

# CHARACTERISTICS OF PAPILLARY RIDGE PATTERNS OF SKIN ON FINGERS AND TOES IN THE CONTEXT OF DACTYLOSCOPIC EXAMINATION

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## Annotation

The material world is characterized by the interconnection and conditionality of phenomena. Every crime affects various objects in the external world and causes changes in the environment. In criminology, all these material influences and changes are called “crime traces”. Since crime traces are not homogeneous, they are investigated by several branches of forensic science techniques. An important part of the trace investigation belongs to the field of trassology. The trassology branch which studies the structure and properties of the papillary ridge patterns and the use of its traces in evidence is called dactyloscopy. When examining an object or a crime scene, investigators often find fingerprints, sometimes palm prints, and less frequently barefoot prints, which display papillary ridge patterns. The author hypothesizes that the papillary loop and whorl ridge pattern on the corresponding toes and fingers of the same-sided hand and foot pairs have statistically significant similarities.

If matching patterns are detected, the number of papillary lines from the delta to the center of the same type of papillary patterns will be counted. This process involves an examination of the general characteristics that are part of the trace verification process when identifying a person. The general features characterize both the external and internal features of the ridge pattern. The lines in the center of the trace indicate the classification type, species, or special category to which the trace belongs. This knowledge is important both for crime scene investigators working at the scene of a crime and for experts in the field conducting forensic examinations.

**Keywords:** crime scene, papillary ridge pattern, hands-feet, expert evaluation, expert, loop ridge pattern, whorl ridge pattern.

## Introduction

The initial fingerprint examination starts at the scene. This is done by the forensic investigator who has discovered, lifted, and stored the fingerprint. The main purpose of conducting the initial fingerprint examination is to classify

which fingerprint group it belongs to. For this purpose, the forensic scientist uses a magnifying glass and carries out a visual examination of the fingerprint identified.

If at the scene, the forensic investigator had at their disposal a fingerprint card of the suspect, in addition to the fingerprints stored at the crime scene, they could compare these on-site.

This process should not be considered as an expert assessment; the comparison carried out has a preliminary value. The individual identification of the trace will always remain the task of the fingerprint expert and the forensic expert's initial examination should not constitute a final assessment.

In the initial examination, the comparison of the fingerprint is usually complicated because the object of the examination is in most cases a fragment, not a fully formed fingerprint. Consequently, it cannot be excluded that the suspected fingerprint fragment may be a toe print instead.

Hypothetically, there may be bare footprints, or more specifically toe prints at the scene, which are similar to fingerprints. It is important to bear in mind that toe prints may be larger than fingerprints. In the case of fragments of papillary pattern prints, it may not be correct to immediately state that the prints found at the scene were left by fingers.

Depending on the location where the fragment of the papillary ridge pattern is identified, certain conclusions can be drawn, but they may not be categorically true.

Barefoot prints are more common in open places, less common indoors. Barefoot prints consist of a footprint or imprint of the sole, which is divided into toes, thumb, midfoot-arch, and heel.

Finding a complete barefoot print at the crime scene is very rare and is associated with the presence of excellent conditions. In most cases, various parts of the sole can be recorded. Indoors, we may encounter surface traces formed by sweat, as they usually show a distinctive pattern of skin papillary patterns under the ball of the foot. Sweat under the soles of feet is usually mixed with dust and dirt, which to a certain extent reduces/fades the imprint of papillary folds. However, this does not mean that it is impossible to identify such prints. Barefoot prints at the scene of an incident are sometimes formed by blood stains or some other coloring agent. Identifying features of barefoot prints, other than papillary patterns, are scars and injuries, warts, corns, and other bumps, anatomical injuries, and various malformations.

An observation of the crime scene is an investigative activity in which,

under the provisions of the Criminal Procedure Act<sup>1</sup> and the requirements and recommendations of procedural tactics, the crime scene is examined to gain direct knowledge of the circumstances of the scene, discover traces of the offense and collect and store data to be used as evidence of the offense and other evidentiary facts<sup>2</sup>. The conditions, conduct, and results of the site observation are recorded in the site observation report. Thus, the first action is to record in writing the papillary pattern prints found. This consists of a description of how the print was detected, the techniques and means used to make it visible, the size of the trace, and the shapes of the papillary lines. If techniques and tools were used that did not produce results, this should also be indicated in the observation report. After describing the papillary ridge prints, they are photographed to scale-this is the second step in the tracing process and the third possible step is the application of the so-called “object tracing”.

Unfortunately, looking at current practice, the use of the written recording is minimal or superficial. The most common way to record the papillar ridge patterns is by photography and object recording.

There are several reasons for this: lack of trace-reading skills, taking pictures is easier than describing, recording of the object shifts some of the responsibility to the experts who, as part of the expert task, are trying to identify possible traces on the object.

Since in Estonia, the schools do not teach forensic investigators working at the scene of the crime dactyloscopy in its broader sense, the importance of the type of the trace, the grouping, the exact location on the object, the size of the trace, and the written fixation of the papillary pattern formed in it is not recognized.

The pre-trial investigation needs to establish who has left the visible or barely visible traces of the dermal papillary ridges discovered during the examination, therefore the investigator will provide the expert with the object, part of it, a print, a trace, or a scale photograph.

The task of the expert is to determine whether the object, part of it, a print, a trace, or a photo in scale, taken of the scene of the crime shows traces of dermal papillary ridges of the person being examined. For the examination, experimental traces of dermal papillary ridges of the suspect are required as reference material. This usually means finger or palm prints.

As a result of this, a situation may arise where bare toe impressions are

<sup>1</sup> Code of Criminal Procedure: <https://www.riigiteataja.ee/akt/106012016019?leiaKehtiv>

<sup>2</sup> Lindmäe, H. (1995). *Menetlustaktika I*. 103.

included in the material submitted for examination, but the finger or palm prints are submitted as reference material for the examination of the papillary ridge patterns of the skin of the person being examined.

This study focuses on the general features, loop and whorl ridge patterns. The author has hypothesized that the loop and whorl ridges on the skin of fingers and toes of the hands and feet on the same side have significant similarities in the pattern.

In the case of matching patterns, the number of papillary lines from the delta to the center of the papillary pattern is counted for all of the matching papillary patterns. This process involves an examination of the general characteristics, which is part of the larger process of determining the suitability of a trace for identification. The generic features characterize both the external and internal features of the papillary ridge pattern.

Depending on whether the loops in the papillary ridge patterns are turned towards the little finger or the thumb, they are called ulnar (in Lad. ulna, going towards the little finger) or radial (in Lad. radiatus, going towards the thumb). Accordingly, the branches of the loops on the little finger of the right hand are turned to the right-towards the little finger. The loops on the fingers of the right hand are turned towards the little finger, with the branches of the loops pointing to the right, while those on the fingers of the left hand are turned towards the left<sup>3</sup>.

The radial loop pattern on the finger adjacent to the thumb is in the direction of the thumb. The fingers of the right hand have radial loop patterns, with the loop branches pointing to the left, while the fingers of the left hand have radial loops pointing to the right (this feature is used in practice to identify the hand and the finger with which the traces have been made: the right hand has loops to the right, while the left hand has loops to the left (except for 30% of the index fingers))<sup>4</sup>.

If it is not known which finger has made the print, we need to refer to them as right or left pointing loops.

### The study

100 people took part in the study. As the aim of this article is to show the relationship between loop and whorl patterns on the fingers and toes of the same hand, a primary study was carried out to identify 66 people (21 women

<sup>3</sup> Топорков, А. А. (2015). *Криминалистика*. 97.

<sup>4</sup> Анищенко, И. А. (2013). *Дактилоскопия и дактилоскопическая экспертиза*. 2-е изд. 48.

and 45 men) out of 100 who had loop or whorl pattern on the fingers and toes of the same hand.

Fingerprints were recorded on fingerprint cards using black ink. *Microsil*<sup>®</sup>: white, brown, grey, and black were used for toe impressions. Because of its elasticity, the use of *Microsil*<sup>®</sup> allowed all five toes and part of the ball of the foot to be recorded by the impression. In a later study, the elasticity of the *Microsil*<sup>®</sup> allowed the impression to be bent when examined with a magnifying glass and to obtain more precise information about the traces formed.

The *Microsil*<sup>®</sup> used gave very good results in recording the toe impressions, given the anatomical structure of the ball of the foot and the positioning of the toes to each other, their length, the size between the toes, and various anatomical differences.

The article uses the terms full and partial overlap (of pattern). By complete overlap, the author refers to the overlapping pattern between the fingers and toes of the right and left hand and leg of the study participant. In the case of partial overlap, it is the same type of patterns on the same fingers and toes of the right hand-leg or left hand-leg pairs.

The study seeks to answer the hypothesis that the loop and whorl patterns on the skin share significant similarities in the fingers and toes on the same side of the body.

To this end, the presence of loop and whorl papillary patterns on the fingers and toes of the same hand and foot will be measured.

The study found that 21 women had loop or whorl patterns on the fingers and toes on the same side of the body.

Six out of 21 women ( 28.5%) had a whorl (see Tables 1 and 2), including one case on the second toe and index finger of the left hand, and three cases on the third toe and middle finger. One case on the big toe and thumb of the right hand, two cases on the second toe and index finger, two cases on the third toe and index finger, and one case on the fourth toe and index finger. In three cases there was complete pattern overlap, one with the second toe and index finger and two with the third toe and index finger. There was a notably lower number of the whorl ridges pattern matches on the fingers and toes of the same hand and foot compared to the loop ridge pattern matches. When comparing the presence of the whorl ridge pattern on both feet, it was detected on the second toe-index finger in 1 case on the left foot and on the third toe-middle finger in 3 cases, so it can be considered as a random coincidence.

On the right hand-foot pair, the whorl pattern occurred on the big toe-thumb in 1 case, on the second toe-index finger in 2 cases, on the third

*Table 1.* Left foot-toe and finger pattern overlap in 21 women with loop and whorl patterns

		1 finger	toe	2 finger	toe	3 finger	toe	4 finger	toe	5 finger	toe
Quant.	Limb	loop	whorl	loop	whorl	loop	whorl	loop	whorl	loop	whorl
21	l.foot	12		12	1	9	3	7		4	
	l.hand	12		12	1	9	3	7		4	

*Table 2.* Loop and whorl ridge pattern overlap on the right side of 21 women

		1 finger	toe	2 finger	toe	3 finger	toe	4 finger	toe	5 finger	toe
Quant.	Limb	loop	whorl	loop	whorl	loop	whorl	loop	whorl	loop	whorl
21	r.foot	10	1	10	2	4	2	3	1	2	
	r.hand	10	1	10	2	4	2	3	1	2	

toe-index finger also in 2 cases, and the fourth toe-index finger in 1 case, so this is considered a random coincidence.

Table 1 shows the frequency of loop and whorl ridges on the toes and fingers of the left foot and hand pairs of 21 women. Papillary ridge patterns on the same foot and hand are of particular interest, since the traces of papillary patterns of the skin, which are identified at the scene usually occur as individual prints, less frequently in the form of complete sets of all five toes and fingers. The pattern match between the big toe and the thumb and the second toe and index finger is 57.1%, the match between the third toe and the middle finger is 42.8% and the match between the fourth toe and the ring finger is 33.3%, which is significantly higher than a random coincidence. The pattern overlap between the fifth toe and the little finger is 19.04%, which can be considered a coincidence.

The occurrence of the whorl ridge pattern on the toes and fingers on the left side may be a coincidence as the study participants had a whorl ridge pattern on the second toe and the index finger in one case and on the third toe and the middle finger in three cases.

Table 2 shows the frequency of the occurrence of loop and whorl ridge patterns on the toes and fingers on the right hand and foot pair of 21 women. The pattern overlap between the big toe and thumb and the second toe and index finger is 47.6%, which is significantly higher than a random coincidence. The overlap between the third toe and the middle finger is 19.04%, the overlap between the fourth toe and the ring finger is 14.28%, and the overlap between the fifth toe and the little finger is 9.52%, which can be considered as a random

coincidence.

Thus, looking at the left and right hand-foot pairs, it can be argued that for the big toe-thumb, the second toe-index finger, the pattern match is significantly higher than it should be if it were a random overlap. For the left hand-foot pair, it is also significantly higher than the random values would be for the third toe-middle finger and the fourth toe-ring finger.

The overlap of the right foot and hand pair for the third toe-middle finger, the fourth toe-ring finger, and the fifth toe-little finger, and the left foot and hand pair for the fifth toe-little finger may be a coincidence.

Examination of the left hand-foot pair and right hand-foot pair of the 21 women in the study showed that the highest number of matches was found in the fingers and toes with loop ridge patterns.

As in the case of the left foot and hand, the occurrence of whorl ridge pattern on the toes and fingers of the right foot and hand must be considered a coincidence, since the study participants had whorl ridge patterns on the big toe and thumb in one case, on the second toe-index finger, and the third toe-middle finger in two cases, and on the fourth toe and ring finger in one case.

Since this confirmed that the fingers and toes of corresponding hands and feet had overlapping patterns more often than at random, the number of papillary lines from the delta to the center were counted for all matching papillary ridge patterns.

The literature, specifically I.I. Prorokov's examination of 1000 people (10 000 fingerprints) provided the following data: 1–3 lines occurred very rarely; 12–16 lines most often and 28–30 lines also very rarely<sup>5</sup>.

Since the data presented by I.I. Prorokov is based on the study of 10 000 fingers, the author of the article also gives the number of papillary lines from the delta to the center of the fingers covered with loop ridge pattern as a comparison, excluding the fingers with whorl pattern. The author grouped the number of lines from the delta to the center into four categories.

The present study showed (see Table 3) that on the female fingers, from the delta to the center, there were 1 to 6 lines rarely; 7 to 15 lines most often; 16 to 20 lines to a less often than 7 to 15, and 21 to 30 lines extremely rarely.

A survey of men's fingers showed (see Table 6) that on their fingers, from the delta to the center, lines 1 to 6 occur to a lesser extent; lines 7 to 15 and 16 to 20 occur most frequently; lines 21 to 30 less frequently than the previous two.

<sup>5</sup> Анищенко, И. А. (2013). *Дактилоскопия и дактилоскопическая экспертиза*. 2-е изд. 128–129.

**Table 3.** Number of loop ridges from the delta to the centrum on the toes and fingers of the left and right hand-foot pairs in women

Limb	Number of lines	Loop ridge pattern									
		1 finger	toe	2 finger	toe	3 finger	toe	4 finger	toe	5 finger	toe
l.foot l.hand	1 6		2	4	2	3	4		3		3
	7 15	6	7	4	7	4		2	2	2	1
	16 20	5	1	3	1	2	2	3	2	1	
	21 30		1		1	1	1	2		1	
r. foot r.hand	1 6			3	2	1	2	1	2		1
	7 15	2	8	3	2	2	1	3	2	2	2
	16 20	6	2	2	4	1	1			1	
	21 30	2	1	2	1			1	1		

Loop pattern lines 1–6 on 14 toes and 7 fingers of the left hand of the left foot; lines 7–15 on 17 toes and 19 fingers; lines 16–20 on 6 toes and 14 fingers; and lines 21–30 on 3 toes and 4 fingers on the hands the 21 female study participants.

Right-foot hand pairs with loop ridge pattern: lines 1–6 on 7 toes and 5 fingers; lines 7–15 on 15 toes and 12 fingers; lines 16–20 on 7 toes and 10 fingers and lines 21–30 on 3 toes and 5 fingers.

The study found that seven women had matching patterns in papillary lines at the area between delta and center.

Papillary line overlap was found in five cases for the left hand-foot pair and in two cases for the right hand-foot pair for the corresponding toes and fingers. One pattern match was found on the big toe and thumb on the left side. From the delta to the center, there were 17 papillary pattern lines. In three cases, overlapping patterns were found on the second toe and middle finger. Of those, two are on the right hand-foot pair and one on the left hand-foot pair. On the right-foot hand pair, the first female participant had 19 papillary lines from delta to center and the second had 13 papillary lines, and on the left hand-foot pair, the corresponding number was 13. Three women had 4 papillary ridges going from the delta to the center on their third toe and middle finger on the left side of the body.

No such overlap of papillary lines was found in the case of whorl ridge papillary patterns, measured from the delta (left to right) to the center.

On the same toe and finger pairs for hands and feet on both sides, the highest number of papillary ridge pattern lines from the delta to the center was most



**Table 4.** The overlap between toes and fingers on the left side in 45 men who had loop and whorl patterns on their skin

		1 finger	toe	2 finger	toe	3 finger	toe	4 finger	toe	5 finger	toe
Quant.	Limb	loop	whorl	loop	whorl	loop	whorl	loop	whorl	loop	whorl
45	l.foot	27	4	13	1	2	2	10	2	3	
	l.hand	27	4	13	1	2	2	10	2	3	

often in the range of 7 to 15; in fewer cases, it remained in the range of 16 to 20; rarely 1 to 6 lines and exceedingly rarely 21 to 30 lines.

Thus, hypothetically, the fragment of a loop-shaped papillary pattern deposited at the scene may have been left not by a finger, but by a toe.

45 male study participants were found to have loop or whorl ridge patterns on the fingers and toes of the same hand-foot pair.

Table 4 shows the frequency of the occurrence of loop pattern and whorl pattern on the toes and fingers on the left side of the 45 male study participants.

The papillary ridge patterns of the hand-foot pairs of the same side are the subject of study, because the papillary ridge patterns identified at the scene occur as individual prints, and less frequently, as the complete prints of all five fingers and toes. The pattern overlap between the big toe and thumb and the second toe and index finger is 60% and 28.8%, respectively, which indicates that this is not a random coincidence. The pattern overlap between the third toe and the middle finger is 4.4%, between the fourth toe and the ring finger 22.2%, and the fifth toe and the little finger 6.6%, which can be considered a random coincidence.

The frequency of whorl ridge pattern on the toes and fingers of the left hand-foot pair can be regarded as a coincidence, since the subjects had whorl ridge pattern on the big toe-thumb in four cases, on the second toe and index finger in one case, on the third toe-middle finger and on the fourth toe-finger in two cases.

Table 5 shows the incidence of loop ridge pattern and whorl ridge pattern on the right hand-foot pair of 45 men. The overlap between the ridge patterns on the big toe and the thumb and the second toe and the index finger is 53.3% and 28.8% respectively, which is significantly higher than it would be if it were a random coincidence. The pattern overlap between the third toe and the middle finger is 4.4% (i.e. the same as for the left hand-foot), the overlap between the fourth toe and the ring finger is 26.6%, the overlap between the fifth toe and the little finger is 15.5%, which may be a coincidence.

*Table 5.* Matching loop and ridge patterns on the toes and fingers on the right side of 45 male study participants

		1 finger	toe	2 finger	toe	3 finger	toe	4 finger	toe	5 finger	toe
Quant.	Limb	loop	whorl	loop	whorl	loop	whorl	loop	whorl	loop	whorl
45	r.foot	24	5	13	2	2	7	12	4	7	
	r.hand	24	5	13	2	2	7	12	4	7	

Hence, looking at the left and right hand-foot indicators for toes-fingers with loop ridge pattern, it can be argued that for the big toe-thumb and the second toe-index finger, the overlapping values for both and feet pairs are significantly higher than they would be in the case of a mere coincidence. For the other toes and fingers on both hand-foot pairs, the overlap is not frequent enough to be statistically significant. The overlap between papillary ridge patterns on the second toe and index finger and the third toe and middle finger on hand and foot pairs is rather significant, respectively 28.8% and 4.4% for the study participants.

The frequency of whorl ridge patterns on the toes and fingers of the right hand-foot pair can be considered a random coincidence, as the subjects showed a whorl ridge pattern on the big toe-thumb pair in five cases, on the second toe and index finger in two cases, on the third toe-medium finger in seven cases and on the fourth toe-finger in four cases.

As with women, male participants were also divided into four categories based on the number of papillary lines. The papillary lines on the toes and fingers from the delta to the center papillary ridge patterns were counted and grouped according to their values.

The toeprints and fingerprints of the 45 male study participants were checked for loop ridge patterns, and corresponding lines were counted. Lines 1–6 were detected on 29 toes and 9 fingers of the left hand-foot pair; lines 7–15 on 63 toes and 45 fingers; lines 16–20 on 20 toes and 41 fingers; and lines 21–30 on 10 toes and 22 fingers.

The study of the fingers showed (see Table 6) that the male study participants had less frequently 1 to 6 lines from the delta to the center; most frequently 7 to 15 and 16 to 20 lines; and 21 to 30 lines appeared half as many times as the previous two.

The overlap occurred in two cases for the corresponding toe-finger skin papillae of the left hand-foot pair and four cases for the corresponding toes-fingers on the right hand-foot pair. In seven cases, there was an overlap on the big

**Table 6.** The number of lines of loop ridge patterns measured from delta to center on the toes and fingers of both left and right hand-foot pairs of male study participants

Limb	Number of lines	Loop ridge pattern									
		1 finger	toe	2 finger	toe	3 finger	toe	4 finger	toe	5 finger	toe
l.foot l.hand	1 6		5	3	5			1	3		2
	7 15	9	15	9	7	2	2	2	6	1	1
	16 20	12	6	2	1		1	6		2	
	21 30	6	3	1	1			1			
r.foot r.hand	1 6		2	2	3	1		1	6	1	3
	7 15	5	13	10	9	1	1	3	5	3	4
	16 20	8	6	2	1		1	6	2	3	
	21 30	10	3	1	2			3	1		

toe and the thumb on the left side. From the delta to the center, the concordance of the papillary ridge pattern lines ranged from 7 to 19. Four pattern matches were found between the second toe and index finger of the left hand-foot pair.

On the right hand-foot pair, two matches were found on the big toe and thumb, the second toe and index finger, and the fourth toe and ring finger. In one case, a match was found between the fifth toe and little finger. Of these, one male participant had an equal number of lines (13) from the delta to the center on the toes and fingers of each hand-foot pair.

Compared to the loop ridge pattern, whorl ridges were a lot less frequent on both feet and hands of the male study participants and no pattern overlaps were found between the left and right deltas measured to the center.

### How study results relate to dactyloscopic expertise

As can be seen above, the papillary ridges of the skin on the fingers and toes can have matching patterns on the foot and hand of the same side. Overlap may occur in terms of both the overall characteristics of the papillary ridge patterns as well as the number of lines from the delta to the center.

Based on the literature, we know that the subject of a dactyloscopic examination is to establish factual information relating to a criminal event by examining the papillary ridge patterns of the hands and feet. The main characteristics of papillary ridge patterns, which allow them to be used for

identification purposes, are their individuality and relative invariability<sup>6</sup>. Individuality is reflected in the papillary ridge patterns of both fingers and toes, and consequently, it cannot be excluded that a papillary ridge pattern fragment deposited at the scene may have been left with the toe but officially recorded as a fingerprint fragment.

In a fully formed fingerprint, a combination of elements can theoretically repeat once per 1040–1050 fingerprints. This allows for the identification of an individual using only 7–10% of the papillary surface area of the distal phalange<sup>7</sup>.

Dactyloscopic examinations pay attention to the system of general and specific features of distal phalanges (also toe), which are applied in forensic identification and diagnostics.

Dactyloscopic features of the papillary ridge pattern system include<sup>8</sup>: type of papillary ridge pattern; type (specific subtype) of papillary ridge pattern; directions of the ascent of papillary ridges; internal structure of the different parts (elements) of the papillary ridge pattern; uniform level of the different ascents of the papillary ridge pattern; shape and size of the papillary ridge; degree of expression of the papillary ridges; width of the papillary ridges forming the fold and their spacing; detailed structure of the papillary lines and folds; differences in the location of the pores.

When carrying out the expert analysis, the expert must take the above into account when examining the material submitted, as a similar system of dactyloscopic features is present in both fingers and toes.

In the case of dactyloscopic examinations of fingers and toes, the traces may arrive for examination on a dactyloscopic film, in the form of artifacts, depressions (rarely), or photographs. Prints on a dactyloscopic film are usually formed by sweat, less frequently by blood or dye. If the fragment of the papillary ridge pattern deposited at the scene has not been correctly recorded in the crime scene report (place where it was recorded, dimensions, method used to make the trace), it cannot rule out the possibility that the expert will compare the prints on the dactyloscopic card of a victim or a suspect with the fragment of a toe print deposited at the scene. We must also take into account

<sup>6</sup> Аверьянова, Т. В., Статкус, В. Ф. (2011). *Практическое руководство по производству судебных экспертиз для экспертов и специалистов*. 475.

<sup>7</sup> Аверьянова, Т. В., Статкус, В. Ф. (2011). *Практическое руководство по производству судебных экспертиз для экспертов и специалистов*. 475.

<sup>8</sup> Аверьянова, Т. В., Статкус, В. Ф. (2011). *Практическое руководство по производству судебных экспертиз для экспертов и специалистов*. 478.

the fact that the number of papillary lines in the bordering ridge folds remains unchanged under any deformation.

Practical experience has shown that dactyloscopic expertise can also be used to resolve non-standard questions that are necessary to establish the various specific circumstances of a criminal case. Such circumstances often include: establishing the fact of tampering with the fingerprints or handprints of a person who is checked; identifying the person who left the fingerprints at the scene of the crime (criminalist, party to the proceedings who participated in the observation), checking the fragments of the fingerprint on the surface of the object taken into the custody against the person who packaged the object; identifying a person against contaminated fingerprints, etc.<sup>9</sup>

Traditionally, the forensic expert is asked by the investigator to carry out a dactyloscopic examination, focusing on the following topics – the suitability of the trace for identification, comparison with the victim, a specific suspect, or, in the absence of a suspect, a check against a database.

Less frequently, rather not at all, the expert is asked questions relating to the time of the impression, the mechanism of formation, what was used to leave the fragment on the surface: finger, palm, or toe?

Therefore, it cannot be ruled out that the material submitted for the expert's opinion does not allow the expert to provide answers to the questions posed, because, as shown in the study, there are significant coincidences in the loop ridge pattern of the fingers and toes of the same hand and foot in both women and men.

However, the division of tasks between the investigator and the forensic scientist, and the expert is sometimes difficult. The problem arises in defining these tasks when it comes to detecting traces of the crime, where specialized expertise is required.

It must be taken into account that an expert will apply non-legal expertise in their research and scientific conclusions when executing their professional tasks. At the same time, it must be recognized that the expert needs to be familiar with their procedural rights and obligations under the provisions of the Code of Criminal Procedure, the procedural rules for conducting forensic examination, and how to draft an expert report or a report on the impossibility of conducting an expert examination. If the expert does not have a legal education or has not acquired specific legal knowledge through professional

<sup>9</sup> Аверьянова, Т. В., Статкус, В. Ф. (2011). *Практическое руководство по производству судебных экспертиз для экспертов и специалистов*. 496.

training, general legal knowledge acquired through self-study is used. The lack or scarcity of specific legal expertise will certainly reduce the effectiveness of the expertise<sup>10</sup>.

In carrying out the expert examination, the expert relies on their specialized knowledge, their own judgment, and the materials provided, to give an expert opinion. Under § 107(3) of the Criminal Procedure Code, the main part of the expert report shall contain a description of the examinations; evaluation results data, and the justification for the expert opinion<sup>11</sup>.

### Instead of conclusions

This article intended to show the relationship between the loop and the whorl ridge pattern and the papillary ridge pattern on the toes and fingers of the hand and foot on the same side. A study was conducted to identify if there was a significant correlation between the papillary ridge patterns of the fingers and toes. Of the 100 subjects in the study, 66 (21 women and 45 men) had the same loop or whorl ridge pattern on the toes of the hand and foot. After this, the authors examined the study results thoroughly and considered their value for the field of dactyloscopic examination.

The study found that women had a statistically significant overlap in loop ridge patterns of the left and right hand-foot pairs in big toe-thumb, second toe-index finger, left hand-foot third toe-middle finger, and fourth toe-ring finger combinations.

The occurrence of a whorl ridge pattern on the toes and fingers of the left hand-foot can be considered a coincidence since the subjects showed a whorl ridge pattern with a papillary ridge pattern on the second toe and the index finger in one case and on the third toe and the middle finger in three cases.

As in the case of the left hand-foot, the occurrence of the whorl ridge pattern on the toes and fingers of the right hand-foot must be considered a random coincidence, since the study participants were found to have a whorl ridge pattern on the big toe and thumb in one case, on the second toe-index finger, on the third toe-middle finger in two cases and on the fourth toe and ring finger in one case.

On the corresponding toes and fingers of both hands and feet, the highest number of papillary ridge lines from the delta to the center of the pattern was in the range 7–15; range 16–20 was less common; range 1–6 was rare and range

<sup>10</sup> Lindmäe, H. Kohtuekspeertiis. Tallinn Eesti Raamat, 1982, 12.

<sup>11</sup> Code of Criminal Procedure : <https://www.riigiteataja.ee/akt/106012016019?leiaKehtiv>

21–30 very rare.

Thus, it is hypothetically possible that the loop ridge patterned papillary ridge fragment deposited at the scene may have been left not by a finger but a toe.

The present study sheds light on an interesting observation about the potential matches between the papillary ridge pattern in the fingers and toes of the same hand. Consequently, the author concludes that the fragments of the papillary ridge pattern trace collected and deposited at the scene may not always have been left on the surface by hand contact. Since the papillary ridge patterns (on the hands and feet) are individual and relatively unchanging, i.e. permanent, they can be used for identification purposes.

The papillary ridge pattern on the distal phalanges of the toes, is classified in the same way as on the fingers, but the whorl ridge pattern occurs less frequently than the loop ridge pattern; and the loop ridge pattern occurs less frequently than the arch ridge pattern.

In males, there were two cases of matching patterns in the same toe-finger papillary lines of the left hand-foot and four cases of matching patterns in the right hand-foot pair. In seven cases there was a matching pattern found on the big toe of the left foot and the thumb of the corresponding hand. From the delta to the center, the overlap of the papillary ridge pattern lines ranged from 7 to 19. Four pattern matches were found on the second toe and index finger of the left hand-foot pair.

On the toes and fingers of the right hand-foot pair, two matches were found between the big toe and thumb, the second toe and index finger, and the fourth toe and ring finger. In one case, there was a match on the fifth toe and the little finger. Of these, one man had an equal number of lines (13) from the delta to the centrum on the toes and fingers of both feet.

The whorl ridge pattern was found in both hands and feet on male participants at a significantly lower rate compared to the loop ridge pattern, and no pattern matches were found between the left and right delta to the center.

A study of the fingers of male participants showed that their fingers had: rarely 1–6 lines delta to centrum; most often 7–15 and 16–20 lines; and 21–30 lines occurred half as often as the two previously listed ranges.

To summarise, the highest number of pattern matches for toes and fingers for women and men were found for the big toe and thumb of the left (57.1% for women and 60% and 28.8% for men) and right hand-foot pair (47.6% for women and 53.3% for men for the big toe and thumb and 28.8% for the second toe and index finger). For the other toes and fingers, the overlap was

significantly lower.

Comparing the results of I. I. Prorokov's study (10,000 fingerprints) with those of the author (660 fingerprints), it can be said that despite the difference in the number of participants, the results are similar. The frequency of papillary lines, counting from the delta to the center-1 to 6 rarely; 7 to 16 most common, 16 to 20 less frequent than 7-16, and 21 to 30, least often (rarely).

The author's hypothetical approach of a significant correlation between the papillary ridge pattern on the fingers and toes of the same hand and foot pair does not imply that the decisive and bearing moment of the presence of specific features on the papillary ridge pattern is neglected in the expertise. The presence of a significant link in the overall characteristics does not entitle the expert to assess whether or not a fragment or trace submitted for examination was left by a particular person. On the one hand, the expert must be able to determine and have an understanding of whether the material submitted for examination is a finger or toe print.

On the other hand, looking at the results of the examination in terms of the general characteristics of both toes and fingers, as well as the number of papillary lines from the delta to the center, the possibility of a misleading expert question from the examiner as to the validity of the identification of the fingerprint (fragment), its verifiability in regards to a specific person, cannot be ruled out. Such a situation can lead to a situation where an expert, based on the material submitted for examination, gives their opinion on the validity of the submitted trace fragment, but cannot find a match in the database and cannot identify a match with a specific person. This, in turn, leads to a situation where the investigator has no doubts about the validity of the opinion or the competence of the expert, but the investigator may miss important information about the nature of the actual trace.

Quite the opposite is the case when the investigator doubts the validity of the expert's opinion: the expert's opinion contradicts other evidence and the investigator is unable to determine whether the expert's opinion is correct or whether other evidence accurately reflects the situation.

Thus, the persons who must apply their specialized knowledge in a pre-trial investigation are the investigator, the criminalist, and the expert. It would be wrong to think that a person can have specific skills but at the same time lack specialized knowledge. There can be no specialized skills without specialized knowledge. Since knowledge and skills are interlinked, and skills cannot be applied in isolation from knowledge, it is inconceivable that only specific skills



or only specific knowledge can be applied in criminal proceedings<sup>12</sup>.

## PIRŠTŲ IR PĖDŲ ODOS PAPILIARINIŲ LINIJŲ RAŠTŲ CHARAKTERISTIKOS DAKTILOKOPIJOS TYRIMO KONTEKSTE

Annika Lall

### Santrauka

Materialiam pasauliui būdingas reiškinių tarpusavio ryšys ir sąlygiškumas. Kiekvienas nusikaltimas paveikia įvairius išorinio pasaulio objektus ir sukelia pokyčius aplinkoje. Kriminalistikoje visos šios materialinės įtakos ir pokyčiai vadinami „nusikaltimo pėdsakais“. Kadangi nusikaltimų pėdsakai nėra vienarūšiai, jie tiriama keliomis kriminalistikos technikos šakomis. Svarbi pėdsakų tyrimo dalis priklauso trasologijos sričiai. Trasologijos šaka, tirianti papiliarinio rašto struktūrą ir savybes bei jos pėdsakų panaudojimą įrodymams, vadinama daktiloskopija. Apžiūrėdami objektą ar nusikaltimo vietą, tyrėjai dažnai aptinka pirštų, kartais delno, o rečiau basų pėdų atspaudus, kuriuose matomi papiliariniai odos raštai. Autorius kelia hipotezę, kad tos pačios pusės plaštakos ir pėdos porų atitinkamų pirštų pėdos papiliarinis raštas turi statistiškai reikšmingų panašumų.

Jei aptinkami sutampantys raštai, bus skaičiuojamas papiliarinių linijų skaičius nuo delta iki to paties tipo papiliarinių raštų centro. Šis procesas apima bendrųjų savybių, kurios yra pėdsakų tikrinimo proceso dalis nustatant asmenį, tyrimą. Bendrieji bruožai apibūdina tiek išorinius, tiek vidinius keteros modelio ypatumus. Pėdsako centre esančios linijos nurodo klasifikacijos tipą, rūšį arba specialią kategoriją, kuriai priklauso pėdsakas. Šios žinios svarbios tiek nusikaltimo vietos tyrėjams, dirbantiems nusikaltimo vietoje, tiek šios srities ekspertams, atliekantiems teismo ekspertizes.

**Raktiniai žodžiai:** įvykio vieta, papiliariniai raštai, pirštai-kojos, ekspertinis vertinimas, ekspertinis trimas.

<sup>12</sup> Lindmäe, H. (1982). *Kohtuekspertiis*. 9.