Article

Determining the Identity of Corpses Using Fingerprints: Results from Practice and Analysis of Process Used in the Republic of Serbia

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ABSTRACT: In today's world, when there is a constant fight against organized crime and terrorism, when we have cases of mass accidents (plane crashes, train crashes, buses, etc.), the constant need for precise and quick identification of persons is evident in these cases. When we have situations with a large number of dead in various conditions, as well as complete or only parts of the body being on the spot, there is a need to use scientific and forensic methods in order to find out the reliable identity of these people. Furthermore, there is a need, in some cases, to identify persons who committed suicide, were killed, or died a natural death (accidental death) and who do not have documents according to which their identity can be determined. The aim of this paper will, however, be to identify a group of persons who need to be identified, known as unidentified corpses. Method. Describe and discuss the way of determining identity based on dactyloscopic data, which provides accurate and unambiguous identification, using fingerprints. Results. The identity was determined in 1271 cases of unidentified corpses by dactyloscopic comparison of fingerprints with a database containing fingerprints of about 8,000,000 indisputably identified persons. It was confirmed in 1139 cases. Conclusion. The high degree of identification in our research, as much as 89.6%, makes this method rightly represented as a standard method for confirming a person's identity.

1. Introduction

From the perspective of the fight against organized crime, terrorism, and cases of mass accidents, the need for precise and quick identification of persons is evident. When there are situations with a large number of dead people in different states where it might be possible to find complete or only parts of the body, there is a need to use scientific and forensic methods to reliably identify those persons. Furthermore, in certain cases, there is a need to establish the identity of persons who committed suicide, killed, or had accidental death and do not have documents according to which their identity can be determined. The aim of this work, however, will be focused on the identification of unidentified corpses using dactyloscopic data.

The easiest way to determine an identity is with identification documents that every person, who is required by law to have an identity card is obliged to carry on, in the Republic of Serbia, as through acquisition in the process of issuing identity documents beside demographic date, mugshot and dactiloscopic data is taken [1]. It is also possible to recognize the deceased if a person who knew him occasionally may be there and might indicate a dead person's identity. However, what happens when the identity of the deceased cannot be established in this way? By the legal framework and procedures defined in them, a medical doctor who performs autopsy, in order to determine the time and cause of death, is obliged to inform the Ministry of Interior, without delay, if he is unable to establish the identity of the dead person [2].

Also, information about the possible identity of the dead person might come from people who recognized him through the media, social networks, and a published photo robot which can help to determine the identity of the deceased. But what if that doesn't happen? The identity of the dead person may be completely unknown when there are no indications of who could be [3]. It is also possible that a person has identification documents with him, but those documents are from another

person, or they are forged. Such situations lead to the fact that other methods must be implemented by which it is possible to find out and/or confirm the identity according to the Art. 77 of Law on Police [4].

There are several ways to determine the identity of a dead person. Today we have many scientific i.e. medical and forensic methods, which might relatively quickly access the relevant data and determine the identity of the person [5–7]. A dead person whose identity cannot be determined, from a forensics aspect and terminology is called an unidentified corpse, or in short, a corpse. The problem is that in some situations, due to the condition of the corpse (decay, consequences of drowning, consequences of accidents) [7,8], occasionally it can be hard to do. Unlike a living person, who can provide all the necessary information about himself, of course, there is a situation when a person does not want to nor cannot, "dead mouth don't speak". Therefore, it is necessary to apply forensic biometric identification, which can be one of the following methods: dactyloscopy, DNA, autopsy, odontology, etc. [8–12]. Determination of the identity of deceased individuals using fingerprint examination still is one of the most challenging tasks. Various methods and techniques may be used to facilitate the successful recording and preservation of postmortem friction ridge detail. The main aim of our study is to test the efficiency of the use of dactyloscopic data for unknown dead person identification and confirm its significance, as we have dactyloscopic data for adult persons to whom personal identification cards are issued in the Republic of Serbia.

2. Materials and Methods

This article elaborates successful corpses identification according dactyloscopic data according data collected over 8 years (2012–2020) using Automated Fingerprint Identification System (AFIS) in the process of issuing identification documents. During this period, some kind of identification of a dead person was needed in 40,085 cases. The sample used consists of 1271 cases of unidentified persons for whom dactyloscopic data comparison was used as a forensic method. Various types of equipment, inks, scanning devices, and techniques are used to record friction ridge detail, to compare against previous records, or for input into automated fingerprint identification systems (AFIS). Comparison of death person fingerprints was compared with a database containing fingerprints of about 8,000,000 indisputably identified persons. These fingerprints were taken in a controlled environment from the persons who applied for issuing identity cards or with parents' consent for the minors or two witnesses who confirmed identity if a person didn't have ID. The comparison was performed using the Automated Fingerprint Identification System (AFIS) currently in production in the Ministry of Interior, Republic of Serbia. For statistical analysis frequencies and percentages, according number of cases in the referent sample were used, regarding successful identification. Chi-square is used as a statistical test to examine the differences between frequencies, with 0.05 used as the level of significance.

3. Fingerprint for Identification Purposes

The procedure for identifying a dead person using fingerprints is the same as for identifying a living person [13,14]. The two basic factors of fingerprints that are used are individually unique and permanent. The difference is that corpses' fingerprints are taken with ink on a fingerprint card, so you should pay attention to the quality of the image of the fingerprints [15–17]. Person recognition by comparison of fingerprint samples with other, already known prints (picture with picture), is not recommended because it often does not give an accurate result. The reasons for the appearance of errors are interference during fingerprinting, scratches, and other damage to the skin in the part from which the fingerprint is taken, then different positions of the finger, as well as deformation of the fingerprint during fingerprinting [18] (Figure 1). The way to recognize and compare fingerprints is to extract details, so-called characteristic points (minutiae) from the image of the fingerprint, using AFIS. In specific circumstances might be difficult to determine minutiae as the points where the lines of the imprint branch or end (begin). AFIS systems, using algorithms for digitizing the fingerprint image, regardless of the damage and deformation caused during the acquisition, can extract the all available minutiae to identify a person. Fingerprint recognition means comparing the set of characteristic points of the taken fingerprint with the sets of characteristic points of already known fingerprints contained in the database. A fingerprint taken in a controlled environment might contain up to 100 minutiae, while the part of the fingerprint collected by the scanner has between 20 and 30 minutiae [19].
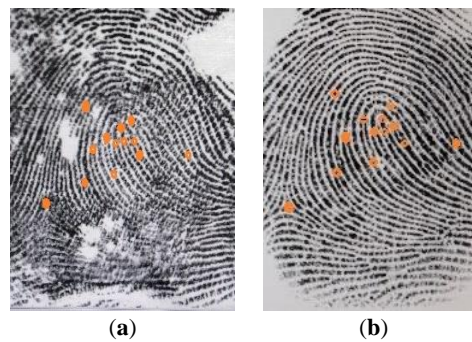
(**a**)	(**b**)

Figure 1. Example of verified identity, (**a**) Deformed fingerprint of unidentified corpse, (**b**) Fingerprint from the database.

3.1. Determining the Identity of Persons and Corpses

The identification of persons and unidentified corpses is regulated by the Art. 77, Law on Police determining the identity of persons, means: "Determining the identity of a person is implemented toward a person who does not have an issued document or when the authenticity of such a document is doubtful if persons' identity cannot be verified in any other way, or by of a special request of the competent authority" [4]. Identity is determined by using forensic records data, applying methods, and using criminal tactics and forensics, medical, or other appropriate expertise [4].

After establishing the identity, a report is made and forwarded to the claimant for identification, by the law, while the police authorities of other countries with which ratified agreements have established international police cooperation are provided with direct information about the person, at their request, by regulations. Regulations governing the processing of personal data on a national level include the Law on records and data processing in the field of internal affairs, Art. 11 [20], the Law on Personal Data Protection, Art. 21 [21], and the Law on Police, Art. 21 [4].

In order to determine the identity of a person, according to the law [4], the police are authorized to publish a drawing, recording or description of the face of the photo-robot. Also, when there is a possibility, and the identity cannot be determined in any other way, the police is authorized to publish a photo of a person who cannot provide information about himself, such as for an unknown corpse. which is in accordance with the procedures that regulate the collection and storage of biometric data in databases [20] as well as the way in which they can be used to identify persons and unknown corpses.

The necessary procedures needed to be followed to identify a person using dactyloscopy methods defined in the Rulebook on criminal-forensic registration [22], implies collecting data, criminal-forensic expertise, and analysis:

1. Acquisition of a person's fingerprint – take fingerprints on a fingerprint card, more prints might be taken, but one is enough if the fingerprint image is of good quality.
2. Check the fingerprints of the deceased with fingerprints from the database of civilians (created during the issuance of identification documents), the so-called 1:1 comparison–verification. This method is used if there is some knowledge of who that person might be. According to legislation (LoP, Art 77) [4], in cases when a person cannot be identified in any other way, the identity might be determined by using data from forensic records, including dactyloscopy data.
3. If there are no indications of the person's identity, a 1: n comparison – identification or search of the fingerprint image in the civilian database is performed. If a person with identical fingerprints is found, the identity is determined, unless a further search and the next step need to be taken.
4. Search through the registered offender's database and the database of asylum seekers might be the next step. There is a possibility for further investigation checking through these databases that contain fingerprints of registered persons who are also foreign citizens, and there is a possibility to identify the corpse in that way.
5. If the person is not in the mentioned databases, there is a possibility to send a request for identification of the person through Interpol or other international organizations, forwarding them taken fingerprints.

All identification methods used for the identification of living persons, such as description, recognition, photography, dactyloscopy, etc., are generally also applicable in the identification of deceased persons, but, as emphasized earlier, this paper considers the identification of persons on the basis of dactyloscopy data (Figures 2).

Identification of the deceased may be difficult if there are advanced postmortem changes or injuries that have destroyed characteristic features of the body, including papillary fingerprint lines (and not just fingers). This is especially emphasized in decay, saponification, charring, dismemberment, and destruction of the body [23] (Figure 3).

According to the legislation [4], except in cases when it is possible to identify a person by personal data from documents or a person who recognizes the deceased happened to be there, it is generally considered that the most reliable ways to identify the deceased are by dactyloscopy and DNA analysis.

When it comes to these two forensic methods, dactyloscopy has an advantage, due to the existence of civil, as well as registered offenders' databases which contain fingerprint images and facial photographs together with personal data (last known address, Unique Personal Identification Number, etc.). Of course, the possibility of identification using these methods is conditioned by the existence of data for comparison as well as the state of the decay of the corpse that needs to be identified. In 2004, the Republic of Serbia established a database of dactyloscopic data of perpetrators of criminal acts, and in 2006 the production of biometric identification documents began, during which the acquisition of images of left and right index fingerprints and photographs of persons was created, thus creating appropriate databases and authentication enabled (Figures 4) [20].
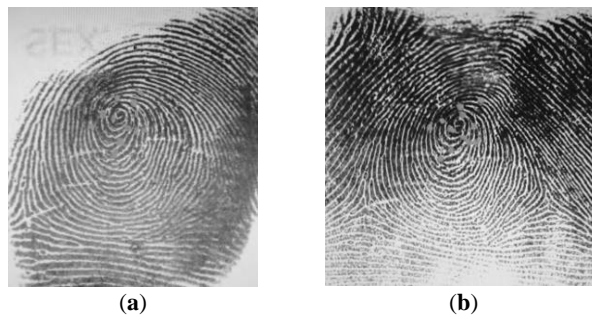

(**a**)　　　　　　　　　　(**b**)

Figure 2. Example of fingerprint verification - good quality, (**a**) Fingerprint of unidentified corpse, (**b**) Fingerprint from the database.
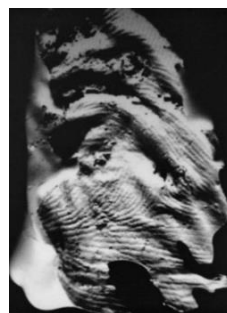

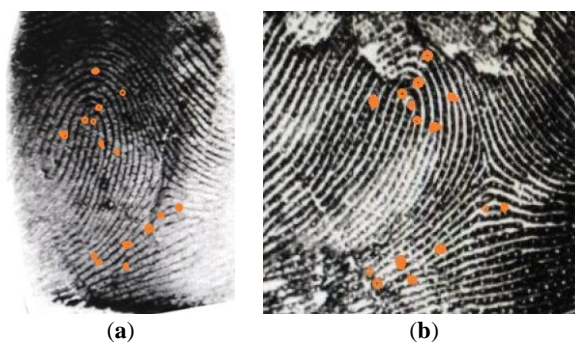**Figure 3.** Example of fingerprint of deformed index finger of unidentified corpse (drowned).

(**a**)　　　　　　　　　　(**b**)

Figure 4. Result of acquisition of fingerprint images example, (**a**) Fingerprintprint of unidentified corpse; (**b**) Fingerprint from the database.

4. Results

In the Republic of Serbia, in a period of 8 years (2012–2020), there were a total of 40,085 dead people who needed some kind of identification. Of these, 35,110 (87.6%) were found dead, 3,378 (8.4%) committed suicide, 27 (0.7%) murders and suicides, 415 (1%) aggravated murders, and 1155 (2.9%) murders (Figure 5). Using dactyloscopic methods, at the request of courts, prosecutors' offices, and the police, 1,271 identities of persons were established, which is 3.2% of the total number of all deceased persons. A significant number of persons were confirmed ($p < 0.001$, Chi-square test), meaning the identity of 1139 (89.6%) persons were confirmed, of which 19 (1.7%) were foreign citizens. The other 132 (10.4%) persons are still waiting for confirmation of their identity (Figure 6) because their fingerprints are not registered in the existing databases, it might be foreign citizens who are not registered offenders in the Republic of Serbia or citizens who do not have biometric documents.
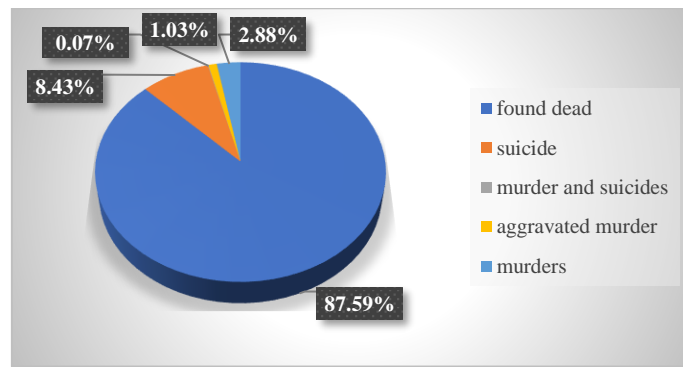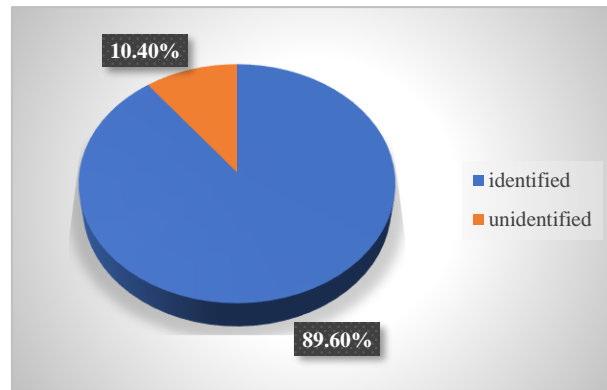
Figure 5. Distribution by the cause of death.

Figure 6. Identified using dactyloscopic methods.

5. Discussion

A thorough search of the literature did not find much information regarding the identification of the unidentified dead person [24] using dactyloscopic data for biometric identification. The application of AFIS is directed to provide unambiguous biometric identification of citizens, to establish and/or confirm the identity of citizens using fingerprints, providing preconditions for the production of reliable identification documents and thus preventing identity theft and preventing multiple identities for the same person [25]. Our approach was to combine fingerprint data collected from dead persons with the fingerprint identification system used in official records in the fingerprint database within the Ministry of Interior. In a study conducted by Sakthimani and Peranantham, fingerprints were taken in 40% of cases of 152 unidentified dead persons registered in one year [24] confirming the importance of dactyloscopic data for person identification. Furthermore, fingerprint identification of murder cases is generally used, especially if the identity of the victim of a murder case is unknown. The fingerprint identification process might be carried out to identify the victim's identity to inform his family and to proceed to the next legal process [26]. In our study was shown that a significant number of unidentified dead persons might be identified using dactyloscopic data.

6. Conclusions

Every death of any man brings with it loss and sorrow for those who knew him and lived with him. Determining the identity of the deceased allows access to his family members and notification of the death of a neighbor. Identification is the first and most important step in finding a dead person. Fingerprint identification and the search of appropriate databases is one of the most reliable methods in the identification of persons and unidentified corpses, which was confirmed by the analysis of the presented sample. Fingerprints are permanent, unique, and unchangeable and as such provide the possibility of unambiguous identification. We should also take into account the speed of identification as well as the cost of the identification process itself, which is also an advantage on the side of fingerprint identification. The fact is that the percentage of identification of deceased persons by fingerprints is 89.6% due to the analysed data, but 10.4% is still unsolved. The disadvantage of these methods, for example concerning identification using DNA, is the possible deterioration and deformation of the corpse, which causes the impossibility of collecting dactyloscopic data, while the great advantage is the existence of databases with which it is possible to compare images of fingerprints and obtain data about the face whose identity we determine.

Author Contributions

For research articles with several authors, a short paragraph specifying their individual contributions must be provided. The following statements should be used "Conceptualization, N.P., S.S. and R.R.; Methodology, S.S., N.P. and R.R.; Software, N.P. and M.P.; Validation, S.S., R.R. and M.S.; Formal Analysis, N.P. and S.S; Investigation, S.S., N.P. and R.R.; Resources, N.P.; Data Curation, N.P.; Writing – Original Draft Preparation, Writing – S.S., N.P., R.R., M.S. and M.P.

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Informed Consent Statement

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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