Positional Statement

Forensic Odontology Radiography and Imaging in Disaster Victim Identification

Positional statement of the members of the Disaster Victim Identification working group of the *International Society of Forensic Radiology and Imaging*;

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The use of radiography by forensic odontologists for the purposes of disaster victim identification (DVI) was established in 1949, when it was used to assist in the identification of the victims of the Great Lakes liner "Noronic" disaster in Toronto, Canada. Of the 119 victims of the disaster, positive identification matches were established for 24 of the most severely disfigured cases through the use of comparative odontology radiography (1-3). Today radiography is an established tool of forensic odontologists for DVI. The precise requirements for dental radiography for any given mass fatality incident will be determined by the working practices of the forensic odontologists engaged in the investigation.

Planning

It is recommended that those planning for a mass fatality incident should ensure that there will be facilities and equipment available to enable dental radiographers, forensic odontologists, or appropriately trained dental ancillaries to undertake a full dental radiography survey of each victim or dental related body part.

Radiography

Traditional wet film radiography in the forensic setting has been the mainstay of forensic odontology radiography for many years. Wet film radiography not only suffered from intra/inter-operator

variability but significantly by variables in exposure, processing and fixing. These latter variables often severely impacted upon by conditions surrounding a DVI event, such as temporary mortuaries, uncontrolled environmental factors, and the need to ensure regular supplies of the chemistry required. The advent of digital radiography - Direct Digital (CCD), Indirect Digital (Phosphor plate) enabled a reduction in many of the variables involved in capturing data. The speed of the image processing enables the operator to assess the adequacy and quality of the image rapidly, and to reproduce images when necessary. This has resulted in a significant reduction in the 'processing' time of the radiographic examination, and removed a significant bottleneck at the dental examination stage of the DVI process. Recent advances in battery technology have also seen the introduction of portable "hand held" dental x-ray machines, which when coupled with wireless Direct Digital (CCD) sensors offer optimum throughput together with the ultimate in equipment portability for the DVI situation.

Whatever equipment options are employed, the resultant radiographs will depend largely on the skill and experience of the operator as obtaining high quality post-mortem intra-oral dental radiographs presents significant logistical challenges. In many jurisdictions it is no-longer acceptable to remove the mandible and maxilla for dental imaging examination and this procedure is not considered appropriate save in exceptional circumstances for which prior approval has been obtained from the relevant authorities.

Access to the oral cavity may thus be severely restricted and will require adaptation of techniques and modification of holders. In certain circumstances it will be necessary to replicate the sub-optimal angulations visualised on ante-mortem records in order to obtain comparable post-mortem films.

Dental Survey

A full dental survey will consist of a full mouth intra-oral (peri-apical) film series (14 films) and bitewing radiographs (2 or 4 films). Direct Digital (CCD), Indirect Digital (Phosphor plate) or film may be used. Paralleling technique should be used where possible (4).

A modified survey may consist simply of oblique lateral mandibular views and bitewing radiographs. Further periodical radiographs can then be undertaken as required by the forensic odontologist. Accessibility and condition of remains may limit the extent of any survey for example incinerated and extremely fragile remains. The body should be placed on a suitable trolley and radiographs undertaken in a separate designated Odontology radiological area, for primarily occupational health and safety concerns. Local Radiation Rules specific to the examination area, equipment and exposure factors

used and throughput of examinations undertaken must be in place.

Images should be correctly recorded with the case number, date, time and radiographers' initials (or person undertaking the radiography). If films are used, they should be mounted in film mounts or laminated in the correct orientation. Whilst lamination of the films minimises film loss/disordering and the risk of damage to the image surface, 'delamination' is essentially impossible if films have been mounted and/or ordered incorrectly. This may appear self-evident but in DVI situations, basic errors commonly occur.

Computed tomography (CT) Scanning in the Forensic Odontology setting.

Computed tomography (CT) scanning in the forensic setting and particularly in the DVI situation is still very much the province of a few well-funded services internationally. Whilst CT scanning has been routine in the clinical setting for some time, its application to forensic services has been much slower to evolve, primarily because of cost and availability. The era of virtual dental autopsy is still some time away. Currently where available for DVI events and dental applications it has primarily served as a triage tool and in the ageing of remains. It is however also of assistance in the identification process (5,6).

The application of CT to the hard and soft tissues of the body, particularly the facial bones and the dentition enables detailed 3-dimensional computer generated images to be produced and manipulated. In a DVI situation the initial benefit of post-mortem computed tomography (PMCT) is to triage body bags by enabling examination of bodies without the need to open the body bags. The images produced will (from a dental perspective);

- locate the presence and position within the remains of dental artefacts,
- determine if remains are human or not,
- determine comingling of remains within a single body bag,
- ageing - i.e. adult v child,
- presence of prosthetic (dental) devices such as implants, metal-based crowns and bridges, and metal parts of dentures.

This information can be provided to mortuary teams to assist in their examinations.

Currently limitations of CT systems do not enable the accurate determination of treated surfaces, and in some cases, the restorative material used. Many of the newer restorative materials replicate (radiographically) the density of enamel. Beam hardening or 'metal flaring' often obscure not only

detail in relation to a tooth but also obscures the dentition or lack of, in the immediate area to the 'flaring'. Work in the area of CT scanning and image manipulation continues to reduce and or overcome these limitations (7,8).

Age estimation

Dental ageing of the dentition of children and sub adults is often of great value in mass casualty situations. CT scanning provides accurate images of the stages of development of individual teeth used by most dental ageing systems (9-12).

Injuries

Analysis of injuries to the facial structures can also be (often) more accurately assessed non-invasively with the use of CT data and its manipulation, or by providing guidance to the mortuary examination process.

Summary

The increasing digital capture and storage of both ante and post mortem data in DVI events facilitates not only the management of this information but enables Odontology experts off-site (of the DVI event), to assist. This results in optimisation of the limited expertise both in terms of manpower utilisation but also in relation to time zones and differing geographic zones. This should result in more expeditious processing and less strain on the often limited or over taxed physical and human resources available at the DVI scene. Ultimately, ante-mortem and reconciliation phases could be performed out of the immediate crisis zone in appropriate situations.

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