

nsCr

The use of palm print comparison for criminal investigation and prosecution

Research commissioned by the Scientific Research and Documentation Center (WODC)

Marijke Malsch
Tom van den Berg
Mark Hornman
Marre Lammers
Bas de Wilde
Lonneke Stevens

Amsterdam, 2017/2021

nsCr

Netherlands Institute for the Study
of Crime and Law Enforcement

The use of palm print comparison for criminal investigation and prosecution

Research commissioned by the Scientific Research and Documentation Center (WODC)

Marijke Malsch
Tom van den Berg
Mark Hornman
Marre Lammers
Bas de Wilde
Lonneke Stevens

Amsterdam, 2017/2021

© 2017/2021 WODC, Ministry of Justice and Security. Copyright reserved.

Table of contents

Foreword	4
Summary.....	5
Reason for the study.....	5
Methods.....	6
Dactylography.....	6
The practice of palm print comparison.....	7
Court decisions and case files.....	8
Comparative law studies.....	9
Introduction.....	10
Background to the research.....	10
Palm comparison.....	11
Research question.....	12
Methods.....	12
The palm comparison.....	14
Introduction.....	14
Forensic investigation.....	14
Dactylography.....	14
HAVANK: database for dactylographic traces and prints.....	16
Dactylographic comparison.....	16
Palm comparison in practice: police and public prosecution.....	18
Introduction.....	18
Research methods.....	18
Types of offense.....	19
The added value of palm traces for the investigation.....	21
Application of palm comparison in practice: court decisions.....	25
Introduction.....	25
Method: sample of court decisions and files.....	25
Criminal offenses.....	26
The role of the palm trace in the case.....	27
Conclusions of dactylographic reports.....	29
Dealing with the palm comparison reports by the courts.....	30
Counter-expertise.....	31
Legal comparison.....	32

Conclusions	33
The added value of palm prints	33
Reporting on palm comparison.....	34
The use of palm print comparison by the courts	34
Literature	35
Appendix 1: Examined court decisions	37

Foreword

Technical forensic evidence is becoming increasingly important. One reason for this is that suspects more often choose to remain silent when questioned by the police. Dactylography is a long-established forensic method that can be used to check whether finger or palm traces found at the crime scene match those of a suspect or others.

Commissioned the *Research and Documentation Center* (WODC) of the Ministry of Security and Justice, The *Netherlands Institute for the Study of Crime and Law Enforcement* (NSCR) and the *Vrije Universiteit* have investigated the taking, use and storage of palm prints, as well as the added value of this type of forensic evidence. We are the supervisory committee for this research very grateful for its expert advice and support during the execution of the research. The sounding board group that was set up also provided valuable advice and protected the researchers from any inaccuracies when writing the report and drawing conclusions.

With the aim of reaching an international audience, the report of this study (*De toepassing van handpalmafdrukken voor de opsporing en vervolging*, Amsterdam, 2017) has been summarized and translated in English. The translated report focuses primarily on the added value and the actual practice of the use of hand palm comparison. Parts that focus on the Dutch legal framework and parts that seem of minor interest for readers from other countries than the Netherlands have been largely omitted from this translation.

Amsterdam, 2017/2021

Summary

Reason for the study

Each hand shows a pattern of lines, the so-called papillary lines. These lines run in the palm of the hand and continue onto the fingers. As far as we know, each person has a unique pattern of lines. Fingers and hands can leave traces on surfaces or objects, which are referred to as 'dactylographic traces'. These are pre-eminently suitable for investigation of crimes, for instance to establish by whom the traces at a crime scene have been left, and whether these traces are possibly those of the suspect. The fingerprint trace is one of the oldest and most effective means of identification. It has proven to be invaluable to the police and the Public Prosecution Service. Although fingers and palms of hands have no essential biometrical difference, Dutch legal standards do clearly distinguish between fingers and palms. This distinction can be explained by the different purposes for which fingerprints and palm prints are collected.

Fingerprints are primarily taken for the purpose of establishing the suspect's identity. When a suspect has been arrested, fingerprints are taken and sent to VVI (Dutch Facility for Verification and Identification, in Dutch: *Voorziening voor Verificatie en Identificatie*) and HAVANK (the Automated Fingerprint System Dutch Collection, in Dutch: *Het Automatische VingerAfdrukkensysteem Nederlandse Kollektie*). The suspect's identity can be established by comparing the finger traces with prints that were taken and saved earlier. On top of that, fingerprints are used for investigation purposes. It is established whether the fingerprints that have been secured, are identical to the fingerprint traces found at a crime scene. HAVANK contains both fingerprints taken from suspects and traces secured earlier at crime scenes. The databank enables automated searches for matches between saved and new fingerprints or between fingerprints and traces. In that way, suspects can be linked to criminal offenses of which they are not yet suspected.

Palm prints are only used to find possible matches with palm traces. Therefore, in the Netherlands they can only be taken if an individual is thought to have been involved in a criminal offense related to which palm traces have been found at the crime scene. The palm prints taken from a suspect are saved in HAVANK, after which an automatic search is conducted for any matches with palm traces that were saved earlier. Since fingerprints and palm prints are thus collected for different purposes, separate legal provisions regulate the collection of these prints. The collection of palm prints is allowed only if an order from the public prosecutor is available, and securing palm prints is necessary in the interest of the investigation (article 61a paragraph 1 sub b and article 62a of the Dutch Code of Criminal Procedure). This interest is usually assumed to exist if a palm trace has been found at the crime scene and the suspect is believed to have been involved in that offense. The statutory provision therefore does not prescribe the default collection of palm prints of arrested suspects, as it does for the securing of finger prints.

The police and the Public Prosecution Service stress that they need palm prints to be taken by default in order to increase the effectiveness of investigation activities. They argue that other European countries do take palm prints by default.

The above issues and questions were the reasons behind this research. The research question is:

What is the added value of using palm prints for the identification of suspects and their prosecution and trial in criminal courts as compared to fingerprints and other types of forensic evidence?

Below, the research methods will first be set out briefly. Second, the subsequent research phases and results will be summarized.

Methods

By means of 'triangulation' (i.e. the combining of various research methods) an attempt was made to provide an elaborate overview of the actual use in practice of palm traces for investigation and prosecution purposes and the added value of this forensic method. The Dutch implementation practice was analyzed using figures on dactylographic traces and prints, on both the use of DNA traces and prints, and the matches that were returned when comparing these.¹ Next to that, 22 officers of the police and the Public Prosecution Service were interviewed on how they process (requests for) palm print comparisons.

Also, court decisions published at the website Rechtspraak.nl in criminal cases where palm prints were used for the investigation (N=43) were analyzed with help of a checklist. In addition, ten criminal case files were studied in which palm print comparisons played a role, again using a checklist.

Dactylography

Dactylography refers to the study of papillary lines, which are the lines in the skin on the inside of the finger, palm, toe and foot. It also includes the study of prints and traces that can be left by papillary lines on surfaces. A distinction is made between a print and a trace. A *print* is a reference print of the papillary lines that was taken of a person under controlled circumstances. Prints used to be taken using ink. Today, they are usually collected by using a scan, at least in case of fingerprints. A *trace* is the print of the papillary lines found at the crime scene.

One of the aims of dactylography is *individualization*, i.e. to establish whether a certain individual is the source of a finger or palm trace that is linked to a presumed criminal offense. Fingerprints are also taken in order to establish an individual's identity. In this, two methods can be distinguished: identification and verification. *Identification* means that the identity of the person involved is established, as part of the application of criminal law rules. *Verification* is the process whereby test material collected is compared one-to-one to reference material of one specific individual. In the latter case, the identity of the suspect is already suspected, so that it only requires verification.

For the purpose of the investigation of a crime it is important that a trace linked to a criminal offense matches with a unique source. This requires that the print has unique characteristics which correspond to other prints of – only – that source and that these unique characteristics remain unchanged over a longer period of time. This is generally thought to be the case for dactylographic traces and prints, including those of the palm. It is assumed that such patterns of papillary lines are unique, and that no pattern is similar to any other.

¹ These figures have been omitted from this English translation of the report. See Malsch et al., 2017; De Wilde et al., 2017.

Assessment of similarities between the trace and the print (for both fingers and palms) takes place based on dactylographic points. Twelve similar points must be found, and both verification and individualization require that there are no inexplicable differences. A number of factors can affect the reliability of the comparison test: the quality of the trace left behind, the subjective assessment of the trace and any associated incorrect conclusions, caused by, for example context information.

Individual or combined forensic traces can increase the effectiveness of the investigation. They complement each other to a large extent. There is a number of differences between dactylographic traces and other types of traces. For instance, DNA-traces, unlike dactylographic traces, are suitable for trace-trace comparisons. On the other hand, DNA is more easily transferable and can, by perpetrators, be 'planted' on a specific location. This is much more difficult for dactylographic traces.

The practice of palm print comparison

Whether dactylographic traces, including palm traces, are found at crime scenes mostly depends on the extent to which the offense was planned and prepared. What follows from the interviews is that most dactylographic traces are found in burglary cases. Although today burglars wear gloves more often than they used to, forensic examiners still find these traces on a regular basis.

It seems that the requirement for securing palm prints of the 'interest of the investigation' is interpreted strictly in the law enforcement practice: public prosecutors only give permission to take palm prints of suspects if a palm trace was found during the investigation of the offense the suspect was arrested for. Even though public prosecutors see grounds for a more liberal interpretation, they always take into consideration whether such an argument will hold in court, should it be challenged by the defense. Furthermore, public prosecutors also prioritize forensic material that is sent in for investigation. So even if there is an interest of the investigation, the request can still be turned down. The decision to ask the public prosecutor for such permission depends on various considerations: the personality of the police officer, the personality of the public prosecutor, previous experiences of/with both, the unit/Public Prosecution Office involved (including its culture and customs), whether the suspect is still held in custody and the amount of additional paperwork or effort involved.

According to the interviewees, the added value of palm traces for investigations would be determined by four factors:

1. Technical forensic evidence (including palm comparisons) has become increasingly important in the investigation during the past few years, as suspects more often choose to remain silent during the interrogation.
2. Dactylographic traces (including palm traces) are of great value for the investigation, as a dactylographic trace, next to DNA, is one of two kinds of traces that can lead directly to a person. Virtually all dactylographic traces are contact traces and these may have an added value on the so-called 'activity level': they give information about the activities due to which traces were left behind (for example climbing traces left by a burglar).
3. Palm traces can be more clear than fingerprint traces and they can provide for the twelve points needed for identification in case a fingerprint has not enough points to come to a match.
4. Sometimes the palm print is the only forensic evidence available. Various respondents mentioned examples of such cases.

5. Palm traces can rather easily provide for information on the activity level: what actions brought this trace at this location.

Court decisions and case files

The analysis of a sample of Dutch court decisions (43) found at the website Rechtspraak.nl, and court files of ten specific cases, shows that palm print comparisons have been used with some regularity to substantiate court decisions. The question how often this is the case in general cannot be answered properly on the basis of the selection, as only part of all court decisions is published at Rechtspraak.nl. The sample may produce a somewhat biased view since only cases that are thought to be of a particular interest to a certain audience are published on the website. In some of the cases studied, the palm trace was the only or the most crucial trace that linked the suspect to a crime scene.

In all cases studied, it was stated that the trace found matched the palm print of the suspect. Both specialists and judges often expressed themselves in absolute terms: the trace and the print were said to be 'identical'; dactylographic traces were 'non-recurrent'; the suspect was the 'donor' of the trace, and it was 'out of the question' that anyone else could have been the donor of the trace. Cases from more recent years show expert conclusions in significantly less strong terms. Judges literally cite and follow the opinions of dactylographic experts in almost all of the cases.

The case files show that there can be important differences in opinion between experts when establishing the number of matching points between a trace and a print. The interpretation of palm traces and prints can at times apparently be problematic and may lead to varying expert opinions. However, in the final conclusion any difference of opinion between experts on the number of matching points found seems to have disappeared. It is unclear whether a different assessment of traces and prints in some cases could lead to an erroneous conclusion, for example due to an incorrect individualization, i.e. the palm of the hand is linked to the suspect, although this individual is not the donor. For this, see the famous Brandon Mayfield case, in which a considerable number of fingerprints examiners came to erroneous individualizations.

Given the fact that judges follow the conclusion of experts in virtually all instances, there is only a small chance that any incorrect individualization would come to light. In so far as could be concluded from the court decisions and the ten specific cases, uncertainty about the assessment of traces and prints was not explicitly raised or brought up for discussion, neither in the reports or records, nor in the court decisions.

Objections of attorneys in cases studied that put forward that there would be differences of assessments were dismissed in all cases by the courts. The same is true for defenses that traces could have been left at the crime scene at a different time. Requests for counter expertise were often not allowed.

In several of the cases studied, a specific activity has been deduced from a palm trace. In that sense, palm traces provide more information about the activities that have taken place during the offense than, for example, DNA traces, as they may indicate a grip, or the leaning of the donor of a trace against a wall or object.

Comparative law studies

Comparative law studies were performed into the laws of, among others, Germany, Switzerland and England and Wales. For these countries, the rules and regulations on the collection, processing and storage of finger and palm prints were mapped. The meaning of statutory rules was established based on literature and – in the case of Germany and Switzerland – case law. Next to that, the statutory provisions of several other countries have been briefly described. The following can be concluded from these comparative analyses.

Palm prints are rarely mentioned specifically in the laws of the countries studied. For instance, the term 'fingerprints' is used to refer to both fingerprints and palm prints (England & Wales), as are terms such as 'papillary lines' (Austria) or 'prints of bodily parts' (Switzerland). Since the same norms exist for the collection of fingerprints and palm prints in Germany, Switzerland and England & Wales, palm prints can in theory be used to establish the identity of a suspect in these countries. However, palm prints are in actual practice not used for that purpose. They are only used to establish who the donor of a palm trace is, as happens in the Netherlands.

Of the countries studied, only England & Wales permit the collection of palm prints by default. In Germany and Switzerland, palm prints can only be taken if this is necessary, which seems similar to the requirement in the Netherlands that there must be an interest in the investigation. Germany and Switzerland however use a wider interpretation of the necessity requirement than the Netherlands, given the fact that the collection of palm prints does not need to be related to the criminal offense of which a person is suspected in these countries.

Germany and Switzerland provide legal remedies against an order to collect palm prints. These are regularly invoked if the collection is not related to the criminal offense of which the suspect is suspected. The Netherlands do not offer such remedies.

In Germany and in England & Wales (higher) police officers are authorized to decide that palm prints be collected. This is in principle the same in Switzerland, but there an order must be issued by the public prosecutor in case of any refusal to cooperate. In the Netherlands, the authority to issue an order in principle only lies with the public prosecutor.

In the countries the study focused on, deprivation of liberty is not a precondition for the authorization to collect palm prints, which it is in the Netherlands. In Switzerland, non-suspects can also be forced to have palm prints taken. In the other countries studied, palm prints of such persons can only be taken on a voluntary basis. The Netherlands, Germany, Switzerland and England & Wales have specific regulations on the storage and use of palm prints.²

² For a full description of het legal comparison, see *De toepassing van handpalmafdrucken voor de opsporing en vervolging*, Amsterdam, 2017.

Introduction

Background to the research

Each hand contains patterns of lines, the so-called papillary lines. The lines continue from the palm of the hand into the fingers and are therefore considered as one whole by dactylographic experts. As far as is known, the line pattern is unique for each person. Fingers or hands can leave traces on surfaces or objects, the so-called 'dactyloprahic traces'. These are very suitable for investigation, for example to determine who left traces at a crime scene, and whether the traces possibly originate from the suspect. The fingerprint is one of the oldest and most effective identifiers. Over the past century and a half, it has proved invaluable to the police and the Public Prosecution Service (Broeders, 2003). Although fingers and palms do not differ essentially from each other biometrically, the Dutch legal standard makes a clear distinction between fingers and palms. This distinction is motivated by the different purposes for which fingerprints are taken from fingers and palms.

Dactylography refers to the study of papillary lines, which are the lines in the skin on the inside of the finger, palm, toe and foot. It also includes the study of prints and traces left by papillary lines on surfaces. One of the aims of dactylography is *individualization*, i.e. to establish whether a certain individual is the source of a dactylographic trace. In a police investigation, it is important that a trace found at a crime scene matches a unique source. This requires that the print of papillary lines has unique characteristics that correspond to other prints or traces from – only – that source and that these unique characteristics remain unchanged over a longer period of time (Broeders, 2003; Saks & Koehler, 2005). This is generally thought to be the case for dactylographic traces and prints from one source, including those of the palm. It is assumed that such patterns of papillary lines are unique (Stol et al., 2005).

To assess the similarities between a trace and a print (for both fingers and palms), so-called 'dactylographic matching points' are established in both (Evetts & Williams, 1996; Broeders, 2003). According to Dutch guidelines, twelve dactylographic matching points between the trace and the print must be found, and there may be no inexplicable differences (Riemen & Voorhoeve, 2015).³ If that is the case, the conclusion of 'individualization' may be drawn.

A number of factors can affect the reliability of the comparison test: poor quality of the trace left behind (vagueness, incompleteness, streaks), subjectivity in the assessment of the trace and any associated incorrect conclusions due to, for example, the influence of contextual information. For instance, if the expert assessing the similarity between the trace and the print is aware that the individual who might be the source of the trace has previous convictions for similar crimes, this may exert a certain influence on their assessment of the similarity between a trace and a print.

The Dutch police follow a special procedure to avoid bias when assessing dactylographic matching points between a trace and a print (in relation to both fingerprint comparison and palm print comparison). Within this procedure, experts other than those involved in the investigation of the crime perform the assessments and, if the traces are unclear, various independent experts are involved in the assessment (Riemen & Voorhoeve, 2015). The procedure aims to reduce the influence of contextual information on the dactylographic comparison, thereby attempting to avoid incorrect conclusions.

³ Explicable differences refer to incomplete traces, or traces that are unclear as a consequence of, for example, a streak through the trace or another distortion.

A number of important differences can be discerned between dactylographic traces and other types of traces. DNA traces, unlike dactylographic traces, are suitable for trace-trace comparisons. In addition, DNA is more easily transferable and can be 'planted' in a specific location. For example, an offender may deliberately leave butts from cigarettes smoked by other persons at a crime scene, which may mislead police investigators. The 'planting' of dactylographic traces is much more difficult and such traces are therefore more unambiguously linked with the original source than DNA is.

Fingerprints are taken primarily with a view to *establishing the identity* of the suspect. Fingerprints are taken from arrested suspects and sent to the VVI (Provision for Verification and Identification) and to HAVANK (The Automatic Fingerprint System Dutch Collection). The identity of the suspect can be determined by comparing a fingerprint with fingerprints taken and stored previously. In addition, the fingerprints taken are used for *police investigation*. It can be established whether the fingerprints taken correspond to the fingerprints found at a crime scene.⁴ HAVANK contains both the fingerprints taken from suspects and the fingerprints secured at crime scenes. It is possible to perform an automated search in HAVANK for similarities between (new) fingerprints and fingerprints. In this way, suspects may be associated with offenses of which they are not yet suspected.

Palm prints are only used to *establish matches with palm traces*. They are therefore usually taken on the basis of the suspicion that the individual has been involved in a criminal offense in respect of which a palm trace was found at the crime scene. The palm prints taken on a suspect are recorded in HAVANK, after which an automated search is made for matches with recorded palm traces.

Taking palm prints is a measure in the interest of the investigation (art. 61a paragraph 1 sub b Sv). In order to be allowed to take palm prints, an order from the public prosecutor is required (art. 62a Sv). Only when there is a specific investigative interest, the public prosecutor may issue this order. Usually this interest is assumed when a palm trace is found at a crime scene and the suspect becomes involved in that crime. The statutory regulation therefore does not provide for default securing of palm prints from suspects, as it does for taking fingerprints. In current practice, palm prints thus are actually not taken as a standard procedure. This situation has given rise to protests by the Police and the Public Prosecution.

The problems and questions mentioned above formed the basis for the research, the results of which are discussed in this report.

Palm comparison

The methods for comparing secured traces with prints are the same for palm traces as for finger traces. After having secured a dactylographic print, HAVANK uses an algorithm to search for palm prints that resemble the palm traces entered, and a human expert (the dactylographic expert) then looks for the 'correct' palm print from this selection, i.e. the print that probably comes from the same person (Riemen & Voorhoeve, 2015).

The most important role of the palm comparison is to identify the origin of a particular trace found at the crime scene. Because palms cover a larger area than fingers, it is conceivable that they

⁴ A palm or fingerprint is the print that the police take from the suspect, and the palm or fingerprint is the print that a person has left on objects and/or the crime scene.

provide more information for individualization. In addition, palm traces probably show whether it is the right or the left hand. Of finger traces, it is not always known from which finger they originate.

Palm traces can also play a role other than identification or individualization. They can help to establish which activities the 'source' of the traces performed: how did the trace get there? Which activity was conducted? Traces may therefore provide information about the activities that may have brought the trace to that location. For example, a grip trace suggests a different activity than a flat-hand trace. Palm traces in that respect they may offer an added value over fingerprints.⁵

Other types of traces

In recent decades, the use of DNA for investigation and prosecution has greatly expanded around the world. Just like dactylographic traces, DNA traces can be linked to a suspect via a database, such as the Dutch DNA database. Special techniques have made it increasingly possible to abstract a DNA profile from small amounts of body tissue. In recent years, in a number of so-called *cold cases*, a suspect could be traced, partly thanks to DNA kinship research, and in a few other cases a wrong conviction could be proven with the help of DNA (Meulenbroek & Poley, 2014; De Keijser et al., 2016; Malsch et al., 2016).

In addition, other identification methods are under development, such as iris scan and facial recognition. Traditionally, possibilities for identification exist for photos and videos, foot, toe, ear and shoe soles. Handwriting experts can also be called in, for example to determine whether a particular document may have been written by a particular person. This report also briefly discusses the use of other types of traces or identification methods for investigation and prosecution and, where appropriate, a comparison will be made with them.

Research question

This report presents a study that provides insight into the practice of the use of palm prints and its added value. The central research question is:

What is the added value of using palm prints for the identification of suspects and their prosecution and trial in criminal courts as compared to fingerprints and other types of forensic evidence?

The research methods that have been applied to answer the sub-questions and the central question are discussed below.

Methods

By means of 'triangulation' (combining different research methods) the research question has been investigated. Below, a brief overview is presented of the research methods used.

Interviews

22 interviews were held with police and public prosecutors that focuses on the actual practice and added value of palm print comparison, partly in comparison with other methods.

Practice of palm comparison

Analysis of 43 court decisions published on the Dutch website Rechtspraak.nl in cases in which palm prints were used for the investigation, with help of a checklist.

File research

Ten files of criminal cases in which palm traces played a role were analyzed. The analysis took place on the basis of a checklist.

Comparison between countries

A comparison has been made between the Netherlands and a number of other countries (Germany and Switzerland and England & Wales) with regard to the legal framework and the application of the palm comparison. The following methods were used to map the law and practice of the selected countries: desktop research, research into legislation, case law research and literature research.

The palm comparison

Introduction

This chapter discusses the technical aspects of palm comparison. It examines the questions of what dactylography is, how and when fingerprints and palm prints are taken on suspects, and how the comparison between prints and traces works. A number of other types of forensic trace investigation are also discussed. Different types of forensic traces (such as palm traces and DNA traces) individually or together can lead to a more effective investigation and are complementary to each other to a certain extent.

Forensic investigation

Forensic investigation contributes to finding the truth about criminal offenses and can give direction to the criminal investigation. An important aspect of this is determining the source of traces. Various types of investigation can be distinguished within forensic investigation, in which palm examination falls under dactylography. A comparison will be made between DNA testing on the one hand and dactylography/palm comparison on the other. For an overview of many other types of forensic investigation, see Broeders and Muller (2008).

Dactylography

General

Dactylography is understood as the study of the skin lines on the inside of the finger, palm, toe and foot. This also includes the examination of the prints and traces that papillary lines can leave on a surface (Riemen & Voorhoeve, 2015; Stol, et al., 2005). A distinction must be made between a print and a trace. A *print* is a reference of the papillary lines taken on a person under controlled conditions, for example at a police station. In the past this was done with ink and nowadays often by means of a scan, at least in the case of fingerprints. Palm prints are still taken by means of ink (interview respondent 1).⁶ A print is taken and stored as reference material in order to be able to identify the same person at a later time or to individualize a trace that has been found. A *trace* is a print of the papillary lines that is left on an (object at the) crime scene (Riemen & Voorhoeve, 2015).

From dactylographic trace to source

Fingerprints are used, among other things, for establishing the identity of an individual. Two forms can be distinguished: *identification* and *verification*. *Identification* takes place when a suspect comes into contact with the police for the first time and therefore does not yet appear in the fingerprint database. In this situation, prints of all fingers are taken and these prints are included in the database. These fingerprints can then be used to determine for the purposes of criminal law *who* the subject is. *Verification* is the process of making a one-to-one comparison between taken test material and the reference material from a single person. Only one fingerprint is then taken from the suspect and this is compared with fingerprints that have already been processed. In this way, the identity of

⁶ Statements made by interviewees are reproduced at a number of places in this chapter for clarification. For a full discussion of the interviews, see Chapter 3.

the suspect is verified. The dactylography also focuses on *individualization*: determining whether a particular person is the source of a finger or palm trace related to a criminal offense (Meuwly, 2008).

For the investigation of a crime, it is important to link a trace related to a criminal offense to a unique source. The issue is not to establish that a trace and a print are identical, but whether it can be determined if the trace and the print come from the same source (Broeders, 2003). This requires that the trace has unique characteristics that correspond to other prints from – only – the source and that these unique characteristics remain constant over a longer period of time. For dactylographic traces and prints, including those of the palm, this is generally believed to be the case (Stol et al., 2005). The distinctiveness of the structure of papillary lines is based on knowledge about the origin of the skin lines in the prenatal phase and on statistical research (Meuwly, 2008). The structure of the papillary lines arises in the first twenty-four weeks of pregnancy under the influence of genetic, developmental and environmental factors. According to Riemen & Voorhoeve (2015), the influence of these different factors explains the natural variation between fingerprints between individuals.

Broeders (2003: 138) points out that the uniqueness assumption, the assumption that no object is the same as another, which counts as one of the foundations of the possibility of individualization, is based on the idea of 'infinite natural variation'. However, this proposition is necessarily inductive in nature and can never be proved with complete certainty. It cannot be scientifically proven that nature has never repeated itself or never will. This also applies to the structure of papillary lines. Logically, according to Broeders, it is therefore impossible to state that every papillary structure is completely unique for every person (Broeders, 2003, p. 138-140).⁷

Reliability of the dactylographic comparison

There are a number of factors that can influence the reliability of dactylographic comparison research:

1. When a trace or print is produced, by definition there is a *loss of information* or *distortion*. Firstly, often only part of a finger or palm trace is found at the crime scene (quantitative loss of information). Secondly, the trace is regularly blurred or distorted as a result of a movement or due to external influences (qualitative loss of information) (Meuwly, 2008). Riemen & Voorhoeve (2015) emphasize that it is part of the expertise of the dactylographic expert to take this into account and to correctly interpret distortions.
2. The individualization of a trace or print is ultimately a *subjective judgement* of a dactylographic expert on the basis of objective standards. This human element in forensics plays a crucial role and, despite thorough training, can lead to variation in the assessments (Dror, 2015). For example, Dror and colleagues (as summarized in Dror, 2016) investigated in an experiment how irrelevant context information influences the decision of dactylographic experts about a match. They did this by presenting cases to dactylographic experts, the second time changing context information that should be irrelevant to a dactylographic expert (e.g., "someone else confessed to this crime"). The submitted trace and reference print were therefore the same as those previously assessed, but the context information was different. The dactylographic experts participating in the experiment were not told that they had previously reviewed this case. In 17% to 80% of the cases, the dactylographic experts

⁷ For reason that it can never be established with absolute certainty that a trace originates from a specific source, Broeders (2003) argues in favor of using probabilistic statements about the question whether a trace originates from a specific source.

reached a different conclusion about whether or not a match existed between a trace and a reference print. There are also famous cases from practice where incorrect conclusions have been drawn by various experts about the individualization of a trace. A well-known case is that of Brandon Mayfield who, on the basis of a finger trace found on a plastic bag with detonators, was suspected of being involved in the 2004 Madrid bombings, while he had nothing to do with it. The trace, which was distributed internationally by the Spanish authorities via Interpol, gave a hit in the US fingerprint database. Four American experts then individualized the finger trace on Mayfield. However, after further investigation by Spanish experts, it turned out that the trace came from another person. Mayfield had then spent two weeks in pre-trial detention (Meeuwly, 2008). Stol et al. (2005) emphasize that it is crucial for police officers to be critical of their own investigations because of the unavoidable subjective element inherent in this type of investigation. The Dutch police try to limit the influence of context information in dactylographic investigations to a minimum, for example by separating phases in the investigation and submitting traces and prints to multiple, independent dactylographic experts (Riemen & Voorhoeve, 2015).

HAVANK: database for dactylographic traces and prints

The database HAVANK contains on the one hand a print database with fingerprints and palm prints of suspects and convicts and on the other hand a trace database with dactylographic traces found at crime scenes. HAVANK is used for two purposes: 1) the identification of suspects within the criminal justice system and 2) the individualization of the source of dactylographic traces found at crime scenes for the purpose of investigation (Riemen & Voorhoeve, 2014; Stol et al., 2005). Two types of comparative investigations are being conducted: the dactylographic identity investigation and the dactylographic trace investigation. During the dactylographic identity investigation, the fingerprints of a suspect are compared with the reference prints present in the database of known suspects and convicted persons, with the aim of establishing the identity of the suspect (Protocol, 2013).⁸ The trace investigation consist of comparing the palm and finger traces found at the crime scene with the reference prints in the print database of suspects, and in comparing the palm and fingerprints offered by suspects with the still unidentified traces in the trace database (Riemen & Voorhoeve, 2014).

Dactylographic comparison

During the first search run, HAVANK the search is conducted completely automatically. The system recognizes first and second level details in the trace and uses them to search the entire database. The system then generates a ranking of the available reference prints in order of degree of similarity and presents a candidate list of the ten highest scoring prints. The comparison is always performed by dactylographic experts of a unit that is not responsible for the case, in order to avoid possible bias in the conduct of the investigation (Riemen & Voorhoeve, 2015).

After the first automatic search, the dactylographic comparison search goes through two phases. In the first phase it is determined whether there is a 'match'. If this is the case, then in phase two, the so-called 'individualization process', it is determined whether the trace can actually be

⁸ In addition to establishing the identity of suspects, HAVANK is also used to establish the identity of victims through fingerprints.

individualized. In phase one, one expert first compares the trace with the ten reference prints provided by the system. The expert looks at information at three levels (the main pattern, the typics and the details of the lines themselves) and excludes prints that show no significant similarity to the trace or that show unexplained differences from the trace. If a reference print remains that shows significant similarities and no unexplained differences, there is a 'match' and the research continues in the individualization process.

If none of the ten reference prints matches the trace in this way, there is a 'no-match'. In this case, the expert performs another search in the system with the trace, but now provides more information manually, for example about the dactylographic points or by indicating that the trace is a print of a certain finger or, for example, of the palm. The system then only searches within the smaller collection of prints with those properties (Riemen & Voorhoeve, 2015). The trace can also be compared with the reference prints of a possible suspect included in HAVANK (Riemen & Voorhoeve, 2015).

In the event of a match, the comparison study is continued in the *individualization* process. In this second phase, the trace with the reference print found are sent to two independent experts to determine whether the trace can actually be individualized. These two experts independently conduct a comparison study between the trace and the print (Riemen & Voorhoeve, 2015). When there are twelve matching dactylographic points and no unexplained differences, the expert can conclude that the trace comes from the same source as the reference print (Stol et al., 2005). Only when the two experts come to this conclusion independently of each other, there formally is an individualization of the trace (Riemen & Voorhoeve, 2015).

When the two experts come to different conclusions, a new procedure is started. In this procedure, another three independent experts carry out the comparison study between trace and reference print. They draw their own independent conclusion and discuss technical arguments together to arrive at a common conclusion. If this is not possible, no individualization takes place, and it is concluded that no convincing conclusion is possible (Riemen & Voorhoeve, 2015).

Until not too long ago, the conclusion of a forensic dactylographic trace examination had little or no probabilistic character, but was deterministic or categorical: individualizations found were presented as absolute. That has changed: nowadays more probabilistic conclusions are being presented.

Palm comparison in practice: police and public prosecution

Introduction

This chapter discusses how the police, the Public Prosecution Service and the Netherlands Forensic Institute (NFI) use and/or deal with palm traces and prints in practice. The chapter is based on interviews with practitioners who encounter palm traces in their work.

Research methods

The selection of respondents for the interviews was based on the so-called 'snowball method': experts from the supervisory committee and the sounding board group suggested possible respondents. As a result, the sample cannot be considered representative for the police and the Public Prosecution Service. This was also not the aim of this study, because an attempt was primarily made to obtain an indication of the way in which the palm comparison is handled in practice, and to identify possible bottlenecks. The sample is sufficient for this purpose.

The interviews were conducted with help of topic lists. Face-to-face interviews were conducted with 15 respondents; five interviews were conducted simultaneously with several respondents. In addition, two short telephone interviews with tactical investigators took place. The respondents come from different units of the Dutch police. Three public prosecutors, each separately, were also interviewed. For an overview of the interviewed respondents, see table 3.1.

The respondents had the following functions:

Senior forensic investigator: visits crime scenes to secure traces and provides guidance in more serious crimes.

Forensic officer: Visits crime scenes (such as from burglaries) to secure forensic evidence. At the crime scene, a forensic officer makes his own decisions about where to look for traces and which traces to secure. In more serious crimes, he has a more assisting role.

Dactylographic expert: enters the traces secured into the computer and makes comparisons with prints of witnesses and suspects. Also advises colleagues on how best to secure traces in order to obtain the best possible quality.

Trace coordinator: acts like a spider in the web. Has an overview of all traces that have been secured at the various crime scenes within the region (e.g. tool traces, shoe traces, DNA traces and dactylographic traces). Checks whether traces from different crime scenes can be linked together in order to build trace clusters consisting of several crimes that can be linked to one or more perpetrators. In this way, an offender can then be linked to multiple offenses on the basis of a single individualization within the cluster. These clusters are worked out in diagrams that can be analyzed, for example to discover trends.

Forensic public prosecutor (FO public prosecutor): each Public Prosecutor's Office has a public prosecutor who is expert in the field of forensic investigation. The FO public prosecutor also determines the prioritization of traces that are sent to the Netherlands Forensic Institute (NFI). This official is the point of contact for both the criminal investigation department and the lawyers when it comes to forensic issues.

Public prosecutor in interventions team: this team handles minor offenses and police court cases. The prosecutor consults with various parties to make a quick decision about what should be done with a suspect.

Two respondents working for the tactical investigation. Only short additional interviews (an average of ten minutes) were held with these respondents by telephone.

Respondent number	Employed at	Position
1	Police	Operational specialist biometrics and product owner and functional manager of the HAVANK database
2	Police	National portfolio holder forensic investigation
3	Police	Employee national portfolio holder forensic investigation
4	Police (FO) ⁹	Senior forensic investigator
5	Police (FO)	Forensic employee
6	Police (FO)	Dactylographic expert
7	Police (FO)	Dactylographic expert
8	Police (FO)	Operational specialist
9	Police (FO)	Trace coordinator
10	Police (FO)	Trace coordinator
11	Police (FO)	Forensic coordinator for Large-Scale Investigation Teams (TGOs) ¹⁰
12	Police (FO) Chief	Chief Forensic Investigation Team
13	Police (FO)	Forensic officer
14	Police (FO)	Dactylographic expert
15	Police (FO)	Trace coordinator
16	Justice	Forensic officer, TGO officer, <i>cold case</i> officer
17	Justice	Forensic officer & hearings
18	Justice	Officer in Interventions team
19	NFI	Official
20	NFI	Official
21	Police	Tactical Investigator
22	Police	Tactical Investigator

Table 3.1 Respondents and job titles

Types of offense

The public prosecutors indicate that they encounter very few palms in the case files they receive from the police. A prosecutor can cite two cases in which palm traces were crucial evidence. Fewer palm traces are being secured than finger traces. In addition, fewer dactylographic traces are found than DNA traces. But palm traces are certainly no exception either.

The number of palm traces found appears to differ per offense. The general picture that emerges is that most dactylographic traces are found in *High Volume Crime* (HVC) cases and slightly less in more serious crimes, such as homicide. Burglaries are listed as the offense in which the most often dactylographic traces are found. Palm traces regularly occur in burglaries as climbing traces:

⁹ FO means Forensic investigation (*forensische opsporing*).

¹⁰ TGO means Large Scale Investigation Team (*Team Grootchalige Opsporing*).

'You often encounter a palm when they climb through a window and then they just put that palm on a windowsill ... You very often have that at the top or indeed the bottom because they lean on something.' (Respondent 13, forensic officer)

According to the respondents, these palms are important for the investigation of burglaries as a clear trace of the perpetrator.

Another crime scene where relatively many dactylographic traces are found are hemp plantations. According to Respondent 13 (forensic officer), dactylographic traces are mainly found there on tools and lamps because they are difficult to handle with gloves on. Almost all respondents indicate that in recent years offenders more often attempt *not* to leave any traces, and that fewer dactylographic traces are found as a result. Perpetrators wear gloves more often than in the past.

Wearing gloves does seem to differ per type of offense. For example, Respondent 4 (senior forensic investigator) indicates that gloves are worn less often in more serious cases, such as homicide. Respondent 15, a trace coordinator indicates that finding dactylographic traces, and therefore also palm traces, is mainly related to the extent to which the offense has been planned and prepared. When, for example, a burglary is committed by a junkie as a crime of opportunity, dactylographic traces are usually found because gloves in such a situation are less often worn. During a robbery of a shop, a more serious crime, gloves are usually worn because this crime has been prepared. The same goes for a murder. When a homicide offense is less prepared or has a more spontaneous character, for example manslaughter as a result of an argument, more often dactylographic traces are found, including palm traces.

Respondent 11, coordinator of Large-Scale Investigation Teams (TGOs) that conduct research into more serious crimes such as murders and homicides, states that in homicides, personal relationships more often play a role than in burglaries, and possible suspects may be identified earlier in such cases, through witness statements or through telephone taps. A palm trace in such cases is mainly of value as *additional* evidence against a suspect, and may thus play a role in the evidence phase.

During the interviews, attention was paid to the question of whether officials at the crime scene still do recover palm traces found while they are aware that the database does not contain many recent reference prints, due to the more strict regulation for securing palms, and thus a match is less probable. Respondent 1 (functional manager HAVANK) thinks that palm traces are still being secured at crime scenes, that would not have changed. Respondent 2 (national portfolio holder FO), however, holds a different view on this. According to him, detectives are very calculating and that is a good thing in his view, because the police have limited resources. Forensic investigators know that due to the shrinking reference database the chance of success is small(er) and so they would be less likely to recover a palm trace. According to this respondent, this does not apply to more serious crimes. This is confirmed by Respondent 12 (team chief FO). Respondents 1, 2 and 12 all have a managerial position and do not (anymore) conduct investigations at crime scenes themselves. It is interesting that the respondents who are close to the trace investigation - the forensic staff, dactylographic experts and trace coordinators - state almost unanimously that they always take all usable traces they find on a crime scene, including palms.

The respondents who are close to the trace investigation often react with surprise to the question whether the reduced usefulness of the database with reference prints of palms could play a role in the decision whether or not to secure a trace.

It can be concluded that palm traces can be found in all kinds of different offenses. However, they seem to be most often found in *high-volume crime*, especially as a climb-in trace in burglaries. They can then be of great value for identifying a suspect, in the investigative phase. In the case of serious crimes, they more often appear to serve as a strengthening of the evidence. The interviews show that the increase in the use of gloves by offenders has a negative effect on the amount of dactylographic traces found, including palm traces. Whether palm traces are found therefore seems to depend more on the extent to which a crime has been prepared in advance. Furthermore, the respondents who carry out the trace research indicate that they do not secure fewer palm traces for reason that the reference database for palms has become less useful.

The added value of palm traces for the investigation

All respondents indicate that palm traces are of added value for the criminal investigation. The ways in which palms can add value are diverse. This section successively discusses the surplus value of the palm trace as a means of technical forensic evidence, as a dactylographic trace, the surplus value compared to fingers and the surplus value as the only useful trace available.

The added value of the palm trace as technical evidence

Several respondents link the value of the palm traces to the fact that technical evidence has acquired an increasingly important role in the investigation in recent years. According to them, this is the result of the fact that virtually no suspect speaks in the interrogation room anymore because this is discouraged by their lawyer, who is allowed to be present at the first interview.

However, according to Respondent 16 (FO public prosecutor), if a suspect is confronted with forensic evidence, he/she will talk:

'A lawyer also has the right to be present during the entire interrogation. As a result, those interrogations have become illusory. (...) And my experience now with the current legislation and jurisprudence as it stands is that suspects confess when confronted with hard evidence. And that can be a witness statement, but above all that is forensic evidence. So a DNA hit, fingerprint hit.' (Respondent 16, FO Public Prosecutor)

As a result, according to the respondents, the technical evidence has acquired a more prominent role in completing the evidence. The respondents see palms as an important part of the total package of technical resources at their disposal and that total package has become more valuable for the investigation.

The added value of the palm trace as a dactylographic trace

Almost all respondents indicate that they do not make a clear distinction between finger and palm traces, but see both as a dactylographic trace.

'I say we don't really have a very clear division between fingerprints and palms because we actually see it as just the same (...)' (Respondent 6, dactylographic expert)

Dactylographic traces are one of the types of traces that, in addition to DNA traces, can lead directly to a person. Respondent 15, a trace coordinator, states that dactylographic and DNA traces are the most important traces for the investigation in a case. For example, shoe or tool traces only have unique characteristics when the shoe or tool in question has been in use for a longer period of time; these typical characteristics for this specific shoe have developed over time. A possible match does not relate directly to a person, but to an object. Footprints and tool traces therefore appear to be of particular value for linking different offenses to each other and for creating clusters of offenses in which the same objects have been used. The trace coordinators who make these clusters state that a dactylographic or DNA trace is then needed to link the cluster to a person on the basis of technical evidence. This individualizing ability of dactylographic traces is cited by many respondents as the reason why palm traces, being dactylographic traces, are of great value for the investigation.

Dactylographic traces also have a number of advantages over DNA traces. Several respondents indicate that the advantage over DNA traces is that dactylographic traces are almost always *contact* traces. This means that they can only have been left behind because the source actually made contact with the object. This applies to palm traces just as it does to finger traces. By contrast, DNA traces can also be placed intentionally at the crime scene, and this can be done by someone else. Respondent 1 (operational specialist in biometrics) indicates that the technique for detecting DNA is getting better, with the result that it is becoming increasingly difficult to distinguish relevant traces from non-relevant traces. This point would not apply to dactylographic traces. Dactylographic traces have another added value compared to DNA when it comes to determining what happened at the crime scene, the so-called *activity level*. Dactylographic traces have a higher reconstructive value than DNA. According to Respondent 4 (senior forensic investigator) the position of the print or the force with which the trace was placed can tell something about the activity with which the trace was left behind. This also means that with dactylographic traces, both with fingers and palms, it is better possible to determine whether the trace was left with an action that can be linked to the offense. In combination with the fact that dactylographic traces are (almost) always contact traces, it would be better possible to determine with dactylographic traces whether it is a *culprit trace*.

An example mentioned by a number of respondents are 'climbing traces' during burglaries. If palm traces are found on the inside of a first floor window frame and the traces are positioned such that they could only have been left if a person grabbed the frame from the outside, then it is clear that the trace was left during the climb in. A climb-up trace would therefore be a clear criminal trace. Due to its individualizing capacity, this trace can identify a possible suspect.

DNA traces also have advantages over dactylographic traces: each person has only one DNA profile. That's a simpler situation than ten fingers or two palms that can also be left behind in many different ways. DNA also seems less sensitive to deformations. Different traces are easier to link to each other, as is a trace to a DNA-profile. However, mixed DNA traces of two or more individuals, leading to, often incomplete, mixed DNA profiles have been found do lead to serious difficulties with interpretation, potentially leading to erroneous decision making regarding a defendant's guilt (De Keijser et al., 2016).

The added value of the palm compared to the finger

The added value of palm traces seems to lie largely in the fact that they are dactylographic traces. Nevertheless, a number of respondents indicated a number of differences between finger and palm traces for the purpose of the investigation.

One of these differences relates to the quality of the traces. Some respondents state that palm traces are often more clear than finger traces. The palm is usually put down with more pressure and thus gives a clearer impression. In addition, the palm is less mobile than fingers and as a result, shifts, streaks and thus ambiguities occur less quickly with palms. According to Respondent 6 (dactylographic expert), it therefore may happen that you only have a usable palm trace left because the finger traces have been disturbed too much, while the palm print has clearly been left behind. Another advantage mentioned by a number of respondents is the large surface area of the palm. As a result, it would be more often possible to achieve the necessary number of points for an individualization, even if only part of the palm is left as a print. This is the case, for example, with palm traces left on plastic bags. Fingerprints are more likely to be useless in such a case than palm traces. Respondent 6 confirms that, due to the larger surface area, palm traces generally provide more dactylographic points than finger traces, and this would sooner enable an individualization. However, according to him, the fact that a palm gives more information has the disadvantage that the comparison itself is more complicated. Making a good comparison takes longer. Other respondents state that the quality of a trace mainly depends on the person who left it (for example, the fatness of someone's hands) and other circumstances such as the subsoil and the pollution. These factors bear the greatest influence on the usability of the trace. They argue that it is therefore difficult to say anything general about the difference in quality between palm and finger traces.

At the activity level, palms could also have added value compared to fingerprints, but the respondents' statements about this differ. Respondent 8 (operational specialist) states that with a certain type of activity, a palm trace is more often left behind than another type of trace. Climbing traces, for example, are often palm traces. When a person leans against something, a palm trace is often left behind. According to Respondent 5 (forensic officer), palm traces are only left on objects that can be held with the whole hand. Respondent 7 (dactylographic expert) mentions bags, cans and cups as objects with which this would be the case. According to Respondent 5, finger traces are often found on small objects that have been grasped. Respondent 8 concludes that the fact that palm traces are found relatively more often in certain activities means that if you cannot individualize palm traces, you will miss certain types of activities.

Dactylographic traces in general, i.e. both finger and palm traces generally play a very small role in linking different offenses to a cluster. According to Respondent 1 (operational specialist biometrics), palm traces are slightly more suitable for this than fingers. It is virtually impossible to link different crimes using finger traces, because of the mobility, the limited surface of the trace and the fact that people (usually) have ten different fingers. According to respondent 1, palm traces are slightly more suitable for trace-to-trace searches due to the larger surface, the limited possibilities to move the traces to another place, and the fact that each person only has two palms. The chance of success, however, remains small. Trace-to-trace searches with palm traces would therefore be carried out to a limited extent. The trace coordinators indicate that clusters are generally formed of DNA traces, shoe traces, tool traces and of the *modus operandi* of perpetrators. Finger and palm however traces could play an important role in linking such a cluster to an individual due.

Added value palm traces as the only usable trace

A number of respondents state that palm traces are sometimes the only usable trace. There are situations in which you only have one palm trace in a case. It is very difficult for the respondents to estimate how often it happens that a palm trace is the crucial trace to bring a suspect in focus or to obtain evidence. Respondents indicate that a palm trace can be crucial for solving entire series of cases when it is the only individualizing trace in a cluster.

When a palm trace is found, finger traces are often found as well. Respondents state that in such a case the individualization is performed on the finger rather than on the palm, because the fingerprint (reference) database is larger and therefore there is a greater chance of success. According to Respondent 7 (dactylographic expert), the palm traces are always entered in HAVANK in such a case, and the tactical investigation team is informed that palm traces have also been found. If necessary, in such a case the palm prints can still be taken from the suspect. It can then be checked, for example, whether the palm trace really belongs to the same suspect as from whom the fingerprints originate, or whether another person may be involved in the case.

Application of palm comparison in practice: court decisions

Introduction

In order to examine the use of palm comparison by the courts, court decisions published on the Dutch website Rechtspraak.nl were examined. The following search term was used: 'palm*'. A total of 43 court decisions¹¹ were found and analyzed, and these originate from the years 2001 to 2016 (see Appendix 1). Of these 43 court decisions, the complete files of nine cases were analyzed in which a palm comparison was used. These nine cases have been supplemented with one file in a case that was not found among the 43 court decisions analyzed. In almost all cases, a palm trace that was found at the crime scene was the reason for performing a palm comparison.

Method: sample of court decisions and files

The published court decisions originated from: District courts (27), Courts of Appeal (10), Supreme Court (*Hoge Raad* (HR) 4¹²), Advice ('Conclusion') Advocate General (AG) to Supreme Court (2).

In one case, both the court's decision and the decision of the Court of Appeal were included separately in the research. In two cases, both the advice of the AG and the court decision of the Supreme Court were included in the investigation. Two cases concern co-defendants. In terms of content, these cases and statements differed from each other, which justified analyzing both separately for the study. In the presentation below of the criminal offenses of which the suspect was accused, double counting resulting from this has been undone. For the rest, each ruling is included in the investigation as a separate case, because each authority makes or can make its own assessments in each case about the use of reports with comparative analyzes of palm traces and prints. In most cases that were also heard on appeal or on appeal in cassation, the palm comparison played a similar role in all instances, however.

In addition to the analysis of the court decisions, the files of ten criminal cases were examined. The files of twenty cases in which a palm comparison had been conducted, were requested from the court or Court of Appeal through the intermediary of the Board of Prosecutors General. Because not all files could be found, an analysis of ten files was ultimately carried out. The researcher analyzed the files on location at the District Court or Court of Appeal using a checklist. The findings from both the analysis of the court decisions and of the files are presented below. The case file analysis' results are in many instances illustrative of the results of the analysis of the court decisions. In some aspects the case file analysis had independent value. For example, the files made it easier to find out what the content of reports from dactylographic experts was; this was not always possible with the aid of published case law, because the court decisions regularly did not discuss the reports explicitly, or presented them incompletely.

¹¹ Including two advices of the Attorney General (AG) to the Supreme Court, in which the AG expresses an opinion on whether the proposed grounds for an appeal should be accepted or not. A ruling by the Joint Court of Justice of Aruba, Curaçao, Sint Maarten and Bonaire, Sint Eustatius and Saba has also been included in the analysis.

¹² Where a court decision of the Supreme Court or Court of Appeal is discussed below, or where an advice AG to Supreme Court is cited, an (unpublished) court decision of a lower court that is reproduced in the cited court decision may (also) be discussed. Where relevant, for example because the content of the court decisions differ, the discussion below will indicate whether a court decision may have originated from a lower authority than the authority that delivered the court decision.

Selectivity

The sample of court decisions and files is not extensive, and moreover it may be biased in certain respects. On Rechtspraak.nl, mainly court decisions are published that have some publicity value, such as cases in which the defendant was charged with a murder or manslaughter. 'Ordinary' cases about theft, burglary and petty drug trafficking are published less often (Van Opijnen, 2014). Because almost all cases for the years 2015 and 2016 have been included, the sample of court decisions provides a reasonably representative picture of the way in which the court handles the palm comparison in those years, at least insofar as these cases have been published. No information is available on palm cases that have not been published. Nothing is therefore known about the extent and nature of a potential bias.

Nevertheless, the analyzed court decisions provide a good insight into the role that palm prints may play in investigation and prosecution, and into the way in which the courts deal with them. Due to the limited size of the sample of court decisions and case files, generalization of the findings must be treated with caution.

Below it is first indicated which (types of) criminal offenses were charged in the cases concerned. Subsequently, the role that the palm traces played in the trial and their influence on the judicial decision are discussed, insofar as this could be deduced from the decision and the reasoning of the judge. The content of the reports of dactylographic experts is discussed. Attention is also paid to other traces found in the case and to the question of whether a counter-investigation has taken place regarding the palm comparison, or whether this has been requested.

Criminal offenses

The suspects in the analyzed court decisions were charged with various offenses, which are shown in Table 4.1. Palm traces mainly play a role in burglaries, theft with violence, robberies, manslaughter, murder and assault cases. The palm comparison is also sometimes used for drug offenses (for example possession of and trade in cocaine, cannabis farms) and sexual offenses.

Based on general experience and the interviews conducted with the police, it could be expected that the palm comparison is used particularly in burglaries. Table 4.1 does not confirm this hypothesis. The aforementioned publication bias is probably the cause of this: on Rechtspraak.nl mainly court decisions are published that have a certain publicity value, and that is much less the case with burglaries than with, for example, manslaughter, murder or sex offenses.

Type of offense	Number
Theft, burglary	9
Theft with violence, robbery	12
Manslaughter, murder, assault ¹³	12
Sexual offenses (including rape)	3
Unlawful deprivation of life	2
Drug offenses	4
Breach of confidentiality	1
Other (including)	3

Table 4.1: Types of criminal offenses charged in the analyzed court decisions.

Explanation: the overlap in the types of offenses caused by the fact that sometimes more than one court has decided on one case (in appeal and in cassation) has been omitted (see above for the earlier explanation). In some cases, multiple types of offenses were charged, resulting in a higher total number of offenses than the number of cases.

The role of the palm trace in the case

A trace (palm, finger or other type of trace) can play two types of roles in a criminal case: at *source level* and at *activity level*. If a trace appears to match a print of the suspect, it plays a role at the source level. It then indicates that the suspect was (very likely) the donor of the trace. In an activity-level role, the trace says something about the activity that was performed and that left the trace behind. An example of this is breaking into a house leaving palm traces on the top of a window frame; the perpetrator grabbed the window frame to climb in through the window. Both levels are discussed below in relation to the palm traces found in the analyzed cases.

Source level

In all court decisions studied, it was established that the palm trace found came from the suspect or a co-suspect ('individualization'). To make this clear, various formulations were used. In the court decisions it was then said that the suspect had left this trace in a specific place, or on a specific object that was found at the crime scene and that was usually also related to the criminal offense. Think, for example, of a plastic bag with cocaine that is found in a car, while the suspect was also in this car when he was arrested and his palm trace was on that bag.

In all cases analyzed, a trace of the palm of the hand was 'identified on the suspect'.¹⁴ In concrete terms, this means that it had been established that the trace (very likely) originated from the suspect. This determination can be made by sending the trace to HAVANK, the database in which traces and prints are recorded, to check whether there was already a matching palm print of this suspect in it due to a previous criminal offense in which he was involved. Prints of an arrested suspect can also be taken at the police station and the traces found can be compared with them.

¹³ Offenses leading to death of the victim and assault have been taken together because these types of offenses involve the use of violence without a property aspect (such as theft, extortion) also playing a direct role.

¹⁴ This is the terminology used in the court decisions. Courts probably adopted the terminology from the police report or from the dactylographic expert.

Usually, the court stated in its decision that the suspect's palm had been found somewhere: 'In addition, his palm traces were on the safe.'¹⁵ Or: 'The suspect's palm trace was found on the front door'.¹⁶ In none of the cases examined, judges do of their own accord deal with uncertainties at source level in the individualization from the trace to the source. They only do so if the lawyer puts forward a defense on that point.

Secured palm traces may play a role during the interrogation of a suspect as well. Occasionally, it appeared from an official report of the interrogation included in the case file that the trace that was found was used as pressure during the interrogation by the police to elicit a statement from the suspect.¹⁷ The police then put pressure on the suspect by telling him that his palm has been found at the crime scene, suggesting that the suspect had been there. Such pressure being applied may become apparent from the case file, which contains the official police or dactylographic reports. It generally does not become clear from the published court decisions.

Establishing a connection between the suspect and the trace on *source* level is in the first place important for individualization. In all cases examined, the palm comparison was used for this purpose. In addition, the level of *activity* may also play a role.

Activity level

Finding a palm trace of the suspect at a crime scene, or on a certain object, can be very incriminating for the suspect. For various types of crimes, a palm trace can say something about the activity of the person who left the trace. Writers usually leave the sides of their hands as traces on the paper, while readers tend to leave fingerprints behind. If, in a violent crime the perpetrator's palm trace was set in blood, that may be a strong indication of his involvement. How a knife is being held can say something about what was done with the knife (cutting bread or slashing the knife on another person).

Among the 43 court decisions analyzed, there were several in which the palm trace that was secured gave rise to certain conclusions about the activities carried out by the perpetrator (and others). In case ECLI:NL:RBSHE:2007:BC1054, for example, it is stated that the 'traces (on the vehicle) fit into the image of pushing the vehicle'. In this case, the activities likely to have been performed are derived from the location and shape of the traces.

In a burglary case, the bars of the latticework on the outside of a commercial building where the burglary had taken place were bent. The defendant's counsel, however, stated that, in view of the suspect's stature and build, it was impossible for him to have done this with one hand, and that it was also not clear when the palm trace was placed.¹⁸ In this case, a discussion took place about the activities that had led to the palm traces. Counsel's defense was not upheld.

After a theft in a Chinese restaurant, a palm trace was found on the counter. The Amsterdam Court of Appeal stated that it is obvious that the suspect placed his palm on the counter when climbing over the counter, whereby the glasses fell to the floor. The cleaning lady had cleaned the counter the night before the theft, when all the customers had left. The defense argued that the suspect had a plausible explanation for the palm print, namely that he picked up food from the restaurant about once every three weeks. That defense was not honored.¹⁹

¹⁵ ECLI:NL:RBDHA:2016:8679.

¹⁶ ECLI:NL:RBLIM:2016:5715.

¹⁷ See ECLI:NL:GHAMS:2010:BL9992.

¹⁸ ECLI:NL:PHR:2016:578.

¹⁹ ECLI:NL:GHAMS:2017:1214.

The location where traces are found can be an indication that they have something to do with the crime, for example because they would not be expected in other types of activities.²⁰ The outside of tape with which a victim has been gagged is a place where perpetrator traces can be expected: if traces of the suspect are found there, that would be incriminating.²¹ The same applies to a suspect of the leakage of secret documents whose traces have been found on the printed piece,²² or of the suspect whose traces have been found on the top edge of an ATM where a stolen card has been debited.²³ Of course, much depends on whether and which other traces are found, and on whether other explanations are possible for the suspect's traces. If traces have been found on the top edge of an ATM, this does not necessarily mean that the account has been debited with a false card. But if a suspect has nothing to do in the vicinity, finding this trace becomes more incriminating for him or her.

Sometimes a palm trace corresponds to the camera footage of the crime, such as in the following case: the images show that the perpetrator goes with his left hand to a door, which then opens. On that door, a palm trace is found that matches the suspect. It is precisely the combination of traces and camera images that is incriminating for the suspect.²⁴

In conclusion, the palm also may give information about the activity that was performed. The shape of the palm may suggest a certain activity (grabbing, leaning, pushing). In that case, a palm may have added value compared to a single finger trace. It is also possible that the location where the trace was found says something about the activity.

Conclusions of dactylographic reports

The reports from police or dactylographic experts that presented palm comparisons, referred to in the court decisions, often stated that the trace corresponded to the print, and the word 'identical' is also being used: 'The traces found are identical to the prints of the palm'.²⁵ Sometimes reference is made to the 'uniqueness' of the traces: 'The official report dated [date], drawn up by [expert], senior advisor dactylography, shows that the dactylographic trace found on the edge of the top drawer of a drawer unit of a desk in the office space is identical to a print of the right palm on the palm print sheet [...]. Because of the uniqueness of fingerprints, which also includes palm prints, this also means that the trace cannot come from anyone else'.²⁶ In a case concerning the theft of a number of tractors and semi-trailers, the following conclusion of a dactylographic examination is cited: 'The result of the established dactylographic examination is as follows: Trace No. 2 is identified on a print of the right palm occurring on the palm print sheet in the name of [suspect]. (...). Because of the uniqueness of fingerprints, which also includes palms, this means that the trace cannot come from anyone else'.²⁷

²⁰ ECLI:NL:RBHAA:2008:BD4753; also see ECLI:NL:RBMAA:2009:BI0654.

²¹ In the cases ECLI:NL:GHAMS:2016:1774, ECLI:NL:GHSHE:2015:2038, ECLI:NL:RBDHA:2015:1884, ECLI:NL:GHARL:2014:8931 en ECLI:NL:PHR:2011:BQ0049 mention is made of tape with traces of the suspect on the outside.

²² ECLI:NL:GHDHA:2013:BZ1878.

²³ ECLI:NL:RBDHA:2015:1884.

²⁴ ECLI:NL:RBAMS:2011:BU5091.

²⁵ ECLI:NL:GHDHA:2013:BZ1878. See also ECLI:NL:GHARL:2014:8931; ECLI:NL:HR:2011:BO2958.

²⁶ ECLI:NL:GHAMS:2010:BL9992.

²⁷ ECLI:NL:HR:2007:BB7127; ECLI:NL:PHR:2007:BB7127.

In the cases that have come before the courts in more recent years, dactylographic experts often use less absolute terms to indicate the individualization of a trace. In those more recent cases, phrases are used like the following: 'The investigation shows both that a very high degree of similarity has been found, and the absence of unexplained differences between trace and print [...] These findings are entirely in line with what could be expected when the trace comes from the donor.'²⁸ This 'turn' to a more cautious form of inference may indicate an increasing sensitivity among police officers and dactylographic experts to the possible lack of certainty of dactylographic traces, including palm traces.

The analysis of the files shows that dactylographic experts do not always report uniformly on the number of similarities they find between a palm trace found and the palm print taken from the suspect. Not every file contained the original reports from the dactylographic experts, and sometimes their findings were only recorded in a police report. Only a limited number of files therefore contained the 'original' reports of the dactylographic experts. The numbers of points of agreement that experts found were sometimes quite far apart. For example, in a murder case, the points of similarity between a trace and a print found by the experts ranged between 12 and 18.²⁹

It is not clear whether the differential assessing of the number of similarities between trace and prints poses a risk to the quality of the reports. However, in view of these differing assessments, it seems justified that in recent years the police have started to report in less absolute terms when it comes to the individualization of a (palm) trace. The differences between the assessments could also have prompted the court to be cautious in using the comparison. However, such caution could not yet be observed in the court decisions examined: judges usually assume an 'individualization' on the basis of the reports, and they express their decisions in absolute terms.

Dealing with the palm comparison reports by the courts

Palm traces that may identify the suspect can be used by the court as evidence. This can be done in different ways, depending on what other evidence is available. In one case, the palm trace was the only evidence linking the suspect to the criminal offense. A palm trace of the suspect of a burglary was found on a box that, according to the resident of the house, must have been taken from a closet in his bedroom by one of the robbers and that was found on the defendant's bed. However, since the police had failed to take pictures of the palm trace, this evidence could not be challenged by the suspect. The evidence was therefore not admitted in court, and the accused was acquitted.³⁰ Also in a case where a burglary was committed and a palm trace was found on the bent bars, that matched the palm print of the suspect, this trace seemed to be the only trace. In this situation, the palm trace was crucial for proving the crime in this case as well.³¹

²⁸ This way of concluding is very similar to the 'logically correct' conclusion form that the Netherlands Forensic Institute (NFI) uses in its DNA reports. During the interviews a forensic officer said about this type of conclusion: '(...) it is striking that the absolute formulation in dactylographic reports has more value for some judges than the probability formulation of DNA. Judges sometimes have difficulty interpreting the results of DNA tests correctly. The confident assessments in dactylographic investigations, even though that is now changing, sometimes unjustly leads to more convinced judges than a DNA hit. This could also be because much has been written about secondary transfers of DNA'.

²⁹ ECLI:NL:GHAMS:2010:BL9992; see also ECLI:NL:RBDH:2015:15101 (16 vs. 14 points of agreement, and 18 vs. 13 points of agreement), and ECLI:NL:RBDHA:2016:8679 (19 vs. 14 points of agreement. Photographs of palm traces and prints in the files were often of poor quality and therefore difficult to assess visually.

³⁰ ECLI:NL:RBAMS:2013:BZ9194.

³¹ ECLI:NL:PHR:2016:578.

In all other cases there was also other forensic evidence in the form of traces. Finger traces were often also found, in several cases there was DNA evidence, sometimes shoeprints were found, or a glass comparison was carried out; and of course, witness statements and the statements of the accused himself played an important role.

Counter-expertise

Occasionally, defense counsel make an objection to the dactylographic comparison. In a burglary case, counsel stated that the palm trace at the crime scene did not originate from the suspect. The court overruled this objection. There were also camera images, and shoe traces had been recovered from the roof, and those traces also pointed in the direction of the suspect.³²

In a case involving violent theft, counsel argued that the palm trace of the suspect may have ended up on the tape at a different time than at the time of the offense. The Court of Appeal did not agree and stated that the traces were found at a location that would preclude the possibility that they could have been placed there before the commission of the crimes.³³ Sometimes the defense argued that the dactylographic trace found was only one of many traces or that it could be an 'old' trace, suggesting that the trace was probably left at an earlier time, and not at the time of the crime.³⁴

Several reports by counter experts have been written. In a drug case, a lawyer who believed that the conclusion of three dactylographic experts was "not reliable" because they identified inexplicable dactylographic differences, gets a slap on the nose. 'Counsel further argued that the conclusion of three dactylographic experts that there is a dactylographic hit between the suspect's prints and the dactylographic traces found on the tape with which the heroin was packaged in the Finland case is not reliable (...). The objection is rejected, since by three dactylographic experts, namely [name], who works at the Forensic Science Service in London, [name], who works as a senior subject specialist at the Forensic Investigation Department, Dactylography & DNA Section of the Rotterdam Rijnmond Police Department and [name], who works independently at the National Expertise Center of the National Police Agency, has been concluded that the palm traces found on the tape and the palm prints of [name] are identical. Counsel has provided insufficient (expertly) substantiation [...].³⁵

³² ECLI:NL:RBAMS:2015:6671; for another case where there was a debate about the source of palm traces, see ECLI:NL:RBAMS: 2009:BH1786.

³³ ECLI:NL:GHAMS:2016:1774.

³⁴ See ECLI:NL:RBHAA:2008:BD4753.

³⁵ ECLI:NL:RBROT:2006:AZ8683; For a case in which the defense's objection has been upheld, see: ECLI:NL:RBAMS:2013:BZ9194. Objections regarding the palm comparison are rarely upheld in the cases examined.

Legal comparison

The text below is a summary of the legal comparison included in the Dutch version of this report (see Malsch et al., 2017; De Wilde et al, 2017.)

- Palm traces are rarely separately mentioned in the legislation of the countries studied. For example, use is made of the term 'fingerprints', which then includes palm prints as well (England & Wales), or terms such as 'papillary lines' (Austria) or 'prints of body parts' (Switzerland). In the Netherlands, fingers and palms are both specified in the statutory regulations.
- Because the same standards exist in Germany, Switzerland and England & Wales for taking fingerprints as for palm prints, in those countries palm prints may in theory be taken to establish the identity of the suspect. However, as in the Netherlands, palm prints are only used to determine who is the donor of a palm trace.
- Of the countries surveyed, only England & Wales have a default authorization for securing palm prints. However, this does not mean that palm prints are taken by default in every case.
- In Germany and Switzerland, taking palm prints must be 'necessary', which seems to correspond to the requirement of a 'research interest' in the Netherlands. In Germany and Switzerland, however, the necessity requirement is interpreted more broadly than in the Netherlands, because the taking of a palm print does not have to be related to the criminal offense of which the suspect is suspected.
- In Germany and Switzerland a legal remedy is available against the decision to take palm prints, while it is not in the other countries. This remedy is often applied when the collection is not related to a criminal offense of which the suspect is suspected.
- In Germany and England & Wales (senior) police officers are authorized to decide whether palm prints will be taken. This is also the case in Switzerland, but when the suspect refuses to cooperate, a public prosecutor must issue an order in this country. In the Netherlands, in principle only the public prosecutor is authorized to issue an order to take palm prints.
- In the countries studied, deprivation of liberty is not a condition for taking palm prints, while it is in the Netherlands.
- In Switzerland, non-suspects can also be forced to have palm prints taken. In the other countries surveyed, palm prints can only be taken from these individuals on a voluntary basis.
- The Netherlands, Germany, Switzerland & England & Wales have specific regulations for the storage and use of palm prints.

Conclusions

This chapter answers the research question, which reads as follows:

What is the added value of using palm prints for the identification of suspects and their prosecution and trial in criminal courts as compared to fingerprints and other types of forensic evidence?

The added value of palm prints

For investigation purposes, the value of palm comparison can be divided into five categories:

1. Palm traces as *technical evidence*. Technical evidence has taken on an increasingly important role in the investigation in recent years, as suspects more often invoke their right to remain silent in the interrogation room.
2. Palms as a *dactylographic trace*. Dactylographic traces are one of the types of traces, in addition to DNA traces, that can lead directly to the source of the trace.
3. Palms in *trace clusters*. In trace clusters, different offenses are linked together by means of forensic traces coming from the same offender (group).
4. Palm as the *only usable trace*. It sometimes happens that a palm trace is the only usable trace at a crime scene, according.
5. Palm traces reveal information on *activity level*, and may do so more than other types of traces.

A number of minor differences between finger and palm traces can be noted. First, the palm is usually put down with more pressure than a finger, and this produces a clearer print. Secondly, hand palms have a larger surface, which means that the required number of points for individualization can be reached more quickly, even when only part of the palm is left. The palm trace can also help to arrive at the necessary number of points of agreement for an individualization if the fingerprint does not provide enough information. Finally, the possible contribution of fingerprints to trace clusters is minimal because a person has ten fingers that can potentially leave a trace, and that gives rise to complications. By contrast, each individual has only two palms, which renders trace-trace comparisons more easy in case of palm comparison, thereby enabling the construction of clusters.

The added value of palm traces compared to DNA traces is that dactylographic traces (both finger and palm traces) can play a greater role in determining what happened at the crime scene, the so-called *activity level*. In that respect, dactylographic traces have a higher 'reconstructive value' than DNA. It is also possible to determine more easily with dactylographic traces than with DNA whether it concerns a *perpetrator trace*.³⁶ This added value of dactylographic traces is greater with palms than with fingers. It should also be noted that most respondents from the Dutch police find the – legal - distinction between fingers and palms unnatural, since both consist of patterns of papillary lines. It seems that the added value of palm comparison has not sufficiently been acknowledged by the Dutch legislator.

³⁶ That is also possible with DNA traces, for example if blood is found on a smashed window during a burglary. With dactylographic traces, however, activity can be determined more easily, and dactylographic traces are much less easily 'planted' than DNA traces.

Reporting on palm comparison

Until a few years ago, dactylographic experts mainly used deterministic, absolute conclusions to indicate the similarity between a trace and a print. Courts generally copied the dactylographic experts' conclusions in their decisions. Fewer absolute conclusions have been used in recent years. An awareness seems to have arisen that subjectivity about, for example, the number of points of agreement between trace and print may play a role during the investigation and the trial of a case. The present study has shown that dactylographic experts may indeed differ in their assessments of similarities between traces and prints. In the cases where more than one dactylographic reports were found, the experts appeared to – sometimes substantially - disagree on the number of points of similarity between trace and print, without this affecting the final court decision on the individualization of the trace. To counteract possible undesirable consequences of this subjectivity, the police use a procedure in which several experts assess the traces independently of each other.

The use of palm print comparison by the courts

The analysis of court decisions and files shows that palm comparisons have been used with some regularity to substantiate a court decision. In some of the cases investigated, the palm trace was the only, if not the most crucial, trace that linked the suspect to the crime scene.

In all cases investigated, it was determined that the trace found matched the suspect's print. Both the experts and the judges often expressed themselves in absolute terms: trace and print would be 'identical'; dactylographic traces would be 'one off'; the suspect would be the 'donor' of the trace, it would be 'excluded' that someone else is the donor of the trace.

Uncertainty about the assessment of traces and prints, insofar as this could be deduced from the court decisions and the files, generally is not explicitly addressed, neither in the reports, nor in the court decisions. It is clear, however, that there can be a difference of opinion between experts; the interpretation of palm traces and prints is apparently sometimes problematic and can lead to differences between expert court decisions. Dactylographic traces and prints leave a lot of room for (subjective) interpretation (Dror, 2016, see the famous Brandon Mayfield case discussed above in this report).

Over time, Dutch experts have come to phrase their conclusions in less absolute terms with respect to individualizations. Courts, however, may still present these as absolute decisions and treat them as such. Judges seem not always aware of the potential uncertainties that may exist in dactylography. Moreover, Dutch courts deny most requests from counsel for counter expertise.

Dactylography, including palm print analysis, is not a hard science, and some even doubt it is a science at all.³⁷ While there are differences between the various types of forensic evidence, no evidence is absolutely hard and undisputable. Even DNA evidence, in the event of mixed or incomplete profiles, is uncertain.³⁸ The risks of uncertainties in the various types of forensic evidence can and must be combated by clear and comprehensive expert reporting that presents the inherent uncertainties. Courts must take the effort to fully understand the contents of such reports and, if they cannot, to ask for explanations and counter expertise, as well as to clearly justify their own decisions in their rulings to enable revision attempts in case of an incorrect decision (Malsch, 2021).

³⁷ See <https://www.aaas.org/report/latent-fingerprint-examination>.

³⁸ See Malsch et al. 2013, 2016; De Keijser et al. 2016.

Literature

Broeders, A.P.A. (2003). *Op zoek naar de bron. Over de grondslagen van de criminalistiek en de waardering van het forensisch bewijs*. Deventer: Kluwer.

Dror, I.E. (2015). Cognitive neuroscience in forensic science: Understanding and utilizing the human element. *Philosophical Transaction of the Royal Society B*, 307: 20140255.

Dror, I.E. (2016). A hierarchy of expert performance. *Journal of Applied Research in Memory and Cognition*, 5 (2), 121-127.

Evelt, I.W. & Williams, R.L. (1996). A review of the sixteen points fingerprint standard in England and Wales. *Journal of Forensic Identification*, 46, 1, 49-73.

Keijser, J.W. de, Malsch, M., Luining, E.T., Weulen Kranenbarg, M. & Lenssen, D.J.H.M. (2016). Differential reporting of mixed DNA profiles and its impact on jurists' evaluation of evidence. An international analysis. *Forensic Sciences International: Genetics*, 23, July 2016, 71-82.

Lammers, M. (2009). *Handpalmsporen in de opsporing. Een onderzoek naar de dagelijks praktijk, de wettelijke basis, het nut & de noodzaak en eventuele standaardafname bij verdachte*. Onderzoek in opdracht van het ministerie van Binnenlandse Zaken en Koninkrijksrelaties.

Malsch, M. (2021). *Law is too important to leave to lawyers*. Den Haag: Eleven International Publishing.

Malsch, M., Taverne, M.D., Elffers, H., Keijser, J.W. de & Kranendonk, P.R. (2013). *DNA-rapporten: makkelijker kunnen we het niet maken, begrijpelijker wel*. Den Haag: Boom / Lemma.

Malsch, M., Keijser, J.W. de, Luining, E., Weulen Kranenbarg, M. & Lenssen, D. (2016). Hoe hard is DNA-bewijs? Internationaal-vergelijkend onderzoek naar de interpretatie van DNA-profielen. *Nederlands Juristenblad*, 18, 1261-1266

Malsch, M., Berg, T. van den, Hornman, M., Lammers, M., Wilde, B. de & Stevens, L. (2017). *De toepassing van handpalmafdrucken voor de opsporing en vervolging*. Den Haag: WODC.

Malsch, M., Lammers, M. & Berg, T. van den (2018). De meerwaarde van handpalmafdrucken voor de opsporing en vervolging. *Expertise en Recht*, 1, 4-11.

Meuwly, D. (2008). De vingerafdruk. In: Broeders, A.P.A. & Muller, E.R. (red.). *Forensische wetenschap. Studies over forensische kennis en organisatie*, Deventer: Kluwer, 323-345.

Riemen, J.A.J.M. & Voorhoeve, I.M. (2015). *Dactyloscopisch onderzoek sporen. Vakbijlage*. Zoetermeer: Landelijke Eenheid Politie, Dienst Landelijke Operationele Samenwerking. Landelijk Forensisch Service Centrum. Afdeling Dactyloscopie.

Riemen, J.A.J.M. & Voorhoeve, I.M. (2016). *Jaarverslag Dactyloscopie en HAVANK 2014 2015*. Zoetermeer: Landelijke Eenheid Politie, Dienst Landelijke Operationele Samenwerking. Landelijk Forensisch Service Centrum. Afdeling Dactyloscopie.

Saks, M.J. & Koehler, J.J. (2005). The coming paradigm shift in forensic identification science. *Science*, 309, 892-895.

Stol, W.Ph., Kop, N. & Koppenol, P.A. (2005). *Eén spoor is geen spoor. Naar een landelijke sporendatabank voor informatiegestuurde opsporing*. Den Haag: WODC.

Wilde, B. de, Malsch, M., Berg, T. van der, Lammers, M. & Stevens, L. (2017). *Geef ze een vinger en ze willen de hele hand. De toepassing van handpalmafdrukken voor de opsporing en vervolging*. Den Haag: Boom juridisch.

Appendix 1: Examined court decisions

Hof Den Haag 2 October 2001, ECLI:NL:GHSGR:2001:AD5053
HR 9 September 2003, ECLI:NL:HR:2003:AF8779
Rb. Maastricht 13 October 2006, ECLI:NL:RBMAA:2006:AZ1481
Rb. Rotterdam December 19, 2006, ECLI:NL:RBROT:2006:AZ8683
HR December 11, 2007, ECLI:NL:HR:2007:BB7127
Rb. Den Bosch 24 December 2007, ECLI:NL:RBSHE:2007:BC1054
Rb. Amsterdam February 29, 2008, ECLI:NL:RBAMS:2008:BR2538
Rb. Amsterdam February 29, 2008, ECLI:NL:RBAMS:2008:BR2556
Rb. Zwolle-Lelystad 27 March 2008, ECLI:NL:RBZLY:2008:BC8227
Rb. Haarlem 12 June 2008, ECLI:NL:RBHAA:2008:BD4753
Hof Den Bosch 5 December 2008, ECLI:NL:GHSHE:2008:BG8081
Rb. Amsterdam February 4, 2009, ECLI:NL:RBAMS:2009:BH1786
Rb. Maastricht 8 April 2009, ECLI:NL:RBMAA:2009:BI0654
Hof Arnhem 8 September 2009, ECLI:NL:GHARN:2009:BJ7123
Rb. Alkmaar 22 December 2009, ECLI:RBALK:2009:BK7362
Hof Amsterdam 2 April 2010, ECLI:NL:GHAMS:2010:BL9992
HR 8 February 2011, ECLI:NL:HR:2011:BP3520
HR 22 March 2011, ECLI:NL:HR:2011:BO2958
Conclusie Advocaat Generaal June 28, 2011, ECLI:NL:PHR:2011:BQ0049
Rb. Amsterdam 17 November 2011, ECLI:NL:RBAMS:2011:BU5091
Hof Den Haag 21 February 2013, ECLI:NL:GHDHA:2013:BZ1878
Rb. Amsterdam 29 April 2013, ECLI:NL:RBAMS:2013:BZ9194
Rb. Amsterdam 9 May 2013, ECLI:NL:RBAMS:2013:5555
Rb. Rotterdam July 8, 2014, ECLI:NL:RBROT:2014:6693
Hof Arnhem-Leeuwarden November 19, 2014, ECLI:NL:GHARL:2014:8931
Rb. Noord Nederland 11 December 2014, ECLI:NL:RBNNE:2014:6510
Rb. Den Haag 29 January 2015, ECLI:NL:RBDHA:2015:901
Gemeenschappelijk Hof van Justitie 4 February 2015, ECLI:NL:OGHACMB:2015:5
Rb. The Hague 27 February 2015, ECLI:NL:RBDHA:2015:1884
Hof Den Bosch 5 June 2015, ECLI:NL:GHSHE:2015:2038
Rb. Amsterdam October 1, 2015, ECLI:NL:RBAMS:2015:6671
Rb. The Hague 5 November 2015, ECLI:NL:RBDHA:2015:15101
Rb. Rotterdam December 1, 2015, ECLI:NL:RBROT:2015:8781
Rb. Amsterdam 9 December 2015, ECLI:NL:RBAMS:2015:8875
Rb. Oost Brabant 12 February 2016, ECLI:NL:RBOBR:2016:554
Rb. Amsterdam 26 April 2016, ECLI:NL:RBAMS:2016:2720
Hof Amsterdam 9 May 2016, ECLI:NL:GHAMS:2016:1774
Conclusie Advocaat Generaal 17 May 2016, ECLI:NL:PHR:2016:578
Rb. Oost Brabant 14 June 2016, ECLI:NL:RBOBR:2016:3718
Hof Den Bosch 1 July 2016, ECLI:NL:GHSHE:2016:2684
Rb. Limburg 4 July 2016, ECLI:NL:RBLIM:2016:5715
Rb. Den Haag 28 July 2016, ECLI:NL:RBDHA:2016:8679