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Proposal for Internet-based Digital Dental Chart for Personal Dental Identification in Forensics

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**ABSTRACT:** A dental chart is very useful as a standard source of evidence in the personal identification of bodies. However, the kind of dental chart available will often vary as a number of types of odontogram have been developed where the visual representation of dental conditions has relied on hand-drawn representation. We propose the Digital Dental Chart (DDC) as a new style of dental chart, especially for open investigations aimed at establishing the identity of unknown bodies. Each DDC is constructed using actual oral digital images and dental data, and is easy to upload onto an Internet website. The DDC is a more useful forensic resource than the standard types of dental chart in current use as it has several advantages, among which are its ability to carry a large volume of information and reproduce dental conditions clearly and in detail on a cost-effective basis.

**KEYWORDS:** forensic odontology, dental chart, personal identification, Internet
1. Introduction

Dental evidence plays an integral and well-known role in the identification of bodies, and there are innumerable examples of its usefulness, such as when public searches have been requested by the Ministry of Foreign Affairs of a particular country [1-5]. Dental evidence has been called upon, for example, when mass disasters have occurred, such as in the identification of victims of the recent tsunami in Thailand, and in the 9/11 terrorist attack on New York.

Generally, dental records of bodies are compared with dental charts, and currently these charts are constructed worldwide using dental data and odontograms. However, the odontogram has yet to be standardized, and there are several styles of odontogram currently available, e.g., the Federation Dentaire Internationale (FDI) and I.C.P.O styles, and the American Dental Association (ADA) and Ryan[6] styles (Fig. 1). While these styles are considered to give an accurate description of the state of teeth, each style has its limitations, especially in establishing the dental conditions of dead bodies. Although the best method is to use an actual intraoral image rather than an odontogram, the use of such images is extremely difficult because of associated costs and technical problems. Therefore, in line with the current trend in various industries toward using IT networks for exchanging information, we have developed a new, more advanced dental chart.
called the Digital Dental Chart (DDC) which uses actual intraoral digital images and makes optimal use of the characteristic features of the Internet and digital technologies.

2. Materials and methods

Preparation of digital images

Intraoral digital images were obtained using a digital camera with a ring flash (Fig. 2), and more detailed images, such as close-up images, were obtained using an intraoral CCD camera (Fig. 3) [7]. In addition, x-ray images were obtained using digital x-ray systems (Fig. 4) [8]. A CCD camera is not essential for taking close-up images if a digital camera can be used instead. However, if the above-mentioned digital instruments are not available, digital images may be obtained by digitally scanning analog photos and films. These images can then be resized, if necessary, to create the required thumbnails.

Construction of DDC

We first created the template for the index page of the DDC by using Hyper Text Markup Language (HTML) (Fig. 5). The template has already been uploaded as an exe file to our website here (URL: http://www.kyorin-u.ac.jp/univ/user/medicine/legal/DDC_Sample.html), and can be freely downloaded for use. Then, using five images
(occlusal surface and labial and buccal views of the upper and lower jaws), we replaced the hand-drawn visual representation part of a Ryan-style odontogram with digital images of actual dental appearances. Subsequently, the condition of each tooth was written in the frame, and the index page of the DDC was completed (Fig. 6). Finally, using a website building application for PCs, we created a website that would allow users to access close-up (enlarged) images or x-ray images by clicking on parts of the dental charts on the index page. The completed DDC can be presently inspected on our website (URL: http://www.kyorin-u.ac.jp/univ/user/medicine/legal/DDC_Sample.html).

3. Results and Discussion

When compared with public searches that used only intraoral photos and traditional paper dental charts, the DDC showed the following advantages: 1) utilization of the Internet provided an ample and flexible platform for public distribution of dental record information; 2) due to digitalization, this system could easily and rapidly supply a large volume of information, such as color and shade of dentition, minute details of dental surfaces, etc.; 3) the information in the DDC could be distributed successfully worldwide by using IT networks; and 4) the construction and transmission of the DDC was economically cost-effective.

In this study, we used the Homepage Builder software (IBM) to construct our DDC.
However, it could also be constructed using any other website building application or HTML text.

The DDC is a very useful resource for personal dental identification of unknown bodies in forensics, especially in open investigations (we are currently working with the Japan Police Department for personal identification of victims on homicide cases, using the following Forensic Odontology Network websites:


In criminal cases in Japan, police departments carry out open investigations on unknown bodies via public magazines, websites and other media. In that situation, dental information and images are often retouched to avoid upsetting the public, and such pictures often include items of clothing and personal belongings. The DDC was developed in order to efficiently detail open dental information in such situations as that described above. Only details released by the police may be used to build such charts.

At the moment, the public use of such information in DDC is permissible in Japan. However, each country may have different laws on the release of personal information. One thing, therefore, that must be considered in the future, is how to adapt DDC in such a way as to make them usable within the parameters of the law of each country.
We believe that one possible way to achieve this would be to build a system where personal ID numbers had to be issued in order for a user or group, for example, a Dental Association, to access such charts. In that way, only authorized personnel would have access and the privacy laws of each country would be respected.

This method holds great potential for the future, particularly when a rich database becomes established and its utility is further expanded.

References


Fig. 1 Various Odontograms.

These old-style dental charts are still in use and are useful for identification in comparing ante- and post-mortem dental information in mass disaster cases, as well as in other situations. However, with these charts, it is difficult to give a detailed description of intra-oral findings. Figures present a problem and it is not possible to give real color of prostheses on such charts. We devised the DDC as a new form of post-mortem record which can recreate ante-mortem intra-oral conditions of bodies even if they have already been cremated.
Fig. 2  Digital camera with ring flash (FinePix S602; Fuji Photo Film, Inc. Japan).

A camera with over two million pixels is recommended, and a ring flash as dental kit, is essential.
Fig. 3 Intra-oral CCD camera (Crystal Cam; GC Corp., Japan)
Fig. 4  Direct digital X-ray system (Compuray; Yoshida Dental Trade Dist., Co., Ltd., Japan). (a) Body of X-ray system. (b) C-MOS sensor. (c) PC.
Fig. 5  Index page of DDC. Completed DDC can be inspected on our web site (URL: http://www.kyorin-u.ac.jp/univ/user/medicine/legal/DDC_Sample.html).