Establishing Identity

6

Case Study

During the summer months, a group of youths noticed a sleeping bag that had apparently become caught in a hedgerow within the designated flood-risk area of a river. After opening the zip of the sleeping bag a few centimeters, they saw a human skull and other bones. The police were informed.

The sleeping bag was found to contain items of clothing and a whole human skeleton. In addition, valid identity and health insurance cards were also recovered. Both documents were issued to a 67-year-old man known to the homeless community. Following osteological analysis carried out as part of a forensic autopsy ordered by the court, it was concluded that the remains were those of a male of advanced years. A skull–photo comparison between the skull found at the scene and the photo on the identity card was not able to either conclusively establish or exclude the victim's identity. However, it should be noted here that the identity photo was very low resolution and the face was covered to a great extent by a beard.

Some weeks later, the police received information from the homeless community that the missing 67-year-old man had "reappeared." The police were able to ascertain the man's whereabouts and interview him. He recounted how the previous autumn he had lent his health insurance card together with his identity card to a "buddy" who had wished to see a doctor. He had not seen the buddy since that time.

Old biplanar head X-rays of the friend dating back 12 years were found. An X-ray of the recovered skull was made and compared with the 12-year-old anteroposterior image (comparative X-ray analysis): an alignment of the bony structures on both images could be seen. Good correspondence was seen between the frontal sinuses, structures subject to high individuality. Identity was subsequently established "with a probability bordering on certainty."

Identification in its wider sense refers to identifying an unknown person, for example, in a closed-circuit television video (CCTV), whereas identification in a narrower sense refers to establishing the identity of a deceased individual from their remains.

Identification is a two-step process:

- The first step involves gathering information about the unknown individual in order to investigate missing persons who could correspond to the unknown decedent.
- In a second step, antemortem data is compared with postmortem data.

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Results from these two steps enable *identity* to be either *excluded* or *established*. If identity is established, an indication of the *probability of identity* is additionally expected.

The following sections deal with the identification of deceased individuals primarily by means of external examination and autopsy but also by means of methods such as radiological investigations.

6.1 Visual Identification by Relatives

Identification by relatives or other individuals who knew the deceased is permissible by law in a number of countries. However, this can sometimes be challenging or barely possible due to the degree of decomposition of the body. There have been numerous cases whereby presumed relatives have been shown a badly decomposed body, were barely able to look at the body due to emotional stress, and confirmed its identity in response to preset expectations. As an alternative, many facilities prefer to use only photos of a body in order to reduce the emotional stress experienced by relatives.

Prior to visual identification, it is important to establish whether, given the condition of the body, this approach is viable. If the body is in a poor condition, the identifying person should be asked to name concrete distinguishing features that may help to identify the deceased.

6.2 Identification Using Personal Effects

Objects found with a body or human remains play an important role in the identification process. While their value as an indicator of identity is undisputed, relying on objects found with the deceased for the purposes of establishing identity can lead to serious errors. Even in the case of an identity card, the possibility of theft or—as illustrated in the case study above—loan during life should be taken into consideration.

Important: The greater the individual nature of an object found with a body, the more likely there is to be at least an association between the owner of the object and the deceased. However, this does not necessarily mean that the deceased is the owner of the object.

6.3 Body Modifications and the Results of Medical Treatment

Body modifications such as tattoos (Fig. 6.1) and piercings have become more common in recent years. At the same time, the increasing number of personal photos in the digital age means that good antemortem images are available for comparison purposes; these can be used for direct comparison with a body. Moreover, attempts can be made to photograph tattoos or piercing configurations on a body from angles and distances comparable to those on antemortem photos. Computer-assisted *superimposition techniques* can then be used to compare ante- with postmortem images (Fig. 6.2).

Aesthetic Surgery and Trauma Surgery. Breast augmentation is the most commonly seen

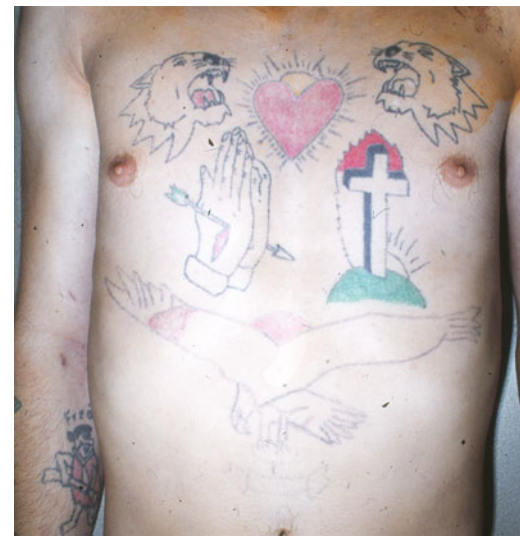

Fig. 6.1 Tattoos as body modification

Fig. 6.2 Superimposition of ante- and postmortem photos of a tattoo. (**a**) A highly distinctive tattoo on the extensor side of the lower right forearm could be seen on the badly decomposed body. (**b**) A family photo clearly showing a tattoo on the individual in question was available. The tattoo on the body was photographed at a similar angle and placed over the tattoo on the family photo using superimposition technology (shown here slightly transposed)

form of aesthetic surgery in women, usually involving the use of silicone implants. Many manufacturers give their implants serial numbers, making it possible to trace the date of implantation and the name of the patient from these numbers. Metal plates, medullary nails, or total endoprostheses used in orthopedic and trauma surgery may also carry a serial number (Fig. 6.3). Although the above constitute "mere objects," their fixed attachment to the body makes them highly reliable indicators of identity.

Implanted metal plates are not the only devices to assist in identification—the serial number of a pacemaker may be equally as helpful.

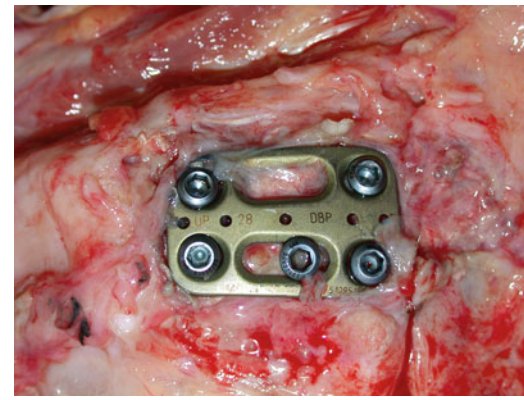

Fig. 6.3 Metal plate with a serial number, implanted during trauma surgery. It was possible to indentify the deceased conclusively with the aid of the serial number

Complex Identification. As discussed above, body modifications or surgical procedures can produce highly individual distinguishing characteristics or provide unique implant serial numbers that can be of great assistance in the identification process. On the other hand, antemortem material or information that might normally have been well suited to comparative investigation may be worthless. For instance, if lower leg X-rays of a missing person are available but the deceased lacks the limb in question as a result of amputation, for example, due to diabetes, comparative X-ray analysis for the purposes of establishing identity is no longer possible.

6.4 Forensic Odontostomatology

Teeth provide a considerable amount of information about a person. A specialized field of forensics known as "forensic odontostomatology" is concerned with forensically relevant information gained from dentition.

For the purposes of forensic identification, the dentition of the deceased to be identified is analyzed in terms of the presence or absence of teeth, particular dental alignment, and dental treatment (Fig. 6.4). Dental treatment to teeth that are present is specified, e.g., crown, filling, and bridge, and a record is made of which of the five surfaces of each tooth is affected. This postmortem dental record is documented using a purpose-made form (Fig. 6.5).

Fig. 6.4 Postmortem dental findings in a lower jaw. Complex dental treatment with partial prosthetic treatment (Image courtesy M.A. Verhoff, specimen courtesy of C. Grundmann, Duisburg)

A wide variety of dental formulas using many different coding systems for the individual teeth are currently in use internationally. Furthermore, in the past, different dental formulas were used at different times even within one country. Translating a foreign dental formula into one's own familiar formula can be challenging.

In Germany, a person's dental status is recorded on each visit to the dentist, such that current dental records are available for all regular dentist visits. Therefore, for the purposes of comparison, a treating dentist can compile or reconstruct the antemortem dental status of a missing person using dental records. Matches and variations are sought when comparing ante- and postmortem dental records. For example, if tooth 24 shows a filling post-mortem that is absent in the antemortem dental status, this is not considered an exclusion criterion since additional treatment by another dentist may have been performed. On the other hand, if tooth 24 is documented as having a filling ante-mortem but is found to be untreated post-mortem, this would exclude identity. However, possible errors should be borne in mind, in particular errors made during the compilation of antemortem dental records. Thus the above exclusion, for example, would carry all the more weight if teeth 23 and 25 were also untreated post-mortem, thereby ruling out the possibility of a simple "slipup" when the antemortem dental records were made.

Important: The greater the correspondence between ante- and postmortem dental records, the higher the likelihood that the records relate to the same person.

In contrast to forensic DNA analysis, there is no basis for calculating a probability of identity in forensic odontostomatology. Instead, an experienced dentist is required to estimate whether dental treatment is of a sporadic or of a more regular nature. In extreme cases, an isolated

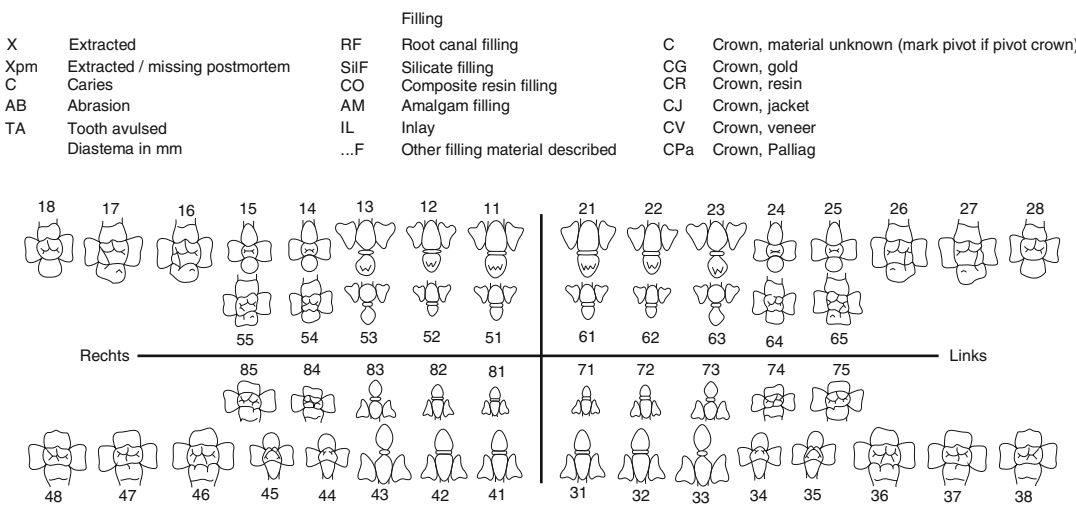

Fig. 6.5 A data entry form to record ante- or postmortem dental status. Using this form enables precise graphic documentation of dental status. The predefined abbreviations are used to record the various forms of dental treatment

instance of dental treatment recognized by the treating dentist can be sufficient to establish identity.

6.5 Comparative X-Ray Analysis

Given the large number of X-ray images produced on the basis of medical indications, the likelihood that antemortem X-rays of a missing person exist is relatively high. X-rays are then made of the body, using the same beam path as in antemortem images where possible. Any *correspondence in trabecular bone structure* or scar formation, etc., becomes apparent on direct comparison of ante- and postmortem X-rays. The *frontal and maxillary sinuses* show highly individual patterns on anteroposterior skull X-rays (Fig. 6.6)

As an accessory measure, ante- and postmortem X-rays can be compared using superimposition techniques: the two images are digitalized (if not already the case) and semitransparently superimposed using an appropriate image processing program. By shifting or scaling the images, a "match" is generally readily apparent.

In extreme cases, very small X-ray images, such as digital intraoral dental X-rays, are sufficient to establish identity (Fig. 6.7).

6.6 Skull–Photo Comparison

In cases where an intact skull—ideally including the lower jaw—is available, this can be used for comparison with portrait photos of a missing person. To this end, it is important to ensure that the skull is photographed at the same angle and from the same distance as the portrait photo. Additionally, spacers can be attached to defined points on the skull, which have been cut to correspond to soft tissue thickness at each individual point as previously investigated experimentally (Fig. 6.8). Using superimposition techniques, the portrait photo is superimposed over the skull and the size scaled (Fig. 6.9). For the purposes of identification, the facial proportions of the skull and photo need to correspond, and ideally the spacers should end at the facial borders shown on the portrait photo. Depending on how old the photo is, greater consideration may need to be given to possible age-related soft tissue variations or jaw atrophy due to tooth loss.

The most challenging aspect of skull–photo comparison is orienting the skull to match the angulation on the photo. Methods permitting superimposition already at the orientation stage are helpful here. This was first made possible by filming the portrait photo and the skull simultaneously

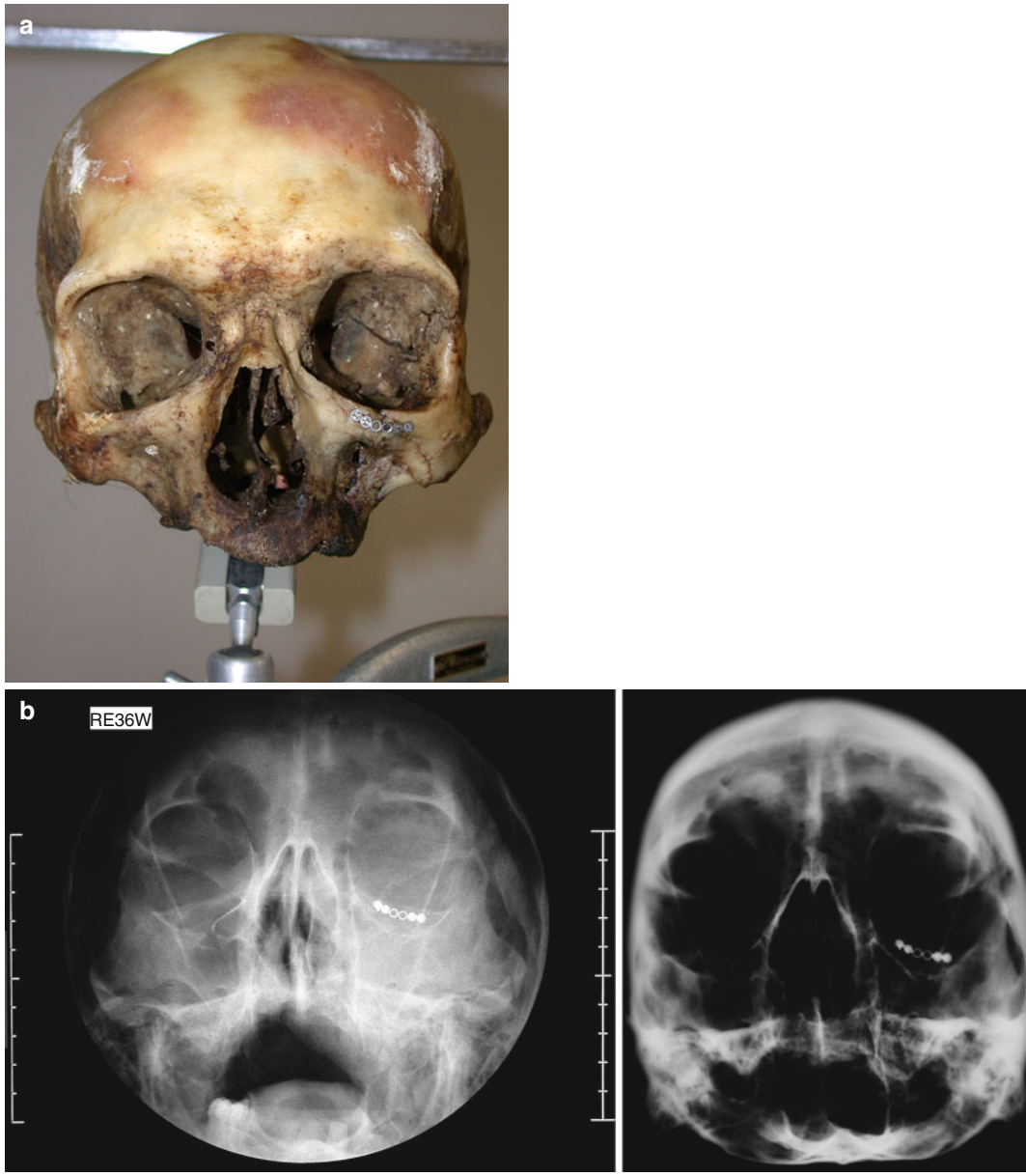

Fig. 6.6 Comparative X-ray analysis of a frontal skull X-ray. (**a**) A healed midfacial fracture that had been treated with a perforated plate could be seen on the skeletonized skull of this unknown deceased individual. The type of treatment suggested that it must have been performed at a center for maxillofacial surgery. Research was undertaken at the nearest center into a patient who had been treated with a plate of this kind 18 months previously. A postoperative follow-up X-ray was available (**b**, *left*). An X-ray of the skull using a comparable beam path was made (**b**, *right*). A highly individual correspondence could be seen, e.g., in the shape of the frontal sinus. Superimposition also produced a correspondence

with two different video cameras and relaying the videos to a video mixer for subsequent processing. This enabled the skull to be aligned in real time with the superimposed semitransparent portrait photo. Modern methods use the live-view function in digital cameras and a computer screen to display the video, onto which the digitalized portrait photo then can be mapped.

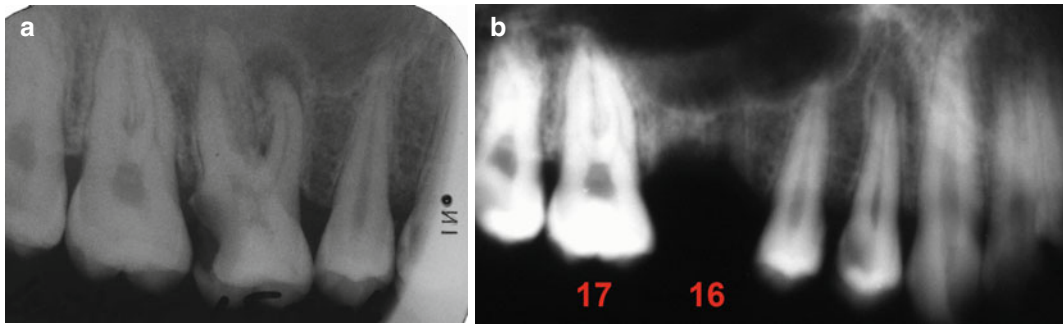

Fig. 6.7 Comparative X-ray analysis using a digital intraoral X-ray of teeth 15–18 (*top*), the only image available for a missing person. The indication for this X-ray is apparent: caries on tooth 16 and root canal infection. As a result, the tooth was extracted 3 months prior to death. The postmortem image (*bottom*) shows distinct correspondence between teeth 15, 17, and 18, as well as bony structures of the upper jaw. Tooth 15 has already moved somewhat distally towards the gap. Superimposition confirmed the correspondence

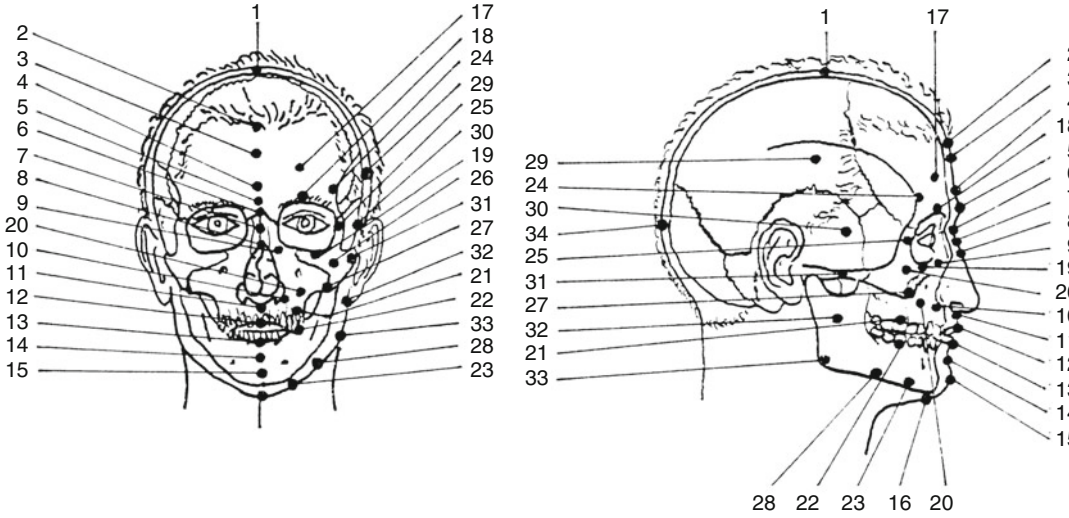

Fig. 6.8 Soft tissue landmarks on the skull. A total of 34 landmarks were defined on the skull and face in order to measure soft tissue thickness. In the case of skull–photo comparison or facial soft tissue reconstruction, these points on the skull are sought and marked with spacers that correspond to statistically investigated age-, gender-, and race-dependent average soft tissue thicknesses (landmarks) (From Helmer (1984))

6.7 Fingerprinting

Due to their high level of individuality, the analysis of fingerprints has been an established method of criminalistics for over 100 years (Fig. 6.10). Whereas early analysis depended on the direct comparison of fingerprints and their morphological description, digitalization opened up the way to the compilation of databases and automatic comparison.

Obtaining fingerprints is always indicated in the case of an unidentified decedent, the body's state of preservation permitting. Various techniques have been developed to obtain usable fingerprints from decomposed bodies: skin removal, "boiling," and electronic fingerprint scanning.

Fingerprints obtained from a body can be compared with national criminal investigation databases; however, a match will only be found if

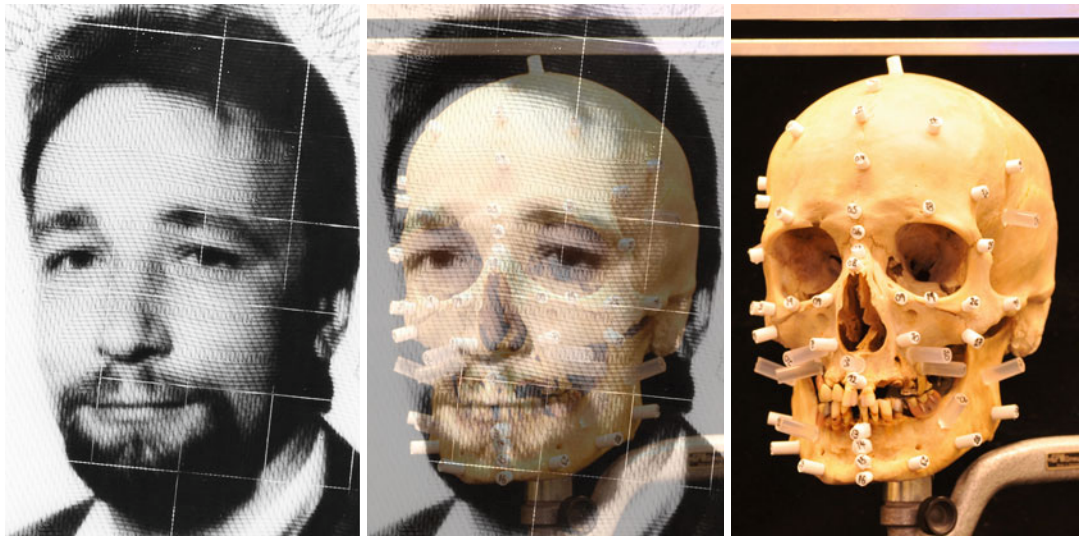

Fig. 6.9 Establishing identity by means of skull–photo comparison. An identity card photo taken more than 25 years prior to death was the only photographic material available for comparative purposes (*left*). The macerated skull was landmarked using spacers for central European men in the 50–59 years age group, placed at an identical angle to that on the portrait photo, and photographed (*right*). Similarities between the forehead, eye sockets, and nose were already apparent on morphological comparison. Once superimposed (*center*), the bony dimensions of the upper face and midface fit in the portrait photo. The boundaries set by the spacers in these areas line up with the skin surface. The spacers on the right lower jaw apparently protrude too far. However, taking the individual's dental status into consideration, one can assume that the lower jaw underwent significant modification in the 25–30 years prior to death; hence, this is not interpreted as an exclusion criterion

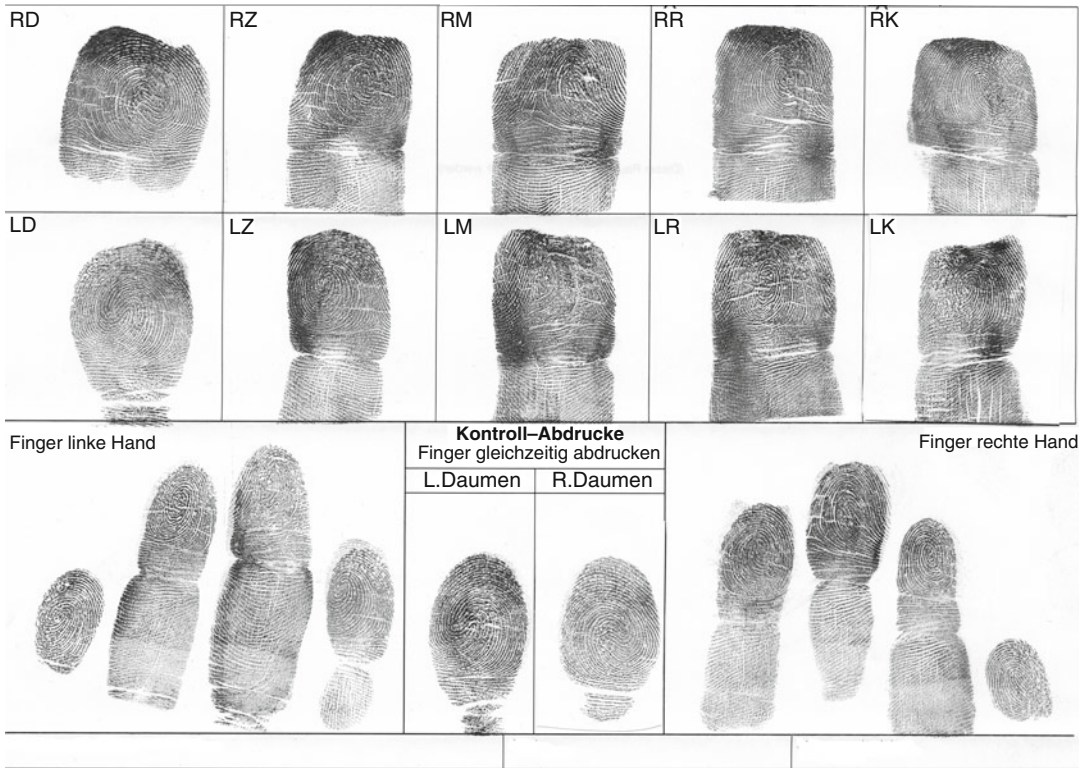

Fig. 6.10 Fingerprints for comparison purposes

an individual was fingerprinted during life. Where other investigative approaches lead to a missing person, fingerprints can be obtained from the individual's personal effects for comparison purposes. However, there will always be uncertainty here as to whether another individual has also touched the object.

6.8 Large-Scale Disasters: Disaster-Victim Identification (DVI)

A "large-scale disaster" is by definition one involving more than 100 victims. One particular aspect of large-scale disasters is the multitude of victims on the one hand and the often limited scenario on the other. In the case of a plane crash, for example, the passenger list provides the names of victims. However, a passenger may have travelled under a false identity. The strict procedure followed in such cases—usually led by the relevant identification commission of the respective office of criminal investigation—involves collecting all available antemortem data relating to the individuals suspected of being victims and comparing these with postmortem data. Investigations of this kind are usually carried out by interdisciplinary ante- and postmortem teams comprising criminal investigators, dentists, and forensic pathologists.

Methods used to establish identity in situations such as these include forensic odontostomatology, forensic DNA analysis, and fingerprinting. Having said that, all the methods discussed in this chapter are equally suitable. Method selection depends on the state of preservation of the body or remains, on the one hand, and on the availability of antemortem data, on the other. In Germany, dental records play the most important role in forensic identification following a large-scale disaster, since antemortem data is usually available for the majority of victims. Once this line of investigation has been exhausted, forensic DNA analysis and comparative X-ray analysis are then performed.

Most large-scale disasters are international incidents, given that victims often originate from different countries and the incident may have taken place in a yet another country. Establishing the cause of death and identity of victims is, in the first instance, the task of the national authorities of the country where the incident took place. National law applies. International collaboration in the identification process is only possible if the country in question authorizes—or requests—such collaboration. If this is the case, Interpol is placed in charge and coordinates the existing national DVI teams from its headquarters. The potential involvement of teams depends on the expected nationality of victims. Ensuring that standard forms are used, e.g., for collecting antemortem data of the missing person and postmortem data of the victim, is part of Interpol's coordination task. To this end, easy-to-use forms have been developed to replace the multitude of different documentation systems used worldwide. Moreover, the forms have been designed in such as way as to simplify comprehensive electronic data collection. The electronic collection of ante- and postmortem data, as well as automated comparison, forms the basis of modern large-scale disaster management. Since errors can occur in both the collection and the transmission of ante- and postmortem data, concepts in automated error-tolerant comparison have had to be developed.

6.9 Photographic Identification

Photographic identification is rooted in a long tradition of meticulously documenting characteristic facial features in a standardized form. Meanwhile, a separate field based on modern photographic methods has become established and plays a particularly relevant role in judicial routine. CCTV cameras are seen in many areas of public life. As a result, images of varying quality and taken under a variety of conditions are produced, which for identification purposes need to match a person with the highest possible level of probability of identity.

Important: By committing their face to a two-dimensional image, every human being creates a "landmap" comprising an individual

pattern of personal characteristics arranged in a specific constellation.

In order to *directly compare photos of two potentially identically persons*, images showing similar head posture and line of vision and taken using similar photographic techniques are required. Depending on image quality, *more than 100 characteristic features can be distinguished* and evaluated according to shape, structure, and degree of prominence. Problems may arise as a result of age differences at the points in time at which the images being compared were taken. For example, identity card photos of the individual under investigation may have been taken at an unknown point in time, possibly long before the document was actually issued.

In order for photographic identification to be successful, the established methods need to be consistently applied and documented. Subject to this condition, direct photographic comparisons can assist in the identification process, for example, in bank raids, computer fraud, the falsification of documents, traffic offenses, as well as many other types of criminal offense.

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