inside uppers also conform to, and are worn by, the tops of the toes. The outsole has wear

areas on the weight bearing areas such as the heel, ball of the foot and toe pads, all of which form part of our comparison. (fig. 1)

The shoe may cause some damage to a foot, eg. a broken sole may cause a callus to build up on the sole of the foot. Stitched areas may cause bunions or other sores on the side and top of the foot or a nail protruding through the shoe may cause a scar on the foot. All of these are accidental characteristics and in sufficient number may lend themselves to a positive physical match of the foot to the shoe.

Excellent progress has been made in the development of a computer program to compare the inked impressions of barefeet collected from volunteers, in order to show the individuality of barefeet. A large collection of footwear from individual volunteers, as well as shoe manufacturers, were gathered in order to see how the sweat areas differ in each shoe.

This method of comparison is also a useful tool in eliminating as well as identifying a suspect and I have in fact eliminated suspects in several cases.

3) CONCEPT

During this study, impressions from approximately 2,500 people (5,000 barefoot impressions) were collected and a total of 38 different measurements were taken of each and 2,000 were entered on a computer database. Once all the measurements were entered, cross searches of one foot against the others were conducted to determine if it was possible to find two feet with the same measurements. The uniqueness of each foot became apparent when after only three to four input measurements, the computer located the exact foot being searched. (fig.2)

An error factor of +/- 5 was then added to each measurement in this search. This was done to increase the chance of finding two feet with similar measurements, however, even with this variance we were able to

produce the correct person after 12 to 15 measurements were input. Nineteen hundred persons were searched in this manner and the proper foot was identified every time.

Many blind searches were conducted where impressions of feet were taken by another person on this section; some of the feet were already in the collection and some were not. I successfully searched and found each of the feet that were in the collection and eliminated those that were not.

The collection of inked barefoot impressions is ongoing. (fig.3) I am presently collecting barefeet impressions from as far away as England, where Dr. Wesley Vernon, Podiatrist, has offered to collect impressions for this research. I have collected many pairs of shoes from individuals interested in this study and have also taken foot casts of many feet for comparison purposes. It was very important over the past year to visit many locations obtaining inked impressions of barefeet, along with casted impressions. Each inked impression had to be examined, measured and entered on our computer program. The 300 or so pairs of shoes had to be examined to determine if any of the impressions inside the shoes were similar. It was found that while some impressions were similar at first glance, upon closer observation, the differences soon became evident.

4) NATIONAL AND INTERNATIONAL COLLABORATION

I have had discussions with several individuals involved in this type of work, namely:

Dr. Facey of Scotland Yard who has done some work in this area;

Special Agent Bill Bodziak of the FBI in Washington who has also done work in this area and has written a book on footwear identification entitled "Footwear Impression Evidence";

Dr. Keith Bettles, a podiatrist from Prince Edward Island who has given evidence in court on barefoot identification;

Dr. Wesley Vernon a Podiatrist from England, who has also done some research in this area;

Bengt Aspegren and Kjell Carlsson who are heading a project on the comparison of bare and socked feet, from the Swedish National Police.

All agree with the direction this research has taken.

I am presently participating in a project, put on by the Swedish National Police, where Lab personnel from across North America and Europe have been asked to compare and possibly identify bare and socked feet impressions from a collection of known donors. The purpose of this project is to see if everyone involved with the comparison of barefeet are on the same wavelength.

I have also been asked by the National Bureau of Investigation Finland to make a presentation at their symposium on tool marks and footwear identification to be held in May 1995.

I have been corresponding with Liu Shuquan of Footprint Dynamics Test Technological Research Centre in China, who claims that he has a computer program he uses to positively identify barefoot impressions to an individual.

5) PRACTICAL USES FOR POLICE

To date I have worked on 14 criminal cases from across Canada. I have given evidence on five and am still actively working on four. I have also been involved in several cases where I was able to eliminate a potential

suspect from having been at the crime scene. We have received positive feedback from crown prosecutors relative to the evidence given in several court cases.

6) COMMUNICATION OF INFORMATION ARISING FROM RESEARCH TO POLICE

I have been, and am presently involved with, lecturing throughout Canada, at Workshops and seminars, on the value of this type of physical evidence both criminally and otherwise. I have given presentations at the C.I.S (Canadian Identification Society) and M.O.I.A. (Michigan Ontario Identification Association) meetings.

I am scheduled to give a presentation at the I.A.I.(International Association of Identification) conference in California, at the European Meeting for Shoeprints/Toolmarks in Finland, and at the C.I.S. annual meeting in Halifax, N.S.

7) FUTURE RESEARCH

1. **Future research still needs to focus on improving the recovery of the stained and indented impressions found inside of footwear for comparison with known impressions.**

2. **More work needs to be done gathering the inked barefoot impressions from volunteers in order to establish a larger scientific database.**

3. **All data gathered from the inked impressions must be added to and searched through, the computer program database.**

4. More blind tests need to be done in order to establish the reliability of the database, as well as comparison techniques.

5. More collaboration with experts in this field must be done and a line of communication with these experts must be established so we can maintain the integrity of this field.

6. More shoe manufacturers must be contacted in order to obtain more footwear for comparison purposes.

7. A controlled subject group must be established so that changes, if any, in the foot may be noted over a period of time. This control group could come from the R.C.M. Police Training Academy, Regina, Saskatchewan, where several troops could be given running shoes and their sweat impressions checked on a regular basis over the life of the running shoe.

8. Police agencies must be visited on a regular basis at their training seminars in order to update them on this new and developing technique.

8) CONCLUSIONS

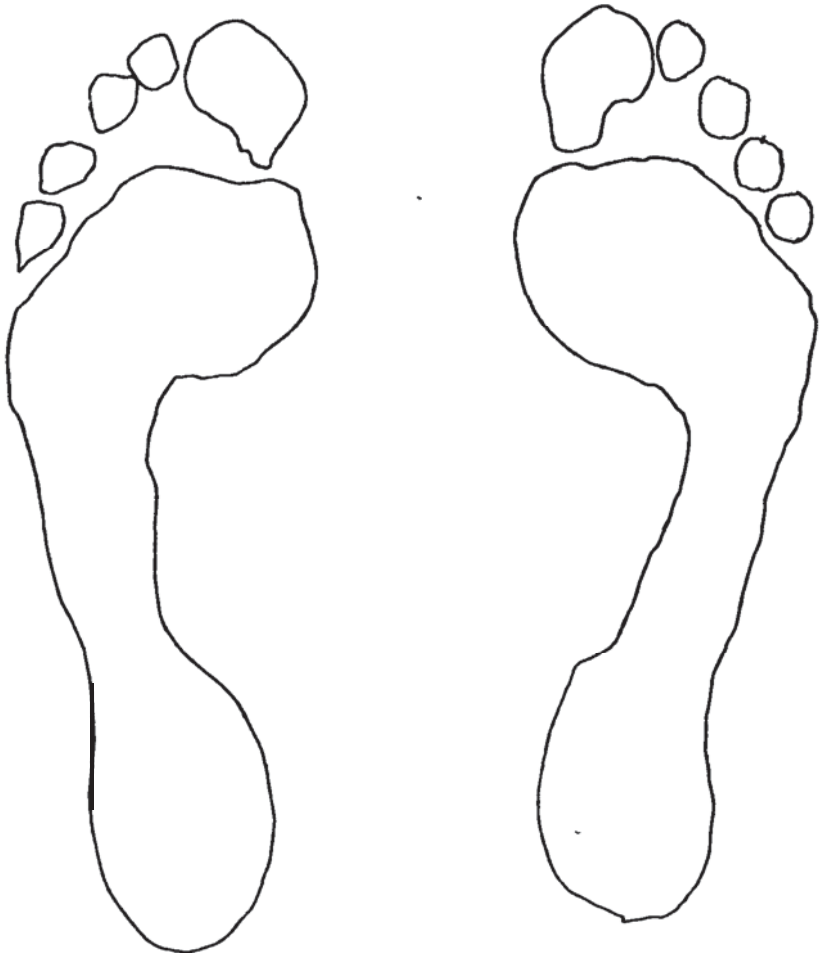
While this research has shown barefoot comparison techniques to be reliable and useful for possible identification purposes in both criminal cases as well as for other types of disasters, much research is left to be done in order to establish this as a useful and reliable piece of evidence in the scientific world as well as in courts of law.

It is hoped that this research can be completed in the next two to three years in order that this technique can be used in the field, with one person in

each province being responsible for the comparison of, and presentation of, this barefoot evidence in a court of law.

FIG.1

FIG.2



MEASURE IN mm	L	R	REMARKS	
LENGTH	245.6	241.8		
B. WIDTH	83.6	82.6		
H. WIDTH	46.4	45.5	Heel to Border	
CENTRE HEEL TO	centre L	centre R	border L	border R
1st T	204.3	206.6	245.6	242.5
2nd T	207.8	208.0	242.8	238.7
3rd T	198.5	193.0	233.3	225.0
4th T	183.6	180.5	217.1	210.6
5th T	169.3	169.0	204.3	199.4

LMT	L 1	L 2	L 3	R 1	R 2	R 3
BORDER	203.3	206.1	184.0	198.8	201.3	182.0
CENTRE	176.1	178.4	156.3	175.2	177.4	158.2

RACE FRENCH

HT	5'	AGE	53
WT	154	ETHNIC ORIGIN	
SHOE SIZE	9	SEX	M

FIG.3