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THE EFFECT OF DIGITIZING DENTAL ANTEMORTEM DATA ON THE EFFECTIVENESS OF VICTIM IDENTIFICATION

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ABSTRACT : Forensic identification was aims to reveal the identity of the victim. One of the identification methods is using dental facilities, but the main problem depends on providing antemortem data and until now the data is in analog format so that it cannot be transferred using a computer. This study was to find alternative solutions for this problem by transformation from analog to digital data in HyperText Markup Language (HTML) format. The experimental research used the Randomized The Posttest Only Control Group Design to 120 samples of dental antemortem data. Sixty data had digitized were assumed to be postmortem data. Sixty data in analog format were assumed to be postmortem to identified manually. Participants had given better answers by 47% with a value of 3.52. Digitizing data antemortem had been successful and more effective than analog format. The digital odontogram (96,6%) and rugae palatine (83,3%) data types show higher accuracy than X-rays foto (71,7%) and digital photo record of faces (72,5%).

Keywords: Dental antemortem, Digitizing data, Information system, Identification forensic.

I INTRODUCTION

The incidence of mass disasters, increasing population, changing climatic conditions, faster public transportation avenues and increasing criminal activities, will likely increase in the future (Prajapati et al. 2018) which cause many casualties, with the physical condition of the bodies damaged and unable to recognized visually, the state is obliged to carry out forensic identification to reveal the certainty of the identity of the victim (Republik Indonesia 2009) .

Disasters can also be further divided into open disasters, closed disasters or open and closed disasters. Disasters such as earthquakes, tsunamis, and train accidents belong to the open Mass Disasters category. In these disasters, the names of the victims are usually unknown. On the other hand, air crashes, ferry disasters, and hotel fires are examples of closed disasters, where the names of the victims can usually be obtained (Nuzzolese dan Di Vella, 2007)

The urgency of carrying out identification, in addition to knowing the causative factors for prevention purposes, is also to uphold human values in order to meet administrative needs related to inheritance rights, insurance, the funeral process for the victim in accordance with religious beliefs and provide psychological comfort for the family left behind (Prawestiningtyas dan Algozi 2009; Singh 2010) Humanitarian forensic action is the application of the knowledge and skills of forensic medicine and science to humanitarian actions, especially following conflicts or disasters (Smitha dan , H S Sheethal, K N Hema 2019). The principle of identification is implemented as quickly as possible, easily and

prioritizes ethics (Maramis 2015), and must not be mistaken in determining the identity of the victim (ACPO 2011). It is better not to be identified than to be mistakenly identified. Forensic identification of the victims is a very challenging task because dead bodies are often mutilated to such an extent that they cannot be identified by general physical examination alone (Nuzzolese dan Di Vella 2007)

Interpol has compiled a forensic identification guide based on Primary Identifier which consists of fingerprint, dental records and Deoxyribose Nucleic Acid and Secondary Identifiers which consist of medical, property and photography information (Forrest 2019; Prawestiningtyas dan Algozi 2009). The identification process consists of 5 phases, namely; first responders, collecting postmortem data, presenting antemortem data, reconciliation and debriefing (Interpol 2018).

The implementation of the concept of self-identity as a universal basic human right is that every country has the obligation to carry out forensic identification of incidents that cause victims to lose their lives to establish certainty about the identity of their bodies. In Indonesia, regulations governing the implementation of identification are contained in the Criminal Procedure Code (Preiden Republik Indonesia 1981), Law on Disaster Management (Republik Indonesia 2007) and Law Number 36 Year 2009 concerning Health (Republik Indonesia 2009). The authority of administering forensic identification of victims of disasters involving civil society is the Indonesian Police (Republik Indonesia 2002) and may involve other elements, including the Indonesian Army (Polri dan TNI 2018).

Experience in the field of carrying out identification using fingerprint data is prone to damage due to the decay process or burns. Until now, the use of Deoxy Nucleic Acid still requires special facilities and competencies and a relatively long time to process it in the laboratory (Rai et al. 2014) Meanwhile, the use of dental hard tissue (Forensic Odontology), has many advantages because the dental material does not decompose even though it is submerged in the water and burns (Pittayapat et al. 2012). Speedup disaster victim identification process is a demanding task and can be successfully completed by proper planning and executing with forensic tools and key experts. Forensic Odontologist can play an important role in victim identification in mass disasters across the world and speed up victim identification. process (Smitha dan , H S Sheethal ,K N Hema 2019).

According to Cordner S, Tidball Binz M (2017) the identification of nameless cadavers by forensic odontologist can provide evidence to the families which may be used in court, and ensuring that the body is available to the family for the funeral. It also helps to understand that what happened to the deceased, so that corrosive uncertainty about this is replaced by something closer to the truth, as terrible as that might be (Smitha dan , H S Sheethal ,K N Hema 2019).

Forensic Odontology has played a significant role in victim identification and considered to be one of the most reliable and economic scientific methods (Prajapati et al. 2018). The identification operation in the Bali Bombing I case in 2002, the disclosure of identity through dental means reached 56%, in the burnt bus traffic accident in Situbondo, Indonesia it reached 60% (Prawestiningtyas dan Algozi 2009). Various methods used in FO for identification include review of dental case records, anthropological assessments, and analyzes of restorations, dentures, radiographs, bite marks and intra-oral photographs, as well as, cheiloscopy and rugoscopy (Prajapati et al. 2018;Pittayapat et al. 2012).

In its histrory, Siegel et.al (1977) introduced the use of computers for the purposes of forensic odontology by changing the character of the data into algorithms. Then in 2007, two identification systems were tested, namely Disaster and Victim Identification (DAVID) and WinID3 and the results were still not satisfactory. Because the algorithm program used is limited to medical record records, namely whether there are bridges, crowns, decayed, missing, restorations, dentures and no eruptions. However updating versions of the DAVID and the WinID3 programs were being produced. The algorithms and dental characteristics of both programs remained unchanged to the versions (Al-Amad 2007). The used of computers in forensic dentistry can be assured with more precision than manual technique. In coming years, as the technology is advancing the digital identification of individuals or deceased will become more precise and authentic (Chaurasia dan Goel 2016) Digital forensics has revolutionized the traditional forensic investigations in terms of acquisition, analysis, and reporting of forensic evidence and its application is becoming common in the mass disasters, earthquakes, and terrorism (Nagi et al. 2019b).

The main problem in the forensic identification process using dental facilities is the difficulty in obtaining antemortem data (Arora dan Kaur 2016;Avon 2004; Interpol 2018;ABFO 2017;Kolude et al. 2011). Another problem is the manual implementation of the reconciliation phase (Interpol 2018) as well as other technical obstacles including a tense working atmosphere, minimal facilities and infrastructure and limited forensic experts as well as different background experiences which are also complicating factors in carrying out victim identification (Henky dan Safitry 2012).

Based on the background of the main problems above, the researchers are interested in researching dental antemortem data management. The research was conducted in two stages. First, analysis of information system requirements using Pieces and Fishbone. Second, digitizing data and using information systems in the identification process. The research was carried out on antemortem data of Indonesian Navy soldiers managed by Naval Dental Institute R.E. Martadinata, in the form of odontograms, radiographic x-rays, digital photographs of faces and dental prints.

II. REASERCH METHODOLOGY

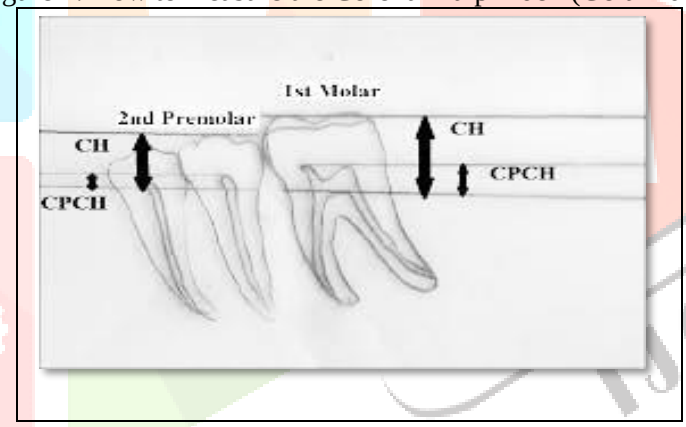
Type of the Study : Descriptive Study
Source of data : Primary and Secondary data
The primary data has been collected from Naval Dental Institude Ladokgi R.E. Martadinata. Secondary sources include information from the journals and online sources
Sampling size : 120
Research approach : This study were pure experimental study
Sampling procedure : Randomized The Posttest Only Control Group Design.
Research instrument : Calipers, metal ruler, pencil, magnifying glass, barcode generator application, barcode scanner, yarn, computer, web-based information system design, android cellphone photo.
Objek of the Study : Odontogram, Foto radiografi panoramic, digital foto of face on centric relation and dental casting.
Place of study : Naval Dental Institude R.E. Martadinata, Jakarta, Indonesia

The procedure for digitizing dental antemortem data related to the measurement results with decimal numbers, then rounding is applied. If a decimal point is below 5, it will be rounded down, but if the number after the comma is equal to or more than 5, it will be rounded up (Nasution dan Nasution, Elfrianto 2017).

2.1. Odontogram. The digitization of the odontogram data is carried out by writing down the examination result data including Decay, Missing, Filling-Teeth (DMF-T). The tooth was considered carious (D) if there was visible evidence of a cavity, including untreated dental caries. The missing (M) included teeth with indications for extractions or teeth extracted due to caries. The filled (F) included filled teeth (Prabakar Jayashri et.al. 2020)

2.2. Radiographic Photo. Panoramic X-rays were measured by CPI (Coronal Pulp Index) on 4 mandibular teeth, namely the right and left first molar and first premolar (Gotmare SS et.al. 2019). CPI = CPH X 100/CH; CPI = *Coronal Pulp ndex;* CH = *Crown Height*
CPCH = *Crown Pulp Cavity Height*

Figure 1. How to measure the Coronal Pulp Index (Goltz 2016)



2.3. Face Digital Photo. Digital photo of the front view with the body and head upright against the wall and the bite in a centric relation was taken with an automatic digital camera with a distance of 40 cm. Furthermore, the photos were recorded in postcard size and then the vertically physiological dimensions were measured (Amiruddin dan Thalib 2019)

2.4. Dental Casting Data. Dental molds were described through 3 data, namely: first, the measurement of the maxillary width at the distance between the mesial sides of the right and left first molar teeth. Second, the arch length of the maxillary teeth was calculated starting from the mesial side of the right first molar to the mesial side of the left first molar (Amalia et.al. 2015). Third, utilize the soft tissue of the palatine rugae using the Trobo Classification which reads from the right molar side clockwise to the left molar side (Setiadi D. et.al. 2019) This classification divides rugae into simple rugae, classified as ABCDEF, where rugae shapes are well defined, and compound rugae, classified as type X, with a polymorphisms variety (the compound shapes result if there is union of two or more simple rugae). The present study regards every separate, well defined ruga as a simple ruga. A compound or polymorphic ruga is one involving the union of two or more simple rugae. Hence, a ruga is either simple or compound (polymorphic). The rugae shapes that correspond to the respective classification are: A = point; B = line; C = curve; D = angle; E = sinuous; F = circle; X = compound (polymorphic).(Suhartono et.al. 2016)

Figure 2 Trobo's Classification of Rugae Palatina

Table 1: Identification effectiveness on the use of the manualy and information system.

Identification Method		Reconciliation Results		Total
		Positive	Negative	
Types of antemortem and postmortem data (odontograms, radigraphs, face photographs, dental prints)	Identification with digital data and integrated information systems QR Code	a	b	
	Identification with analog data Manual	c	d	
	Total			

Source: Principles of Epidemiology in Public Health Practice (Dicker 2006)

The reconciliation procedure for determining the identity of the victim was simulated through random sampling and a blind method of two times ten antemortem data for members of the Indonesian Navy which was assumed to be post mortem data. The first ten were data digitization and antemortem data matching through the information system. The second ten as a control group were not subject to manual treatment and matching of their antemortem data. Furthermore, to measure its effectiveness, including specificity, sensitivity and accuracy, the 2x2 epidemiological table rule is used (table 1). Sensitivity = a / (a + b) x 100%, Specificity = d / (b + d) x 100%, Accuracy = a + d / (a + b + c + d) x 100%; a = positive identification on the QR Code integrated information system; b = negative identification in the QR Code integrated information system; c = positive identification in manual method; d = negative identification in manual method.

The problem in this study is how much influence digitizing dental antemortem data on the effectiveness of victim identification?

III. OBJECTIVES OF THE STUDY

To Analize the effect of digitizing dental antemortem data and using an integrated QR Code information system on the effectiveness of victim identification

IV. DISCUSION

Naval Dental Instiude R.E. Martadinata, the institution in charge of identification activities within the Indonesian Navy, has collected four types of antemortem data on the teeth of Indonesian Navy members, including odontograms, facial records, panoramic radiographs and dental prints (Winarno Sugeng et.al 2020). Based on the results of observations at the research location, identification activities at Dental Instiude R.E. Martadinata has been carried out since 2014. The activity carried out was the collection of dental antemortem data for members of the Indonesian Navy. There are four types of data, namely odontograms, digital facial photographs, panoramic x-rays and dental prints. The basis for the implementation of this activity is the Regulation Chief of Naval Staff Number 54 of 2011. According to Informant 1, dental antemortem data management in Dental Instiude R.E. Martadinata has used an information system built by the Indonesian Navy's Information Service in 2014, but data input is still manual and data types are still analog.

Table 2. The Amount of Antemortem Data for Indonesian Navy Soldiers in 2019

No	Year of Collection	Working Units	Total
1	2014	Jkt Lanudal, Kopaska, Brigif 2, Kilonlamil, Ambar, Foreign Service (QuarterIII and IV)	3,995
2	2015	Kormar, Koarmabar, Kopaska, lanmar Jky, Lantamal III, Yonkemar, YonmarIV, Pasmar 2, Dinal Foreign Affairs	1,600
3	2016	Pushidrosal, Pasmar 2, AAL, Department of Foreign Affairs	1,600
4	2017	Yonmarhalan III, Pasmar2, AAL, Armatim, Armabar, Foreign Service	1,600
5	2018	Armada I, AAL, Lanal Banten, Lanal Jogjakarta, Lanal Bandung, Lanal Cirebon, Dinal Foreign Affairs	1,600
6	2019	Lanal Tegal, Lanal Cilacap, Lanal Semarang, Denma Mabesal, Lantamal VII, Fasharkan MTG, Foreign Service	1,600
		Total	11,995

(Data source from the Ladokgi R.E. Military Dentistry Department Martadinata)

Table 3.The effectiveness of the reconciliation stage using an integrated information system quick respond code based on the type of data

No.	Type of data	Sample size	speed	Sensitivity (%)	Specificity (%)	Accuracy (%)
1	Odontogram	120	< 1 menit	94,2	83,8	96,6
2	X-rays foto	120	> 1 menit	76	68,6	71,7
3	Digital photo record of faces	120	> 1 menit	73,7	71,4	72,5
4	Dental Casting (rugae palatine)	120	< 1 menit	67,4	95,5	83,3

(The data is processed from the research findings)

Table 3 shows that the effectiveness of victim identification using an integrated information system quick respond code is very effective with the highest accuracy rate of 96.6% (p.0.05) on the odontogram. These findings are in accordance with the statement of Nagi et.al. The digital forensics has revolutionized the traditional forensic investigations in terms of collection and analysis of data. Moreover, computerized images are more reliable, accurate with fewer errors and could not be manipulated by the third person. These technologies are very helpful in DVI in which innumerable bodies are severely mutilated and allow digital transfer of the images without loss of information(Nagi et al. 2019a).

Information systems require infrastructure in the form of a website (Asfinoza et.al 2018) and data in digital format, which can be HTML (Hypertext Markup Language) to convey data descriptively in text (Omar et.al. 2018) or Jpeg (Joint photographic) experts group) in picture form (Prabowo 2016). The system design is built to accommodate the need for automatic data storage and distribution (Susanti 2016) and can be integrated with a Quick Response Code (Q.R. Code) which can store data in it (Wijaya dan Gunawan 2016). Q.R. Code is a type of two-dimensional barcode that has been approved as an ISO international standard and the Chinese National Standard in 2000 (Fitriyan 2017). Q.R. Code can change any type of data into information so that it can be accessed quickly via a computer (Rahaman Wasim 2016).

In Indonesia, forensic identification activities are under the authority of the Indonesian National Police (Republik Indonesia 2002) but in its implementation it can involve other elements (Polri dan TNI 2018), including the forensic military odontology force from the Indonesian Navy ((Djuyandi Yusa et.al. 2019); (Republik Indonesia 2004). Regardless of the method used to identify a person, the results of the comparison of antemortem and postmortem data lead to 1 of these 4 situations; first, positive identification, it mean comparable items are sufficiently distinct in the antemortem and postmortem databases, no major differences are observed. Second, possible identification, it mean commonalities exist among the comparable items in the antemortem and postmortem databases, but enough information is missing from either source to prevent the establishment of a positive identification. Third, insufficient identification evidence, it mean insufficient supportive evidence is available for comparison and definitive identification, but the suspected identity of the decedent cannot be ruled out, then the identification is then deemed inconclusive. Forth, exclusion, it mean unexplainable discrepancies exist among comparable items in the antemortem and postmortem databases (Avon 2004). In India, Forensic Odontology would help in identifying bodies of their soldiers and also to protect the nation from terrorists who impersonate and spread terrorism acting as a threat to the security of the nation.(Arora dan Kaur 2016). Japan, Body identification by dentists based on dental findings preserves the dignity of the individuals and has great value in maintaining social peace and order (Komuro et al. 2019). Several countries in Europe, India, Singapore, Thailand have indeed required their dentists to complete medical records according to Interpol standards (ABFO 2017; Arora dan Kaur 2016) , however, the format is still analog so that it affects the speed in the data transfer process (Trisnowahyuni et.al. 2018) Dental identification is one of the most reliable methods, as teeth and dental structures may survive adverse conditions. The techniques involved in forensic odontology include: bite mark analysis, tooth prints, rugroscopy, cheiloscopy, dental DNA analysis, radiographs, and photographs (Kaleelullah dan Hamid 2020).

V. CONCLUSIONS

The digitizing of antemortem data including odontograms, radiographic x-rays, facial records and dental prints into HTML format and the use of information systems on victim identification are more effective and efficient than manually. The digital odontogram (96,6%) and rugae palatine (83,3%) data types show higher accuracy than X-rays foto (71,7%) and digital photo record of faces (72,5%).

SUGGESTIONS

Forensic identification is a humanitarian and non-profit operation, therefore it is necessary to have support from the state to meet its resource needs. In order to obtain diversity, it is necessary to develop and further research a digital dental antemortem data standard that engages every stake holders.

RESEARCH LIMITATIONS

In collecting qualitative data through in-depth interviews and questions in the questionnaire, there are factors that the researcher cannot control, namely the potential answers of respondents which sometimes do not represent the actual conditions.

AUTHORS 'NOTE
The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirm that the data and the paper are free of plagiarism.

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