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CASE REPORT

Human identification based on cranial computed tomography scan — a case report

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Today, there is increasing use of CT scanning on a clinical basis, aiding in the diagnosis of diseases or injuries. This exam also provides important information that allows identification of individuals. This paper reports the use of a CT scan on the skull, taken when the victim was alive, for the positive identification of a victim of a traffic accident in which the fingerprint analysis was impossible. The authors emphasize that the CT scan is a tool primarily used in clinical diagnosis and may contribute significantly to forensic purpose, allowing the exploration of virtual corpses before the classic autopsy. The use of CT scans might increase the quantity and quality of information involved in the death of the person examined.
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Case report

An adult male, initially unidentified, passed away as a result of a traffic accident. The body was transported to the regional Legal Medicine Institute for identification and routine medico-legal examinations: determining the cause of death, its circumstances and the instrument that caused it. After 30 days, the victim remained unidentified and the body had not been claimed by any next of kin. As a result, routine proceedings were conducted prior to burial, such as taking facial photographs and collecting post-mortem fingerprints and DNA samples.

As the victim had been missing for a long period of time, the supposed family members searched for him in hospitals as well as with friends and relatives. The result of this search ultimately ended when the victim was recognized based on post-mortem photographs filed in the unclaimed bodies section of the Legal Medicine Institute where the body had been examined. Immediately, the standard fingerprints were requested, which should have been on file with the civil identification authorities. However, the file containing those fingerprints (taken when the victim was alive) could not be found, which made a comparison of the prints impossible. Therefore, another methodology for confirming the victim's identification became necessary, leading family members to search for information and documentation related to old medical and dental treatments as well as photographs of the missing person.

The results of this investigation revealed the existence of a brain CT scan and seven thoracic and abdominal conventional radiographs. The imaging exams had been made approximately 6 years prior to the victim's death as part of the diagnosis for skull trauma, resulting from a traffic accident at the time. As a result of trauma, part of the parietal bone and part of the squamous portion of the temporal bone, both on the left side, were surgically removed. On the right side of the cranium, in the parietal bone, the victim was subjected to a surgical intervention for intracranial decompression, at which time a circular-shaped osteotomy was performed. Afterwards, the victim did not undergo a new surgical procedure to replace the lost area; the defect remained uncovered by any sort of metal plate.

During the evaluation of the CT scan images of the cranium, two well-defined hypodense images were observed from the scanogram (Figure 1a): the first with a polygonal shape, similar to a quadrilateral, situated in the left temporoparietal region (Figure 1b); and the second with a circular shape located in the right parietal region (Figure 1c).

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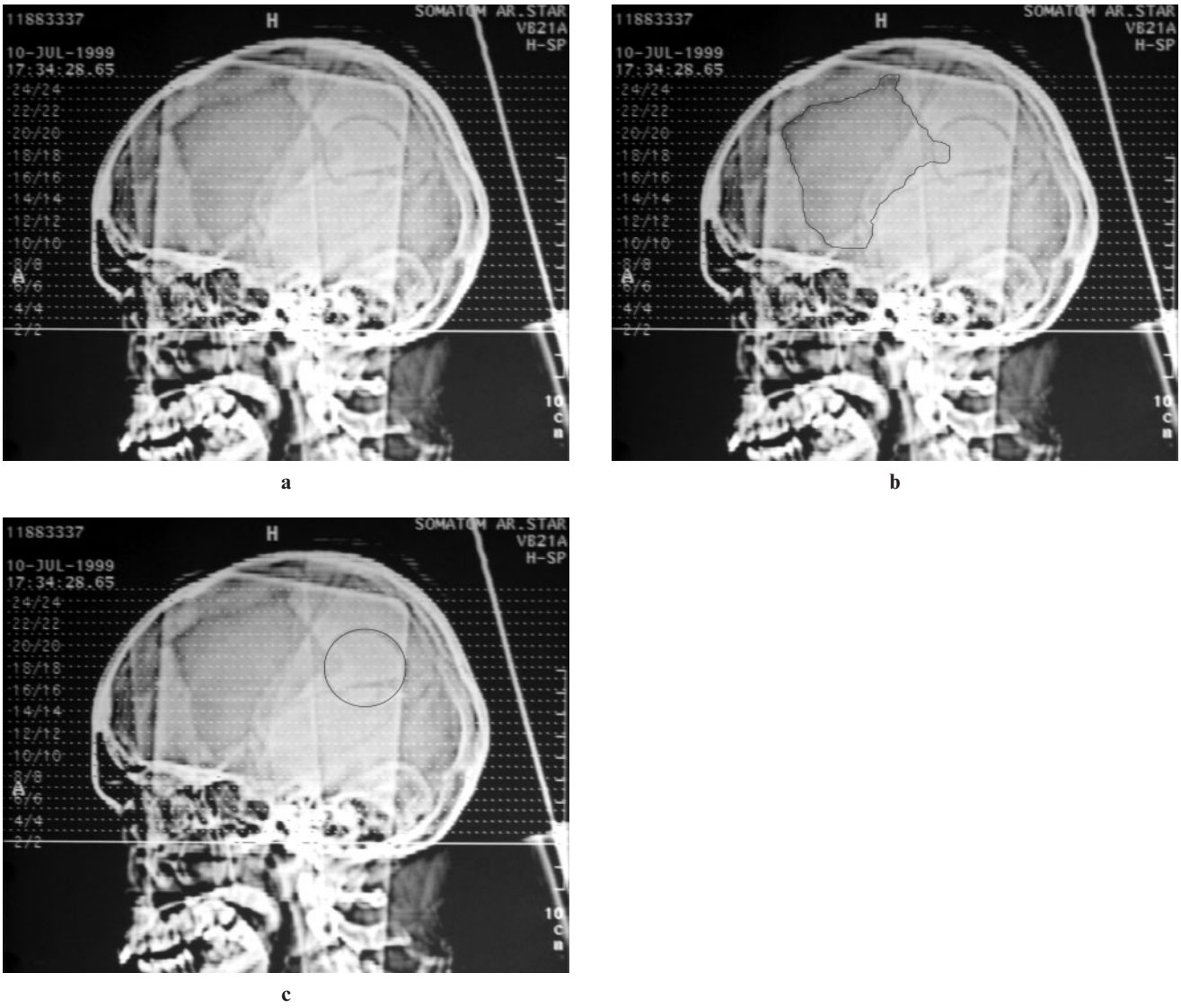


Figure 1 Scanogram demonstrating bilateral hypodense areas with different shapes (a). Delination of the edges of the images located on the left (b) and right (c) regions of the cranium

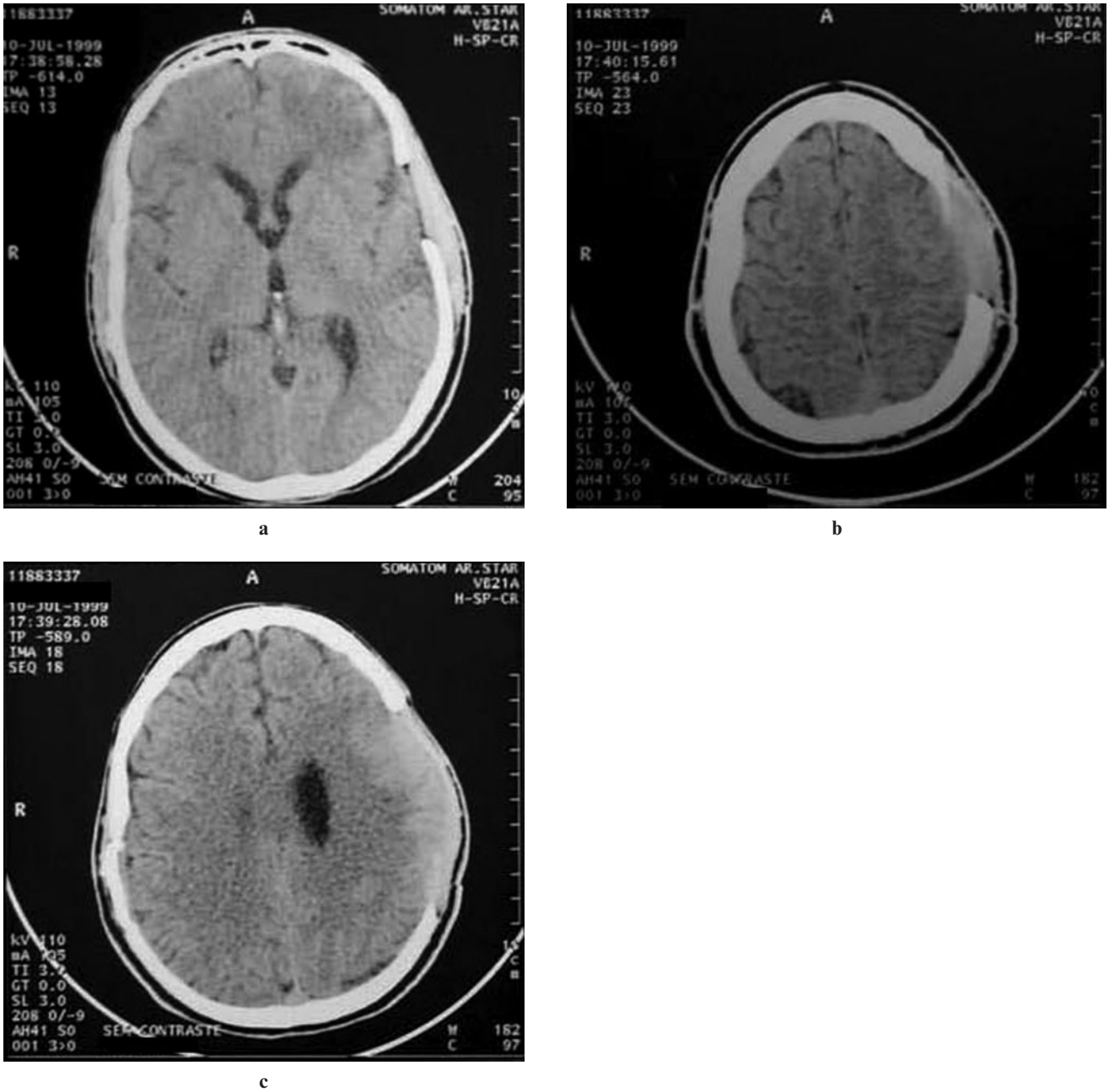
From the axial slice exam, an important bone loss was observed in the left side of the cranium, extending from the beginning of the squamous portion of temporal bone (Figure 2a) to the parietal bone (Figure 2b). It was also possible to observe the borders of a circular-shaped fenestration in the right parietal bone at the level of the largest axis of bone loss on the left side (Figure 2c).

Given this new possibility for identification, the body was exhumed approximately 1 year after burial, at which point only the cranium and the mandible were collected. The parts were adequately cleaned and bone fragments and teeth were glued, which enabled the performance of the post-mortem exams.

By examining the cranium, a cut in the cranial vault was detected, compatible with that produced during the autopsy. A circular-shaped fenestration in the right parietal region and a polygonal-shaped open defect in the left temporoparietal region were also detected (Figure 3) — both with dimensions, shapes and locations compatible with the images from the CT scan made *in vivo*. The bone edges that delimited these two bone lesions appeared blunt and smooth, indicating they had been produced in life, as a result of trauma (left side) and surgical procedure (right side), with no signs of recent change and not related to the medico-legal procedures performed.

Discussion

The identification of human remains from the direct comparison of morpho-radiographic traits evidenced through *in vivo* and post-mortem images has become routine in forensic medicine departments. Of these, the



a **b**

c

Figure 2 Axial slices of the cranium, evidencing bone window with the absence of part of the bone structure of the left side, extending from the squamous portion of the temporal (a) to the parietal bone (b). Also noticed is an irregularity in the surface of the right parietal bone at the same level of area of largest bone loss on the left side (c). This image also shows a subcortical haemorrhagic contusion

radiographs most often used for forensic comparison are dental,[1] cranial[2] and extremities.[3,4]

Nevertheless, with the increased use of CT scans for clinical uses, these examinations have also become a relevant source of information for human identification, as they are currently performed at most public or private medical facilities.

Regarding the specific case presented here, the positive identification of the victim was possible because a cranial CT scan that had been made when the victim was alive was located, which allowed the visualization and measurements of specific characteristics related to bone loss owing to skull trauma resulting in surgical intervention. These traits were located on the left and right sides of the cranium. The qualitative and quantitative aspects of these findings, regarding location, borders and dimensions, were also adequately evidenced in the post-mortem examination, producing extremely relevant results that allowed a positive identification of the victim to be established exclusively by CT scan analysis.

a b

Figure 3 Left (a) and right (b) lateral view of the cranium, reconstituted after exumation

The result of the analysis of thoracic and abdominal conventional radiographs, when compared with the post-mortem findings, did not show specific features that could positively identify the victim, demonstrating that the images of the craniofacial region had a higher potential for identification when compared with the thoracico-abdominal region.[5]

Highlights must also be given to the fact that certain legal medicine facilities already have CT scan equipment that is used exclusively for cadaver examinations.[6–9] This demonstrates the importance of investing in imaging technology for forensic needs. In this regard, the reference is the Legal Medicine Institute of Copenhagen, Denmark, which since 2002 routinely performs a full CT scan of all corpses examined in the forensic pathology department prior to the traditional autopsy.[10]

The use of CT scans before classical autopsy are relevant to the analysis of trauma,[7,11] decomposed bodies[12] or human remains, helping or even making possible the identification of the circumstances and cause of death,[13] and also in enhancing the view of anatomical features that could be disguised. A post-mortem CT scan also significantly contributes to image comparison in human identification because it represents an exam of quality, objectivity, accuracy and data which has general acceptance by the scientific community.[14]

It is of upmost importance that imaging examinations produced during medical appointments at private practices, clinics or hospitals (public or private) be filed correctly. In case these exams are not filed, they should preferably be given to the patients or their legal guardians, emphasizing the importance of careful storage in case they become necessary.

To summarize, CT scans produced in life, in addition to their clinical importance, can currently be used as an aiding tool for the identification of unidentified bodies, producing reliable results and important evidence to the authorities.

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