Journal of Forensic Radiology and Imaging 2 (2014) 52–59

Contents lists available at ScienceDirect

Journal of Forensic Radiology and Imaging

journal homepage: www.elsevier.com/locate/jofri

Review article

RADid: A pictorial review of radiologic identification using postmortem CT

Gary M. Hatch [a,*], Fabrice Dedouit [b,c,d], Angi M. Christensen [e,1], Michael J. Thali [f], Thomas D. Ruder [f,g]

[a] Radiology-Pathology Center for Forensic Imaging at the New Mexico Office of the Medical Investigator, Departments of Radiology and Pathology, University of New Mexico School of Medicine, 1101 Camino de Salud NE, MSC07 4040, 1 University of New Mexico, Albuquerque, NM, USA
[b] Laboratoire d'Anthropologie Moléculaire et Imagerie de Synthèse, AMIS, UMR 5288 CNRS, Faculté de Médecine, 37 allées Jules Guesde, 31073 Toulouse, France
[c] Service de Médecine Légale, Centre Hospitalier Universitaire Rangueil, 1 Avenue du Professeur Jean Poulhès, TSA 500032, 31059 Toulouse Cedex 9, France
[d] Service de Radiologie, Centre Hospitalier Universitaire Rangueil, 1 avenue du Professeur Jean Poulhès, TSA 50032, 31059 Toulouse Cedex 9, France
[e] Federal Bureau of Investigation Laboratory, Quantico, VA 22135, USA
[f] Department of Forensic Medicine and Radiology, Institute of Forensic Medicine, University of Zürich, Winterthurerstrasse 190/52, CH-8057 Zürich, Switzerland
[g] Institute of Diagnostic, Interventional and Pediatric Radiology, University Hospital, CH-3010 Bern, Switzerland

ARTICLE INFO

Article history:
Received 8 February 2014
Accepted 27 February 2014
Available online 5 March 2014

Keywords:
Forensic radiology
Forensic identification
Comparative identification
Postmortem computed tomography
Virtopsy

ABSTRACT

Radiologic identification (RADid) is a powerful and frequently successful tool for personal identification (ID). Postmortem computed tomography (PMCT), in particular, is uniquely well suited for the ID process, given the fact it may be reformatted or rendered to match almost any AM medical imaging examination. RADid may also offer a faster and less expensive alternative to other methods, such as DNA analysis, in selected cases. This paper presents a brief overview of the role, capabilities and techniques of medical imaging in the process of ID, introduces the lines of evidence that can contribute to ID and highlights specific case examples of RADid, with a focus on the use of PMCT for RADid. Although used routinely by various practitioners and institutions (including those of the authors), RADid is, in our opinion, underused in the forensic community. The case examples presented here demonstrate the wide range of IDs that are possible using RADid and will hopefully encourage practitioners in its use.

Contents

* Corresponding author. Tel.: +1 505 925 0520.
E-mail address: ghatch@salud.unm.edu (G.M. Hatch).
[1] The views expressed in this paper are those of the authors and do not represent the views of the FBI.

http://dx.doi.org/10.1016/j.jofri.2014.02.039
2212-4780

1. Role

RADid encompasses comparison of antemortem (AM) and postmortem (PM) imaging in the attempt to identify a decedent (a process sometimes referred to as "comparative identification" or "identification comparison" using medical imaging). RADid may include the use of radiographs, ultrasound, computed tomography (CT), or magnetic resonance imaging (MR) and may involve a combination of modalities. Traditionally, fingerprint, DNA and dental were considered the most reliable ID methods, but any feature that is sufficiently rare in the general population can be reliably applied to assist in ID, and RADid should therefore also be considered a reliable identification method. The frequencies of observable traits and fundamental method of application closely parallels that of other ID techniques, with the advantage of the ability to compare anatomical sites throughout the entire body.

ID usually proceeds based on local protocols and the availability of experts, and approaches may vary depending on whether it is an isolated identification or a more complex event such as a mass fatality incident. There are no established national or international protocols for personal ID, although some general guidelines do exist relating to disaster victim identification [1,2], and those outlined for personal ID by specific identification subspecialties, e.g., the Scientific Working Group for Forensic Anthropology (SWGANTH) and the American Board of Forensic Odontology (ABFO) [3,4], The general principles describe in this paper, however, can be applied in a variety of scenarios.

Several methods for ID can be employed, including: visual identification, fingerprint analysis, DNA analysis and RADid. Depending on the case, the process of RADid may require the expertise of forensic anthropology, forensic odontology, forensic pathology and/or radiology. Close interdisciplinary collaboration will ensure the optimal method of ID (or technique within the scope of RADid) is applied in each case and that all avenues are explored in challenging cases. It is recognized that practitioners have varying experience and specialties, and consultation with other practitioners is strongly suggested when examinations and comparisons using technologies, procedures or anatomical regions are beyond one's expertise.

2. Capabilities and techniques

2.1. Overview

Medical imaging, in particular radiography, PMCT scout views and PMCT, provide an excellent overview of the decedent that can be used to assess areas for further investigation. Whole body imaging allows for rapid assessment of body part inventory and the presence of possible commingled or nonhuman [5] remains. A fundamental strength of imaging is the localization and identification of the myriad foreign bodies that may be encountered in forensic investigations, including: debris, personal effects, implanted devices, life support and/or monitoring devices and projectiles. The ability to quickly and reliably perform the body part inventory and screening for foreign bodies is especially useful in severely charred, traumatized or decomposed bodies.

2.2. Access to AM records

The digital format of the vast majority of modern medical imaging enables straightforward transfer of image data either electronically or on electronic media. This fact is routinely exploited in clinical radiology both for primary interpretations (via teleradiology) and to obtain comparison studies from outside institutions. What may be less well recognized by the forensics community is the fact that these same procedures are currently in use for forensic investigation. For example, the authors have direct links to the picture archive and communication systems (PACS) of their local hospitals and can retrieve entire imaging studies within

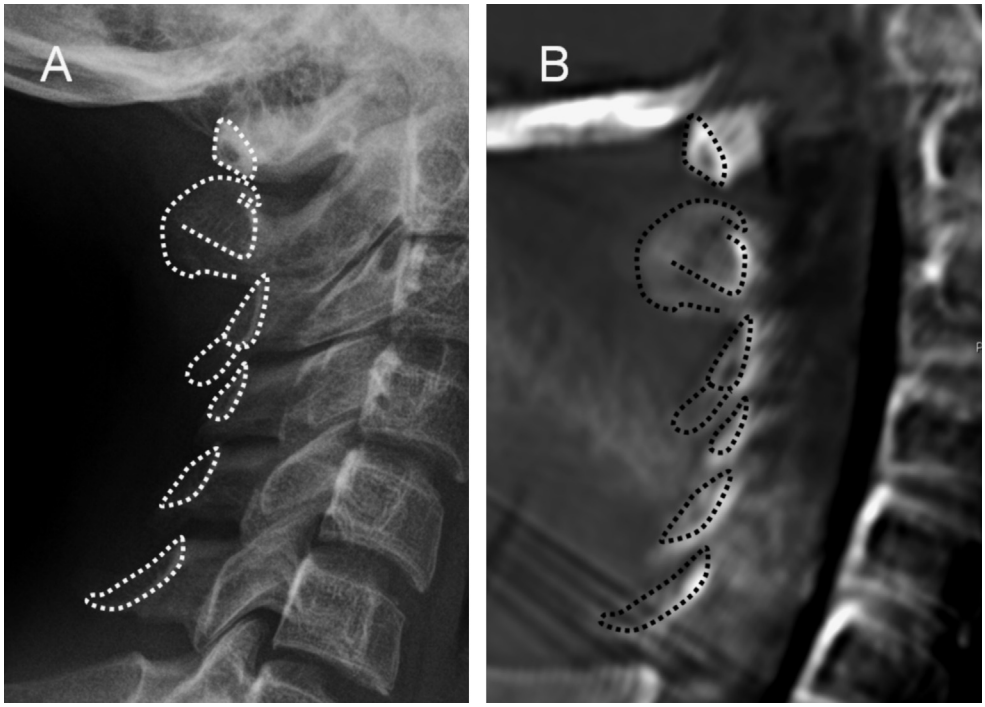

Fig. 1. RADid using normal anatomy – cervical spine posterior elements. (A) AM lateral cervical spine radiograph. (B) PMCT – pseudo-radiograph created with thick slab MPR using mean rendering and matched to the orientation of the AM image. The matching cortical outlines of the posterior element anatomy were used in this ID, indicated by the dotted lines. Severe thermal damage was present in the decedent, exhibited by low density areas of marrow rarification and cortical damage of the vertebral bodies (lower right in B) but this did not preclude ID in this case.