

DVI SYSTEM INTERNATIONAL: SOFTWARE ASSISTING IN THE THAI TSUNAMI VICTIM IDENTIFICATION PROCESS

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ABSTRACT

DVI System International is software that operates on the PC-Windows platform. It is capable of managing aspects of identification in day-to-day cases and major disasters, where it has particular advantages when victims of several nationalities are involved. The system uses Interpol forms as standard protocols for input and transfer of antemortem and postmortem information. Following the Thai Tsunami Disaster of 26 December 2004, Interpol recommended that its member country Thailand use DVI System International software, as it is one of the few internationally approved systems. This paper focuses on the concepts upon which the dental forms, F1 and F2, of the DVI System International are designed, describes how it works and some of the adjustments implemented during the ongoing Thai Tsunami Victim Identification process.

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INTRODUCTION

Modern technology offers means of processing and transmitting data that can significantly expedite identification procedures. Following the natural disaster that took place on 26 December 2004, the Interpol organization recommended that its member country Thailand use the DVI System International software, as it is one of few internationally approved systems in data handling and matching of missing persons to unidentified human remains. The software is based on the Interpol Disaster Victim Identification (DVI) form¹ that has particular advantages when victims of several nationalities are involved, as in the disaster in question. The forms consist of two sets of data sheets: a yellow form set for recording latest known data concerning a missing person; and a pink form set for recording all findings concerning a dead body. The yellow and pink forms have sections recording the same type of data: C forms contain

technical descriptions on effects (clothing, jewellery, documents etc.); D forms contain physical characteristics; E forms contain medical information; F forms dental information; G form any further information that may assist in identification. Furthermore A forms in the yellow form contain personal data of a possible victim or missing person while B forms in the pink form are the report on the recovery of the body from the site.

This paper focuses on the concepts upon which the dental forms, F1 and F2, of the DVI System International are designed, and describes how the system works and some of the continuous adjustments and improvements implemented during the ongoing Thai Tsunami Victim Identification (TTVI) process.

HISTORY

Denmark has taken an active role in the DVI form set developed by a working party established by the Interpol Standing Committee on Disaster Victim Identification. It was, in fact, one of the Committees co-founders, forensic odontologist, Soren Keiser-Nielsen (deceased), who, assisted by police inspector, Gunnar Johnsen, designed this international form in 1988. Since then the DVI forms have been continually reviewed and revised by the Missing and Wanted Persons Search Squad of the Danish Police Force in close collaboration with Interpol's Standing Committee on DVI. The first and second electronic versions of the Interpol DVI form, known as DVI/IDDONT System (DOS) and DVI System (Windows), were designed and developed in the early and mid 1990s by the Danish DVI Group in cooperation with Plass Data Software A/S. These software programs were based on standards and complied with the Interpol guide for DVI, the Interpol DVI form set, search and comparison methods, dental standards for nomenclatures and tooth numbering. Progress in design and development of the DVI System, taking into account the experience acquired, has currently been presented to Interpol Standing Committee members. The software has finally been tested and approved by Interpol. The

software used in the TTVI process is the latest version known as DVI System International (commonly referred to in Thailand as Plass Data™). This System has been developed in Delphi and data are stored in a Microsoft SQL database* to comply with updated requirements for computer assisted DVI including exchange of data with external systems via XML-files.

FUNCTION OVERVIEW

DVI System International operates on the PC-Windows* platform and all functionalities of the system can be selected from the menu in the main window (Fig.1). The form-selector toolbars below the menu bar are used to open individual pages in the antemortem and postmortem forms sets. With an active antemortem case, all buttons in the post-mortem toolbar are disabled and vice-versa. The case

*Microsoft Corporation, Redmond, WA, USA

selector toolbar manages open cases and displays the currently active case. Provided the active case is a search case, a search button is enabled on the bar and executes a form search upon activation. True images of the individual form pages are displayed in the windows workspace and entering of data is performed in these form windows.

Online Case Manager

The software opens with the *Online Case Manager* (Fig.2). As needed, this manager may be opened from the file menu. The case lists can be filtered by entering text or by selecting sex, case kind or case state. The targeted case is loaded by a double click of the line. A panel of buttons allows the user to choose between different tasks: create a new antemortem or postmortem case; edit or delete an existing case; change the number of an existing case; search for cases; import or export cases (XML files); print DVI forms with case data; print case list.



Fig.1: Main menu bar and toolbar area

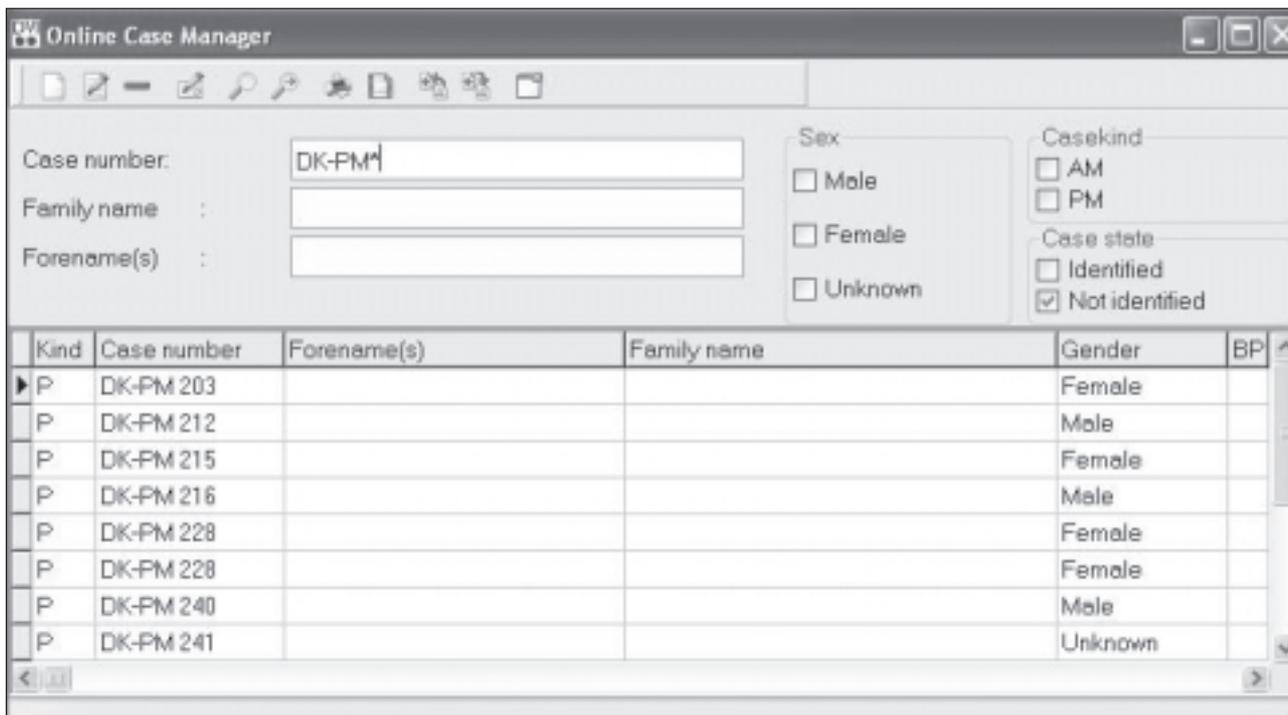


Fig.2: Online Case Manager filtered by Case kind

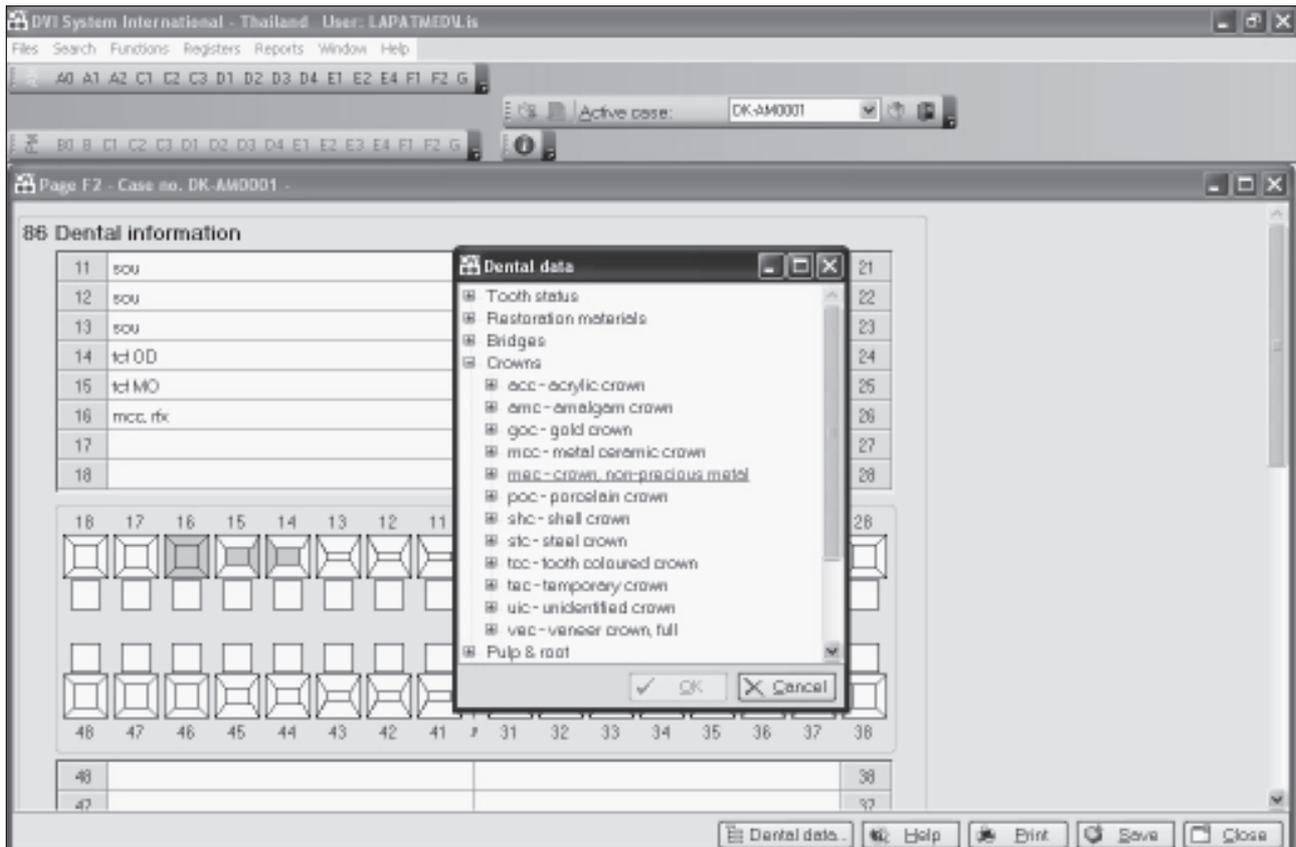


Fig.3: Main window with display of dental antemortem page F2. The Dental data register has been activated with display of a subdirectory for crowns to assist entry of sys code in text field

DENTAL DATA ENTRY

Antemortem/Postmortem form F1

The most important information to be entered on the yellow antemortem form F1 is data on the dentist or institution (present and past) that the missing person has visited for examination or treatment. The pink postmortem form F1 is mainly for description of the condition of the dead body using cross-off boxes and text field. On both F1 forms the *Officer* e.g. the forensic odontologist has to fill in appropriate data e.g. name, institution and phone number.

Antemortem/Postmortem form F2

Tooth nomenclature/numbering

The FDI two-digit system is by default the tooth numbering system. This system is among the favoured worldwide numbering systems and makes visual sense, cognitive sense and computer sense. In the individual user settings it is possible to choose between FDI, Universal or Haderup tooth nomenclature. When forms are viewed with a different setting, all registrations are automatically translated. The tooth number is by default the permanent dentition but the user may change the numbering to reflect a mixed or primary dentition by double

clicking the tooth number. This operation will also change the tooth number in the odontogram.

Sys codes

Fields for entering dental findings (field 86) will accept the codes from the *Dental data* register. This restriction is made to ensure uniformity and provide comparable antemortem and postmortem data of major importance in the searching mode. Entry of system (sys) codes is made easy by access to the register either by right clicking in the data field or clicking the Dental data button in the bottom pane. This operation will bring up a dialog from where to select the relevant sys code and click the OK button (Fig.3). The sys code is automatically transferred to the tooth field as is its graphic presentation in the odontogram. The colours associated with the sys codes are specified in the Dental data register. Free text in a tooth field can be entered by adding a quotation mark followed by the text. Free text is not displayed graphically in the odontogram but can be searched for in the free text search mode. An extra square per tooth has been added to the odontogram. Clicking the square bring up a dialog with a panel of symbols that may further characterize the tooth

(Fig.4). The symbol is selected by marking followed by clicking the OK bottom. At present one symbol only is accepted per square.

The sys codes and associated sys text is based on English terminology. To make visual sense all codes comprise three letters: one word designations: three first letters (e.g. ede for edentulous); two word designations: two first letters of the first word and first letter of the second word or the opposite, if the first letter of the second word is reserved – see below (e.g. dio for distal occlusion; cfr for crown fracture); three word designations: the first letter of the three words (e.g. fud for full upper denture). For dental restorations, the first two letters of the material form the first and second letters in the code, followed by the restoration type (f for fillings, i for inlay, c for crown, p for pontic, b for bridge, d for denture). These latter third letters are the so-called reserved letters, implying that they cannot appear as the third letter in any other code within the *Dental data* register. Sys codes applicable to restoration of one or more surfaces (f, i) will require entering of the actual surfaces by capitals (O, M, D, V or L). The user may indicate that a filling covers only part of a surface by adding a star

e.g. *VG for vestibular gingival filling. If uncertain on type of treatment the code tre for treatment is to be selected. System codes with x or v as the third letter imply observations seen on x-ray or visible on clinical examination, respectively. Two materials/conditions per surface are allowed e.g. two surface/tooth codes or one surface code and one tooth code. A sys code should be entered in each text field to indicate that all teeth have been taken into consideration; if nothing is known about a tooth the code non for no information should be entered into the antemortem F2 field. The code pre for present is to be selected if only part of tooth is seen on an antemortem radiograph. When printing the dental forms, the user may choose between sys codes, sys text or sys codes without graphics on F2.

Observations on anatomic variations, oral pathology, malocclusion etc. can be entered within field 87 and 88 either as sys codes/text or free text. This information may subsequently be targeted with the form search or free text search mode. Digital photographs and radiographs of teeth and the body as a whole can be imported and linked to field 89 on the F2 form. Field 89 will show the number of photos available on the system.

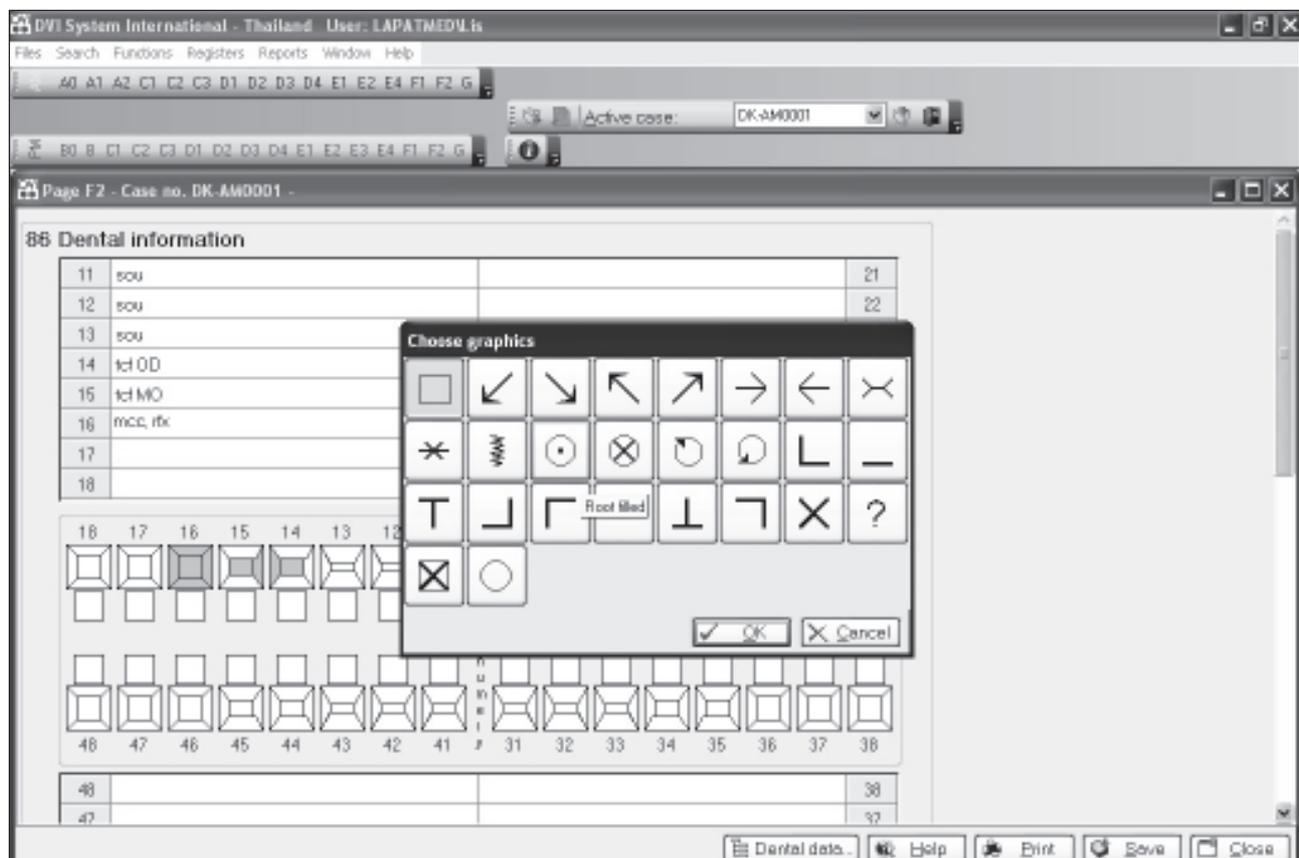


Fig.4: Dialog with symbols to be selected for entering in squares of the odontogram

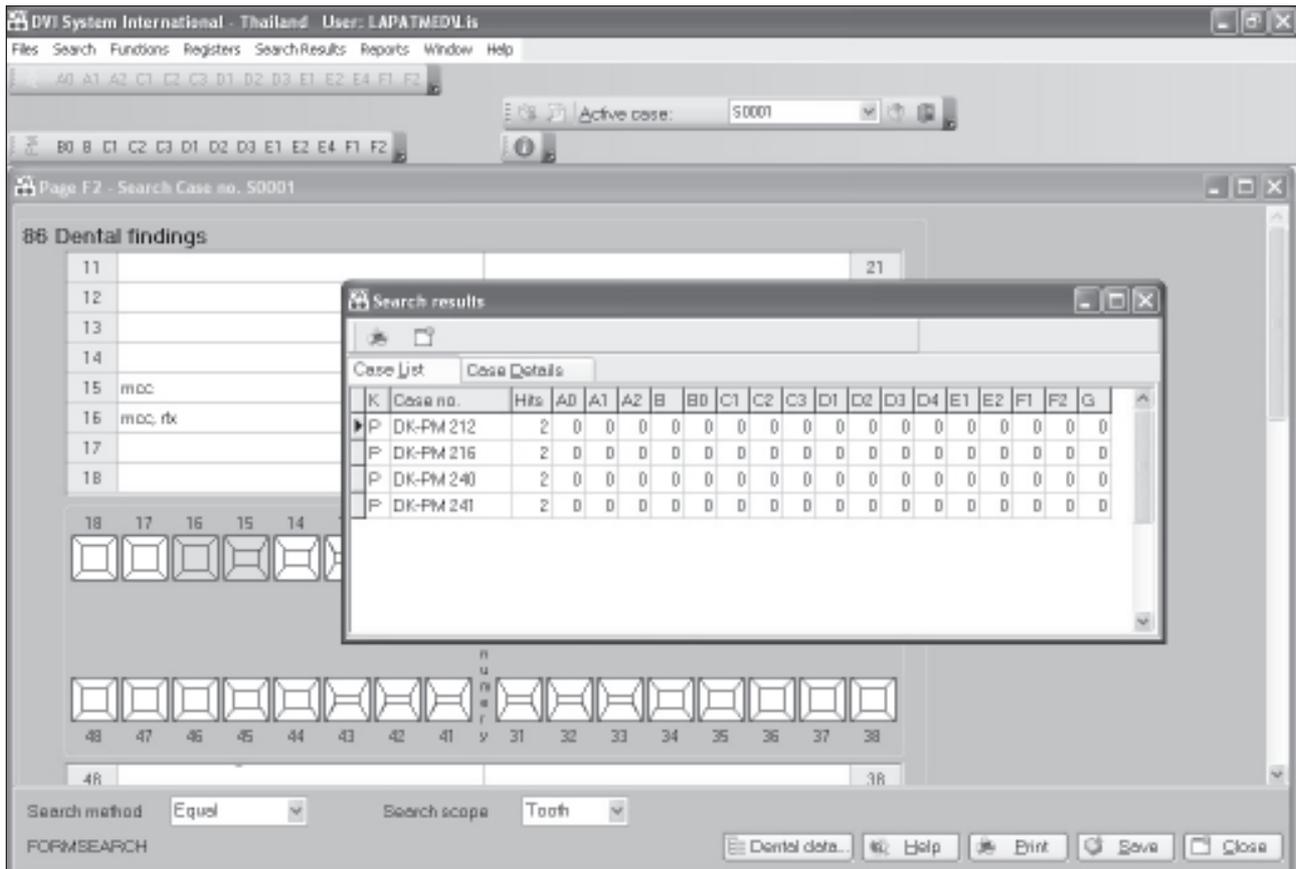


Fig.5: Main frame with display of form search and corresponding search results. The search provides no hit on the dental page F2 but two hits that refer to sex and case state to be displayed if clicking Case details

SEARCH FACILITIES

The search functions are aimed at making searches to display the most probable candidates for match to be reviewed by simultaneous comparison of antemortem/postmortem forms on the screen or manually on printouts. Searching can be performed in both the postmortem and antemortem databases. There are four search modes to facilitate cases to be found and matched e.g. fast search, free text search, form search and with active case. These modes can be selected in the search menu. Irrespective of search mode the search result window will display *Case List* with details on number of hits (e.g. match of any parameter) and their position in the form set (Fig.5). The corresponding case is loaded and made the active case by double clicking the line. Before doing so the user can choose to activate *Case detail* and double-click a detail line for display of both case and form.

The *Fast search* forms a rational sorting tool. This search mode brings up a dialog from where to specify a search on common parameters (gender, age

interval, height, weight, build, hair colour, eye colour or case ID-state). The search can be performed against either antemortem and postmortem cases by clicking the actual button in the bottom pane. *Free text search* allows natural language searches to be carried out across all information in the antemortem or postmortem databases. This search mode brings up a window for entering the text. Before running the search the user is asked to select the gender to be included (all, female and unknown or male and unknown).

The *Form search* brings up a dialog e.g. *New antemortem or postmortem Search Case* to be given *Case No* and *Disaster* characteristics before becoming the active case (Fig.5). An empty F2 form for entering search criteria in the field/s can subsequently be activated by clicking the appropriate button in the toolbar. In field 86 the search is made by the input of a sys code, or rather combinations of codes, that reflect dental patterns of missing, restored and unrestored teeth. Before running the search case the user is advised to select items in the *Search method*

and *Search scope* that will influence the reliability of the search results. Activating the search scope menu in the bottom pane will display: tooth, quadrant, jaw or dentition as the matching parameter; the search method menu will display: specific, equal, equal to or less (in antemortem search), or equal to or more (in postmortem search). Specific search implies that only cases with fully identical sys code(s) will be included in the search result whereas treatments/conditions of similar weight will be displayed provided equal search is requested. Before the search is activated a window appears in which to select gender characteristics. The weighting system designed match antemortem and postmortem sys codes is based on a hierarchical system reflecting progressive disease and treatment modalities of the individual tooth: weights 0-1 for tooth without disease; weight 2 for tooth with disease (caries); weights 3-6 for tooth with disease and treatment; weight 7 for tooth missing; weights 7-10 for tooth missing and with treatment. The two materials/conditions allowed per

surface, as described in the section on dental data entry, form the basis for the match tooth by tooth in the form search mode. When entering sys codes in field 86 it is therefore mandatory to enter codes by priority in accordance with appropriate tooth characteristics.

When clicking search mode 'With Active Case' in the menu the active case is transformed into a search case of the opposite kind (antemortem to postmortem and vice-versa). This mode is considered less appropriate for matching dental data due to inconsistency in record keeping and the possible time frame between antemortem and post-mortem recording.

OTHER FUNCTIONS

Simultaneous display of comparable antemortem and postmortem pages in the same window is performed as part of a Microsoft Office Word* function, whereas similar display of digital photos

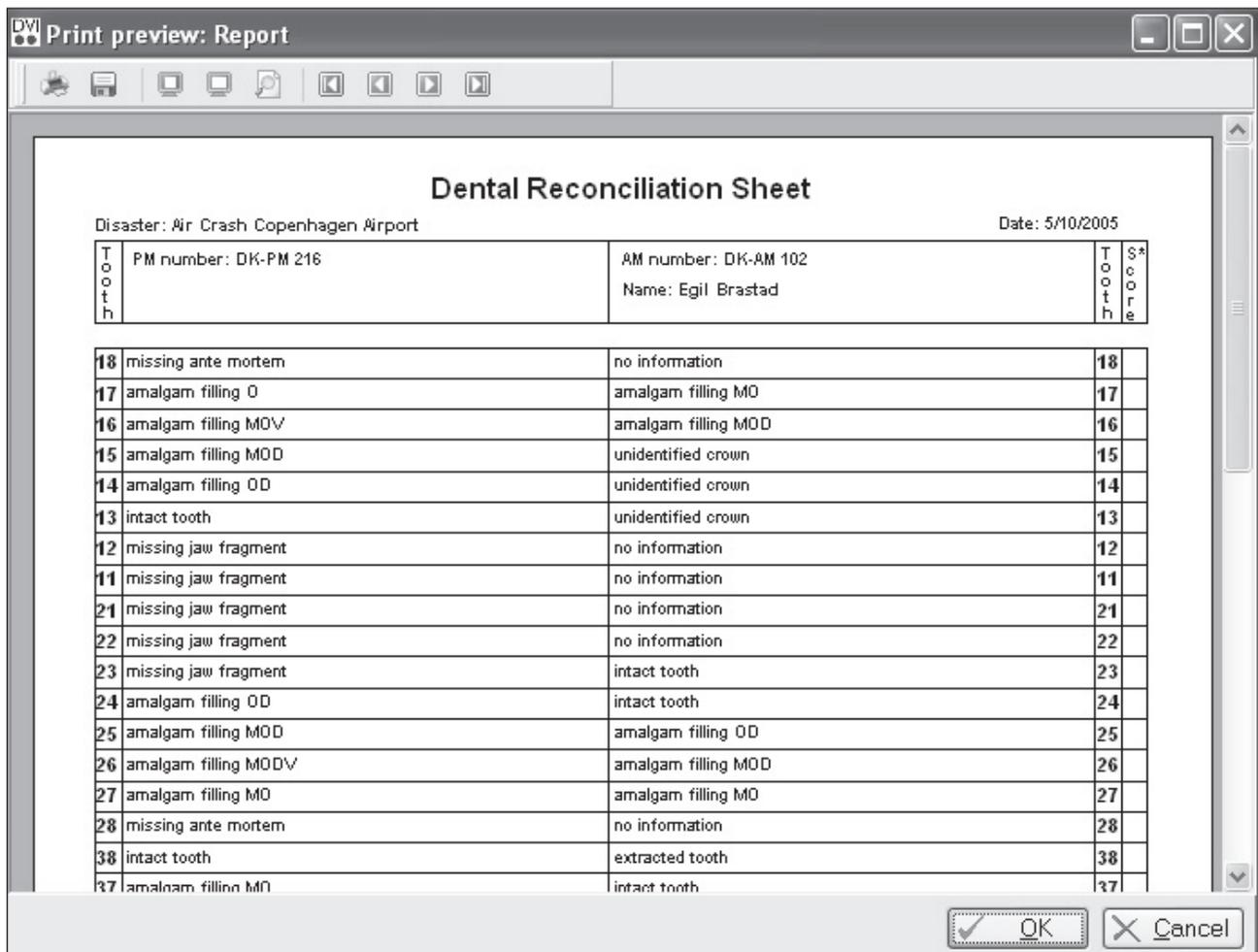


Fig.6: Window form area with display of Dental Reconciliation Sheet

and radiographs is at hand using the Microsoft Office Picture Manager*. Simultaneous display of photos and radiographs, as well as the possibility of having several photos open at a time, was implemented during the TTVI process.

A *Dental reconciliation sheet* with simultaneous display of dental field text tooth by tooth for selected antemortem and postmortem cases can be supplied by activating this task in the *Reports* menu (Fig.6). Updated reports that comply with the Interpol recommendations e.g. case lists, comparison lists, and ID-lists can further be selected from this menu from where also disaster statistics and instant supply of empty DVI forms are among the choices. Program language and print language is by default English but a change in the users interface is possible by selecting another language either in *Preferences* or in the individual *user* settings. Such changes may be useful when preparing translations before transmission of form data to another country. Settings for printing in the form may be conducted in the Interpol languages or in any other languages in which the DVI form has been made available electronically (Albanian, Croatian, Danish, Dutch, English, Finnish, French, German, Icelandic, Italian, Norwegian, Spanish, and Swedish). Before the TTVI process DVI professionals in Austria, Belgium, Denmark, France, Iceland, Netherlands, Norway, Sweden, and Switzerland were among the users of the DVI System International.

COMMENTS

The identification work after the Tsunami in Thailand has definitely been a great challenge for the DVI community and DVI System International. So far this software has assisted in mass disasters with casualty numbers of up to a few hundred. The lessons learnt during the TTVI await results of quality assurance of both the procedures and the staff at work. Until then a few comments based on my experience achieved from work at sites (1A, 1B and 2) and in the Information Management Centre. The inter-individual and intra-individual differences in practice and competency between forensic odontologists from a diversity of countries will inevitably result in a large variation in the way the sys codes are used. Such an obstacle could be surmounted by filtering, e.g. reducing, the number of sys codes to be used. Though providing a great number of sys codes a few new codes (jew for jewellery; une for unerupted) were indeed added to DVI System International during the TTVI process. This ongoing process has

highlighted the needs for a review and revision of sys codes, in particular those characterizing stages in mineralizing teeth. In the form search mode measures could be taken to compensate for possible inconsistency in entering of dental antemortem/postmortem. For example, display of a temporary cross off dialog in field 87 to secure storage of important information (crowns, bridges, edentulous, etc.) for use in the search function. Such functionality was at hand in a previous version, the DVI System. In a future version, the System might be capable of handling translations (national/regional/state codes and text) for all supported languages. Such functionality was at hand in the previous version (DVI System) that did allow a country to apply its own codes. The person in charge could define optional national codes as well as full text to be used to a given number of system codes and during transmission of dental forms to other countries, the codes of a particular country was translated via the sys codes to those of another country. The searching possibilities and capacity are further issues to be reviewed and possibly revised. The search facilities were twice improved, in mid February and in April, by implementation of an additional identity match program designed and developed by Jens Heidmann, Denmark, and working in parallel with the established modes. It remains for further analyses of the identification match progression data to decide whether sorting algorithm of this later program or other types of algorithms should be incorporated in a future version of DVI System International.

ETHICAL NOTIFICATION

The author has no commercial interest in the program but has expressed the wish that the DVI System International will be applied as wide as possible, in order to make international cooperation more effective.

REFERENCES

1. <http://www.interpol.org/Public/DisasterVictim/forms/default.asp>

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