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**THE IMPORTANCE
OF FORENSIC ODONTOLOGY IN IDENTIFYING
THE VICTIMS OF MASS DISASTERS****Introduction**

Identification of human remains – victims of catastrophes, fires, in the advanced decay process and skeletonized bodies, in addition to genetics, which is at the forefront of identification methods, can also be carried out on the basis of the so-called forensic odontology. At the outset, two concepts existing in the literature and the Polish legal community should be explained: odontoscopy and odontology. The first concerns the forensic method dealing with the identification of tooth traces, while the second one refers to the medical method that identifies a person on the basis of the dentition. Both fields are connected by dentistry with regard to the examination of teeth in odontoscopy, however, the research concerns the traces of teeth in various forms and on various objects, while odontology concerns the teeth and the traces left by them¹. J. Kasprzak made an enormous contribution to the identification of criminals by conducting research on the systems of identification features of human teeth as well as the evidence and detection use of odontological expertise.

Odontological identification is used in forensics due to:

- the most durable part of the human skeleton, which is the dentition,
- obtaining special features resulting from the wear of the teeth that occur over time and its damage²,
- orthodontic and prosthetic elements, e.g. orthodontic appliances, dentures.

¹ J. Kasprzak, *Odontoscopia kryminalistyczna*, Olsztyn–Szczecin 2011, p. 32.

² B. Sygit, *Dorobek nauki w badaniach nad ustrojem człowieka wykorzystywany w praktyce śledczej i sądowo-lekarskiej*, „Problemy Współczesnej Kryminalistyki” 2003, Vol. VII, part II, p. 97.

Identification of the body

The dentition, due to the fact that it undergoes decomposition processes for the longest time compared to other bone parts, and does not change as a result of high temperatures, is one of the best objects that can be used for human identification research³. This method, known before the First World War, was more widely developed in Norway in the 1940s and 1950s⁴. Identification of the human body on the basis of dentition is used when the human body is devoid of soft tissues⁵. It is perfect for identifying carcasses found in a fire and significantly affected by an advanced decay process. Teeth deteriorate only when they are exposed to prolonged exposure to high temperatures, and also when immersed in burning gasoline. In such cases, it happens that only the back teeth or their fragments are not damaged. The teeth are protected against fire by the tongue, which is protruding out, which is better protection than the lips, which open when exposed to fire. Any dental material that is used today during treatments is exposed to high temperatures⁶.

The dental examination during post-mortem examination should be carried out in great detail by an experienced dentist⁷. It consists not only in the registration of teeth or their parts in the form of e.g. a root, but most importantly, registration of gaps, mechanical damage to the enamel of individual teeth and lesions, e.g. caries, fillings, crowns, dentures, etc.⁸ The research process should start with detailed assessment of the number and type of preserved teeth. Next, the presence of fillings should be determined, taking into account all the details, i.e. the number of fillings in each tooth, their location, including the type of material used for the filling. It is also necessary to assess the location of the teeth in the alveoli, individual features, type of bite, determine any developmental anomalies in the form of impacted teeth, enamel hypoplasia, etc. All prosthetic materials (dentures, bridges and crowns)⁹ are also extremely valuable for the purposes of identification. Currently, the victim's DNA profile is determined on the basis of precise genetic profiling.

The dentition and its arrangement in the oral cavity are presented in various ways. The basis of each of them is a cross that divides the dentition in the patient's mouth into the lower and upper arch, and each arch into the right and left half.

³ A. Buczek, *Uzębienie ludzkie jako środek identyfikacyjny*, „Służba MO” 1979, No. 6, p. 778.

⁴ P.J. Stevens, *Their Medical and Pathological Investigation*, Bristol 1970, p. 152.

⁵ C.B. Chavez, *Identification des personnes par la fiche odontoscopique*, „Revue Internationale de Police Criminale” 1975, No. 286.

⁶ J. Biedowa, *Ustalanie tożsamości nieznanymi zwłokami*, „Problemy Kryminalistyki” 1963, No. 46, p. 758.

⁷ See: И.Э. Никитина, *Организация взаимодействия судебно-экспертных учреждений европейских государств*, „Российский следователь” 2011, No. 19, p. 31.

⁸ A. Buczek, *Kryminalistyczne badania śladów zębów*, Warszawa 1980, p. 69.

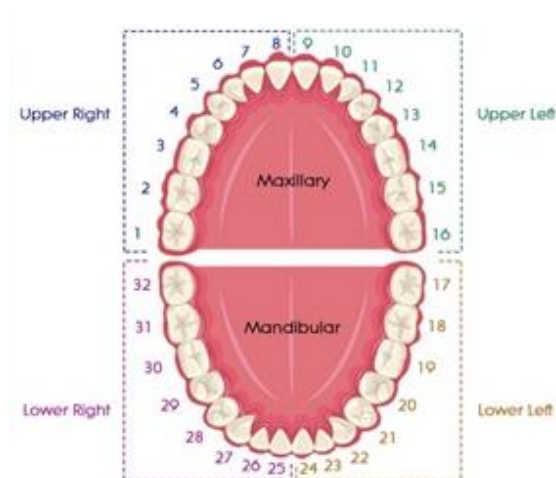
⁹ D. Lorkiewicz-Muszyńska, J. Sobol, *Zarys antropologii sądowej* [in:] *Wybrane zagadnienia z medycyny sądowej*, ed. C. Żaba, Poznań 2014, p. 69.

Graphic designation of human dentition for practical and scientific purposes has been a problem for many years. The first tooth designation system was proposed in 1861 by an Austrian dentist – Adolf Zsigmondy – who quickly became popular all over the world and until recently was found in Poland. He marked his teeth with numbers from 1 to 8 (from the medial incisor to the third molar) for the left and right sides of the body in the maxilla and mandible. For recording, he used a system of two vertical and horizontal lines. In which the horizontal line was to separate the upper and lower teeth, and the vertical line – left and right. Until recently, the Haderup system with the Allerhand correction was also widely used in Poland. In this system, individual permanent teeth are marked with numbers from 1 to 8, while the milk ones are marked with Roman numerals from I to V. The maxillary teeth were identified by a plus sign, mandibular teeth – minus – for the teeth on the right side, and numbers on the right side, and left – on its left side.

Currently, teeth are marked with the use of the International Dental Federation or the two-digit system (TDS) in force in Europe and the UNS – universal numbering system in force in the USA. In the International System, the marking of the quadrant of the mouth from which the tooth originates was added before the number of the tooth.

In the Universal System, permanent teeth are marked only with numbers from 1 to 32, while milk teeth are marked with letters from A to T. In Poland, the International System is in force¹⁰.

Universal Tooth Numbering System



Source: <https://dentagama.com/news/dental-numbering-systems> (6.06.2022).

¹⁰ *Stomatologia zachowawcza. Współczesne metody opracowania i wypełniania ubytków próchnicowych. Anatomia zębów stałych. Podręcznik do ćwiczeń fantomowych dla studentów stomatologii*, ed. D. Piątkowska, Łódź 2010, pp. 16 end n.

The description of the condition of the dentition, traces of conservative and prosthetic treatment in the case of extensive craniofacial injuries, as well as the lack of fragments of the jaw and mandible, is very complicated and time-consuming. The desired effect can only be obtained if the dentition specialist has at his disposal the reference material in the form of dental cards¹¹. It should be noted that the cards should be filled in accurately and reliably. Due to the difficulty that sometimes occurs in obtaining dental documentation, it is possible to create a central computerized dental database¹². For comparative studies, material from dental offices where the victims were treated with an antemort should be obtained, in the form of:

- dental treatment cards,
- all kinds of X-ray pictures taken during dental procedures (on film, in electronic or paper form),
- plaster casts of the entire upper and lower jaw,
- fragments of temporary crowns, dentures, etc.,
- orthodontic casts,
- face and intraoral photos.

In addition, materials should be obtained from the family that may be helpful in the identification process, in the form of:

- photographs taken with an antemort, on which the teeth are visible,
- old, artificial teeth; dentures; dental prostheses, etc.¹³

The aforementioned material is necessary for odontological expertise performed with the victim's antennae with regard to the existing fillings, prosthetic and orthodontic materials, etc. in the form of medical documentation. Such documentation should contain a detailed description of dental restorations, treatments and prosthetic materials, including information on the materials used.

It is essential that all treatment material is original and labeled with the patient's name, surname and date of birth and the date, signature and stamp of the treating physician. The source of obtaining the aforementioned documentation is the dentist who performed the dental treatment (prosthetic, orthodontic) of the victim.

During an odontological examination carried out in a forensic medicine institution, the standard medical and dental nomenclature used in a given country should be used, also in relation to identified citizens of another country. The

¹¹ B. Andreas-Ludwicka, U. Wojda-Gradowska, R. Stańczyk, B. Młodziejowski, *Tok postępowania i uwagi na temat identyfikacji ofiar katastrofy lotniczej na Okęciu*, „Archiwum Medycyny Sądowej i Kryminologii” 1981, Vol. 31, part 4, p. 245.

¹² D. Lorkiewicz-Muszyńska, M. Łabęcka, C. Żaba, M. Kis-Wojciechowska, J. Kozłowski, J. Sobol, *Trudności identyfikacji zwłok i szczątków ludzkich w oparciu o dokumentację i badania stomatologiczne*, „Archiwum Medycyny Sądowej i Kryminologii” 2009, No. 3, p. 223.

¹³ C. Grundmann, H.P. Kirsch, R. Lessig, K. Rötzscher, *Identification Procedures of Dead Bodies by Dental Means*, „International Poster Journal of Dentistry and Oral Medicine” 2008, Vol. 2, No. 2, p. 405.

forms presented above (pictures 1 and 2) should be used for the examination. X-ray photos taken during identification in the form of plates should be numbered separately and placed in numbered envelopes.

The upper jaw should be left in place during the examination. The dentist performing the odontological examination independently makes the decision regarding the removal of the lower jaw for a detailed examination. Both the upper jaw, the lower jaw and all prosthetic materials (jaw, bridges, etc.) can be cleaned and subjected to more precise dental examinations¹⁴.

The material obtained, both that prepared during the post-mortem examination and obtained from dental or orthodontic offices, will be used to prepare an odontological expert opinion. The American Board of Forensic Odontology (ABFO) recommends an expert opinion limited to four types of conclusions:

- positive identification: postmortem and antemortem data are compatible with each other, all details are consistent and there are no discrepancies,
- possible identification: postmortem and antemortem data have similar features, but due to the poor condition of the teeth or inaccurate treatment documentation, it is not enough to issue a categorical opinion,
- insufficient evidence: insufficient data to issue a categorical opinion,
- exclusion: the received data is contradictory¹⁵.

Due to the development of technology, most of the dentist's offices are nowadays owned their equipment includes digital x-ray machines, which are used in the performance of most of the above-mentioned medical indications¹⁶. The photos taken are stored in the memory of computers along with the patient's electronic cards, thanks to which the access to the photos is easy, with the possibility of printing them and using them for identification purposes.

Military pilots, in the course of examinations under the medical commission conducted by the District Military Aviation and Medical Commission in Warsaw, which carries out jurisprudence in relation to military aviation personnel, the subjects are required to take a panoramic X-ray of the teeth, the so-called pantomogram. Data on the condition of the dentition of the examined person are archived in the form of an appropriate dental diagram. The odontological data obtained in this way can be an excellent material for a comparative study of the unidentified bodies of victims of an air crash.

As an example of identifying the victims of the crash on the basis of odontological data, one can cite the crash of the Vickers Viscount 739 A, which took place on August 9, 1968 near the German Langenbruck, during which 44 pas-

¹⁴ *Ibidem*.

¹⁵ A. Pretty, D. Sweet, *A look at forensic dentistry – Part I: The role of teeth in the determination of human identity*, „British Dental Journal” 2001, Vol. 190, No. 7, p. 362.

¹⁶ B. Turski, *Badania stomatologiczne [in:] Postępy medycyny lotniczej. Opracowanie zakresów badań wstępnych, okresowych, okolicznościowych dla wojskowego personelu latającego*, ed. B. Turski, Warszawa 2008, p. 117.

sengers and 4 crew members – citizens of England, were killed. After the catastrophe, experts from London were asked to the then West Germany in order to identify the victims of the catastrophe. At that time, identification was based mainly on dental data, due to the existence in England of a central dental registry, to which materials are supplied by all dentists. The file was created to identify missing persons and unknown bodies. The individual cards contain not only information on treatments, but also detailed descriptions of the materials used for them¹⁷. The value of odontological identification is still of great value in the USA, thanks to this method, categorical identification is possible in 60.4% of cases¹⁸.

Odontology was of great importance in identifying the victims of the tsunami in Thailand. The DVI¹⁹ teams that work there, consisting of specialists in dactyloscopy, forensics or pathology, anthropologists, odontologists or dentists. Depending on the needs, their composition can be extended to include specialists with other specialties. During the examination, the corpses forensic-dental, and their results are recorded in a special DVI form, then supplemented with results from other tests and analyzed in a special computer program Plass Data²⁰, intentionally created for DVI teams by one of the Danish IT companies.

The identification method, based on a comparison of dental records, was used to identify the remains of the victims of the IL-62M plane crash in the Kabacki Forest. Dental treatment cards for Polish citizens who were under the care of dental clinics in the country were obtained then. During the identification tests, the documentation obtained from the laboratories producing prosthetic elements was also used.

Thanks to this method, one of the victims of the Lufthansa plane crash in Okęcie in 1993 was identified. The comparison was fruitful due to the dental treatment documentation received from Germany.

Many computer systems are used to collect and analyze dental data. One of the first was CAMPI (Computer Assisted Postmortem Identification), a system developed and implemented by the US Military Institute of Dental Research to facilitate the identification of human cadavers and remains. It functioned on the basis of algorithms for processing the most frequently appearing dental information regarding the differences in the teeth filled, missing or implants. The pro-

¹⁷ H. Herrmann, *Identyfikacja zwłok po wypadkach samolotowych*, „Służba MO” 1969, No. 4(73), p. 499.

¹⁸ I. Sołtyszewski, B. Młodziejowski, R. Płoski, W. Pepiński, J. Jońca, *Kryminalistyczne i sądowo-lekarskie metody identyfikacji zwłok i szczątków ludzkich*, „Problemy Kryminalistyki” 2003, No. 239, p. 8.

¹⁹ DVI (DisasterVictim Identification team) have been established in some EU countries to identify victims of natural disasters, major terrorist incidents, etc. They count from 10 to 15 people, they include forensic physicians, pathomorphologists, anthropologists, dentists, odontologists, geneticists, technicians forensics, clerks and other specialists depending on the needs and type of event.

²⁰ M. Spólnicka, I. Sołtyszewska, *Procedura identyfikacji ofiar tsunami w Tajlandii*, „Problemy Współczesnej Kryminalistyki” 2006, Vol. X, p. 314.

gram was precise, as it contained a description of each of the five sides of the tooth (face, mesial, distal, incisal, palatal), thus creating 160 possible features. Due to the operating system – DOW, in which this program works, its use is abandoned.

Currently, the United States uses a large number of odontological identification programs, including:

- CAPMI: Computer Assisted Post Mortem Identification,
- WINID: System for matching missing and unidentified persons,
- NCIC2000: National Criminal Information Center,
- NDIR: National Dental Image Repository,
- NamUs: National Missing and Unidentified System,
- VICTIMS: Victim Information, Catalog, Tracking and Image System,
- NAMPN: North American Missing Persons Network,
- DOE: Missing persons network,
- EDAN: Everyone Deserves a Name,
- FLUIDDB: Florida Unidentified Deceased Data Base,
- IDIS: Intelligent Dental Identification System,
- LOCATOR,
- INTERPOL DVI: Disaster Victim Identification,
- CPIC: Canadian Police Information Center,
- NCMA: National Center for Missing Adults,
- NCMEC: National Center for Missing and Exploited Children²¹.

Unfortunately, in Poland, when there is a need to collect data on the dental treatment of a disaster victim, there are major problems with collecting dental treatment documentation. This is due to the fact that in most cases the family is not able to provide the surgery where the victim was treated. Moreover, another difficulty is the fact that people are treated by different doctors. Therefore, it would be advisable to create a computerized dental data bank in line with world standards. The creation and launch of such a system would greatly affect the ease and speed of access to dental treatment documentation. A functioning database would contribute not only to the identification of victims of mass disasters, but also of unidentified bodies and identification for the purposes of law enforcement agencies²².

Conclusion

Odontological expertise, despite the fact that it is one of the oldest methods of human identification, is still often used. In some cases, it is the only method that can be used. In situations where taking a DNA sample is impossible due to

²¹ P. Polak, *Odontologia w ekspertyzie kryminalistycznej*, Gdynia 2012, s. 93.

²² D. Lorkiewicz-Muszyńska, M. Łabęcka, C. Żaba, M. Lis-Wojciechowska, J. Kozłowski, J. Sobol, *Trudności identyfikacji...*, s. 223.

significant degradation of biological material, odontological expertise is the right way to determine the identity of murder victims, detected after many years, mass communication disasters, or other mass events in which many victims were killed, e.g. fires. The experience gained over the years related to the need to identify victims of mass disasters proves how important it can be to carefully keep detailed patient records in dental offices. Unfortunately, the obligation on dentists to keep medical records, both in private and state-owned entities, is not always properly fulfilled. Something that, in the conditions of quiet everyday life, may seem to be only a formality, documentation that may possibly help dentists in the future treatment of their patients, in a crisis situation may turn out to be a very important tool that will decide whether the victim will be identified or the list of missing persons will be extended up for the next position. For this reason, it is very important that patient treatment records kept by dentists are professionally prepared and used for comparative purposes during the odontological identification process. A common problem, especially in Poland, is the location of the clinic where the victims were treated, so perhaps a future solution to this problem would be a central, global dental database. Such a tool would undoubtedly facilitate quick and easy access to comparative data, which could significantly shorten the time of obtaining comparative material for identification purposes.

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Summary

The article presents the issues related to the identification of victims thanks to odontological expertise. The development of genetics gives forensics a great tool, which is the analysis of the genetic profile of DNA, which categorically enables the identification of human remains. However, this type of test is not possible in all cases. It is only applicable for the preservation of soft tissues, otherwise the preserved dentition will be an excellent identification material. The method is often used when identifying bodies exposed to high temperatures and in advanced decomposition. The development of odontological expertise would be impossible without the contribution of eminent dentists, such as Adolf Zsigmondy. By developing the first graphical tooth marking system, he paved the way for today's TDS and UNS systems. A good dentition classification system is an indispensable tool for odontologists and dentists working on the identification of cadavers and is directly related to the need to use comparative materials, also key in the effective identification of cadavers, and sometimes human remains. These are data obtained from dental offices, in the form of comprehensive information about patients – their dental treatment cards, orthodontic casts, fragments of dentures and crowns, X-rays, etc. and enriched through dental databases. As a result, the odontological expertise and its development enable the effective identification of about 60% of the corpses examined with the help of this procedure, when DNA material cannot be used for this purpose.

Keywords: forensic odontology, mass incidents, forensics, identification of victims

ZNACZENIE ODONTOLOGII SĄDOWEJ W IDENTYFIKACJI OFIAR KATASTROF MASOWYCH

Streszczenie

Artykuł przedstawia problematykę związaną z identyfikacją ofiar dzięki ekspertyzie odontologicznej. Rozwój genetyki daje kryminalistyce wspaniałe narzędzie, jakim jest analiza profilu genetycznego DNA, który w sposób katagoryczny umożliwia identyfikację ludzkich szczątków. Badanie tego typu nie jest jednak możliwe we wszystkich przypadkach. Zastosowanie znajduje

jedynie w sytuacji zachowania się tkanek miękkich, w przeciwnym razie doskonałym materiałem identyfikacyjnym będzie zachowane uzębienie. Metoda często znajduje zastosowanie podczas identyfikacji ciał narażonych na działanie wysokich temperatur oraz w posuniętym rozkładzie gnilnym. Rozwój ekspertyzy odontologicznej byłby niemożliwy bez wkładu wybitnych stomatologów, takich jak m.in. Adolf Zsigmondy. Opracowując pierwszy, graficzny system oznaczenia zębów, przetrwał on szlak powszechnym dzisiaj systemom TDS oraz UNS. Dobry system klasyfikacji uzębienia jest niezbędnym narzędziem odontologów i stomatologów pracujących nad identyfikacją zwłok oraz bezpośrednio wiąże się z koniecznością wykorzystania materiałów porównawczych, także kluczowych w skutecznej identyfikacji zwłok, a niekiedy szczątków ludzkich. Są nimi dane pozyskane od gabinetów stomatologicznych, w postaci kompleksowych informacji na temat pacjentów – ich karty leczenia stomatologicznego, odlewy ortodontyczne, fragmenty protez i koron, zdjęcia RTG itp. W dobie powszechnej komputeryzacji metody zapoczątkowane w XIX w. są usprawniane dzięki specjalistycznym programom komputerowym i wzbogacane za sprawą baz danych stomatologicznych. Ekspertyza odontologiczna i jej rozwój w rezultacie umożliwiają skuteczną identyfikację ok. 60% zwłok badanych z pomocą tej procedury w przypadku niemożności wykorzystania do tego celu materiału DNA.

Słowa kluczowe: odontologia sądowa, zdarzenia masowe, kryminalistyka, identyfikacja ofiar