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Case Report

Positive identification by X-rays bone trabeculae comparison

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ABSTRACT

Positive (certain, absolute) identification of human remains needs a scientific comparison between ante mortem and post-mortem biologic features, as fingerprint, odontological, radiological or DNA comparisons. X-rays comparison has been extensively used, usually comparing some peculiarities such as outlines of the bones, degenerative evolution or pathological conditions. Trabeculae comparisons are sparsely underlined in the forensic literature. We report on a case of decomposed body where fingerprint, DNA and odontological comparisons were not possible. After dissecting the leg and preparing the bones, comparison of ante mortem and postmortem trabeculae led to a positive identification. It was observed that tens of radiolucencies and radiodensities drawn by the trabeculae were useful for comparison, within a very small part of bone. In the case reported here the positive identity could have been assessed only by the comparison of the first metatarsal. The statement of positive identification needs scientific criteria that will be discussed in this article.

1. Introduction

Forensic investigations concerning unknown bodies or remains are very frequent in forensic pathology or forensic anthropology. Results of the identification process must be classified as precluded, possible, probable or positive identification [1]. Only methods leading to a precluded identity or a positive (certain) identity are recommended by the scientific community. These methods of investigation require ante mortem records for the purpose of establishing a comparison. There are four main ways of performing this comparison: fingerprints, odontological, X-ray or DNA comparison. Other methods of positive identification (e.g., comparison of a very peculiar scar or tattoo, reference number of an orthopaedic prosthesis or a pace maker) [2] are rarely available.

X-ray comparison has been extensively used [3,4], because it is a very simple, cheap, fast and efficient method. Furthermore it is quite rare for a family not to have previous X-ray records. CT scans are also used for help to give the biological profile, and for radiological comparison [5,6]. There are many options available for radiological comparison. Any part of the skeleton can be used [3,7,8], as clavicle, shoulder, ribs, vertebrae (including comparison of transverse and spinous processes, pedicle and margins of the vertebrae), long bones, pelvic bones. Nearly each bone and each part of the bone contain clues as to the identity of the person and may allow for positive identification, including difficult cases like fragmented or burned remains [9,10]. The skull is probably the most useful part of the skeleton for positive identification: the frontal sinus [6,11], sphenoid and mastoid sinus, vessel prints, cranial suture patterns, mastoid cells, CT Scan ethmoid air cells or sagittal suture, sella turcica and above all teeth and roots have all been studied.

Usually, radiological comparison requires the study of peculiarities such as shape characteristics of the outline of the bone, Harris lines, shape and extent of periosteal reaction, calluses,

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exostoses or pathological conditions [10,12], whose very specific features allow for positive identification. In contrast, comparison of bone trabeculae is rarely quoted in the forensic literature. Van der Schelt et al. [13] proposed trabecular patterns comparison from dental radiographs. Mann [14] examined 42 adult distal left femora and 38 proximal left tibiae and concluded that no two bone trabeculae were identical. At least four features (sketches drawn by radiolucencies and radiodensities) were unique features available for the purposes of positive identification. Kahana et al. [15,16] claimed that the trabecular architecture is unique to each individual and stable in time. These authors were enthusiastic about the possibilities of this method of positive identification, after having studied the bone trabeculae from a sample of 305 X-rays (including 103 women) of the left wrist. They concluded that this is potentially the best radiographic forensic marker. Ciaffi et al. [17] assessed the reliability of bone density patterns of the humerus from chest X-rays. These five articles are dedicated to bone trabeculae analysis. Other works quote the comparison of ante mortem and post-mortem bone trabeculae as a mean of identification, among others [7,18–27].

To our knowledge, there are no more scientific papers in the forensic literature specifically devoted to the identification by bone trabeculae comparison. We present hereafter a case where the bone trabeculae comparison was the only method available for identification. This method may be used each time there are available ante mortem X-rays. It is easy to get the specific part of the bone to compare trabecular X-rays by dissecting the concerned area in the autopsy room. Obviously this method implies altered human remains, but is could be used even with fresh bodies, because it is an easy, not time consuming and very cheap way of identification. We will then discuss the criteria required to obtain a positive (certain) identification using this method.

2. Case report

A decomposed body was found in a technical locale. The autopsy stated that the cause of death was skull trauma resulting from a fall from the ladder that led to the technical locale. But the identity of the deceased person was unknown. The police investigation pointed to a homeless man. This man had no known family, no DNA record in the national French DNA database, and had no known odontological practitioner. We looked for possible medical records in the local hospitals and found out that the putative victim had consulted three times at the emergency department. One of the consultations was motivated by ankle pain. The patient underwent an X-ray examination of the ankle and foot at that time. Only three months had lapsed between the ante mortem X-rays and death.

Therefore we attempted to identify the patient by radiological comparison. This comparison required the dissection of the leg in the autopsy room and the preparation of the bones in boiling water. When the bones were clean and dry the challenge was to reproduce the angle of the ante mortem X-rays. We brought the bones and the ante mortem radiological plates to the radiology department. Several trials were required to obtain adequate X-rays plates. The general outlines of the bones were similar, but, in our opinion, insufficient to positively identify the patient.

We found a great number of points (more than 50 points) for trabecular comparison in the ankle and in the foot. We present here 13 points of comparison that were obvious in the foot (Fig. 1). The easiest points of comparison were discovered in the first metatarsal (Fig. 2).

We concluded that our deceased person matched the records of the patient seen in the emergency room three months before. The data from the trabecular comparison led to a positive

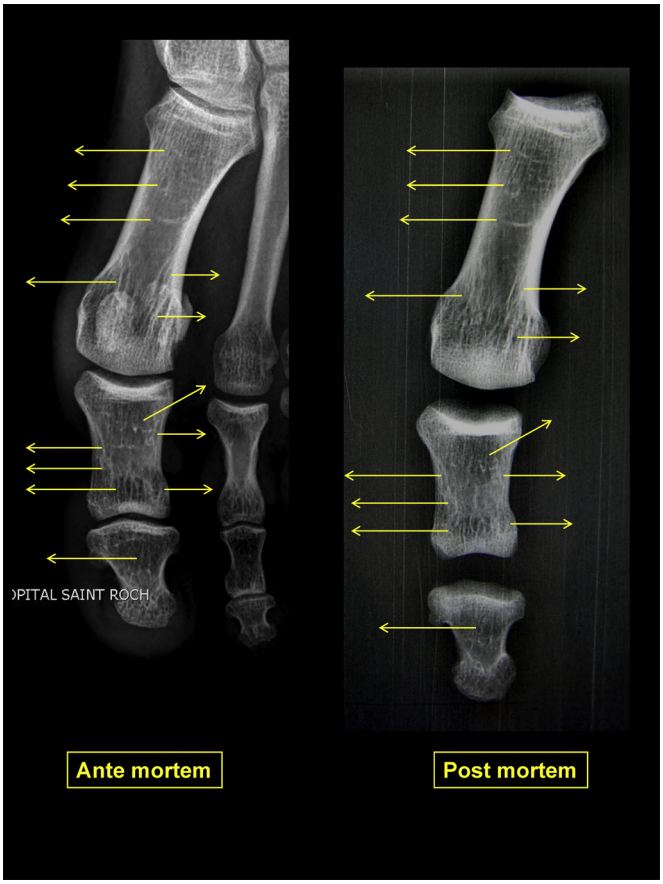

Fig. 1. Trabecular comparison between the ante mortem available X-rays and the post mortem X-rays of the same bones, obtained after dissection in the autopsy room and anthropological preparation. Each arrow represents a specific and unique point of comparison. 13 obvious points of comparison are pointed out on the figure, but there were more than 30 useful points of comparison in each available bone of the foot.

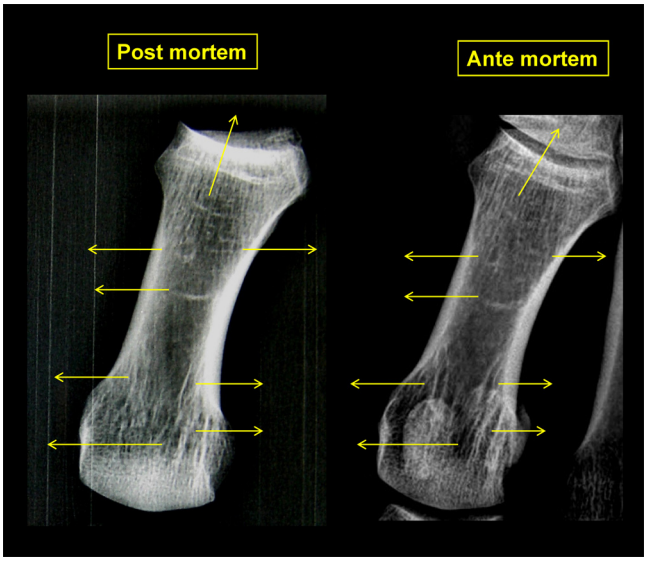

Fig. 2. Trabecular comparison of the first metatarsal. 8 obvious points of comparison are underlined on the figure, but there were more than 30 useful points of comparison within this first metatarsal. There are some differences between some specific points, but there are due to the slight difference of the orientation of the radiological beam, and slight difference in average radiological density between ante mortem and post mortem X-rays.