Forensic Science International 206 (2011) e67–e70

Contents lists available at ScienceDirect

Forensic Science International

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

Case report

Scanning electron microscopy as an auxiliary method in the study of exhumed bones

João A.D. Melki [a], Carmen C.S. Martin [b], Talita Zerbini [b,*]

[a] Medical Legal Institute of Ribeirão Preto, Ribeirão Preto, São Paulo, Brazil
[b] Department of Legal Medicine, Faculty of Medicine, São Paulo University, São Paulo, São Paulo, Brazil

ARTICLE INFO

Article history:
Received 11 May 2009
Received in revised form 27 August 2010
Accepted 6 September 2010
Available online 6 October 2010

Keywords:
Scanning electron microscopy
Crime weapon
Skull fracture
Exhumation
Vital reaction

ABSTRACT

Scanning electron microscopy (SEM) has been used in forensic science in many ways. The reports of cases in which SEM has been used as an auxiliary method in the investigation of exhumed bones are rare. In this article, we report an exhumation that was made to determine if a seized weapon could have been used in a homicide. We used SEM to analyze a fracture in the interior of the skull of the victim. The findings described in this article showed us that it is possible to develop new researches in this field.

1. Introduction

Scanning electron microscopy (SEM) has been used in forensic science in many ways, particularly in studies concerning skin morphology, wound lesions, residue identification and vital reaction [1,2]. In the studies regarding vital reaction, what is basically analyzed is the presence of erythrocytes out of the blood vessels, taking into consideration that such cells remain intact even months after death [3].

The living organism responds to injury by activating inflammation and blood coagulation, systems which are closely related. The coagulation system triggers the activation of thrombin, thus being responsible for the fibrin formation, which occurs in minutes [4].

The vitality of lesions has been fairly studied mainly on skin, particularly through immunohistochemical analysis and molecular biological techniques such as RT-PCR. However, the studies on bones are still scarce [5–7]. Cattaneo et al. studied fractured bones obtained from bodies of people with a known time of survival. The optical microscopy and the immunohistochemical study revealed blood clot, fibrin deposits and initial bone deposition, suggesting that these signs could possibly indicate the vitality of lesions even on dry bones [8].

In fractures occurred during life, fibrin nets and erythrocytes can be easily visualized [9]. However, the published reports of cases where SEM has been used as an auxiliary method of vital reaction investigation in exhumed bones are still rare [10].

In this article, we report an exhumation case of a homicide victim, who had been buried three and a half years ago, in which it was necessary to investigate a fracture found on the interior surface of the exhumed skull.

2. Case report

A 43 year-old white man was watching a football game at a sugarcane farm when he had a misunderstanding with another fan, a fact that was witnessed by many people. After the game, the two men met on a public way and had a further misunderstanding. According to the report of the suspect, he pushed the victim, who fell and hit his head on a stone. He denied the use of any instrument during the fight with the victim.

2.1. Autopsy

During the external examination, we observed a stab of 2 cm on the right temporal region of the skull, with path to the interior of cranial cavity. In the internal examination, we found multiple

* Corresponding author at: 455 Doutor Arnaldo Avenue, Oscar Freire Institute, São Paulo, São Paulo 01246-903, Brazil. Tel.: +55 11 87525482.
E-mail address: tazerbini@yahoo.com.br (T. Zerbini).

0379-0738/$ – see front matter © 2010 Elsevier Ireland Ltd. All rights reserved.
doi:10.1016/j.forsciint.2010.09.004

Fig. 1. Skull of the victim with a hole on the right temporal bone, measured in cm (profile view).

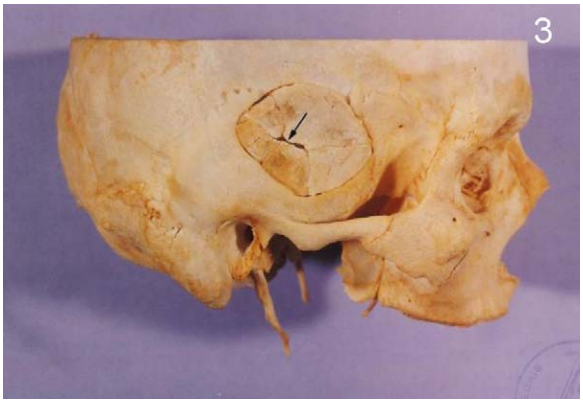

Fig. 3. Fragments on the hole of the right temporal bone of the skull of the victim, demonstrating perfect match (profile view).

fractures and bone sinking in an oval form of 5 cm of diameter, in addition to a transfixing brain lesion from the right side to the contralateral side, with rectilinear path. The death occurred as a result of head trauma caused by a knife or a dagger.

When the autopsy report was concluded, the police authority began to search for the possible instrument used as the crime weapon. Only after three and a half years said authority seized a dagger that was in possession of a friend of the suspect. To conclude the investigation, the Medical Legal Institute was required to analyze the instrument found to determine if the seized weapon could have been used in the crime. Thus, we requested the exhumation of the victim's body to analyze the skull and to confront it with the suspect weapon.

2.2. Exhumation

In the macroscopic examination of the skull, we found an oval hole at the right temporal bone measuring 4.8 cm × 3.8 cm. In the act of exhumation we collected seven bone fragments of small sizes and irregular shapes that were beside the skull, inside the coffin. The fragments were put together and glued, adjusting perfectly to the hole in the skull. Therefore, we concluded that the fragments were part of the fractured temporal bone (Figs. 1–3).

During the examination of the interior surface of the left temporal bone we observed an irregular orifice measuring 1.0 mm × 1.5 mm. To determine if this finding was caused by a trauma or if it was a natural anatomic orifice, we made a transillumination examination in this region and in a normal skull, which was used for comparison. To accomplish this, we used an incandescent lamp placed in the interior of the skull and thereafter on the exterior of the skull, at the level of the region in study (Figs. 4 and 5). During the illumination, we visualized a darker circle measuring 0.5 cm of diameter, concentric to the orifice, while in the normal skull the same was not observed. This fact indicated to us that said orifice was not natural.

2.3. Suspect weapon analysis

With the conclusion that the orifice was not an anatomic finding, we made a simulation of the dynamic process of the mortal lesion to determine if that orifice could have been produced by the suspect weapon.

The suspect weapon had two edges with a tapered and piercing tip. The blade was 28.4 cm of length and 2.9 cm at the largest width of the cutting edges (Fig. 6). The tip had a slight deformation. It was not possible to obtain biological material from the dagger to proceed with the DNA comparison.

In possession of the suspect weapon, we made a serial photographic demonstration from different angles of the possible path of the weapon into the skull. The upper view demonstrated that the seized weapon entered through the hole of the right temporal bone and reached the orifice on the contralateral portion of the skull, which fact allowed us to conclude that said path was coincident with the transfixing lesion brain path described in the first autopsy (Figs. 7 and 8).

After the above finding, it was necessary to establish if the orifice found in the interior of the skull was produced during the crime or if it was created during the first autopsy. In order to do so, we removed a circular bone fragment concentric to the orifice in study, measuring 2.0 cm of diameter. Said fragment was divided in

Fig. 2. Fragments found beside the skull after they were glued (external view).

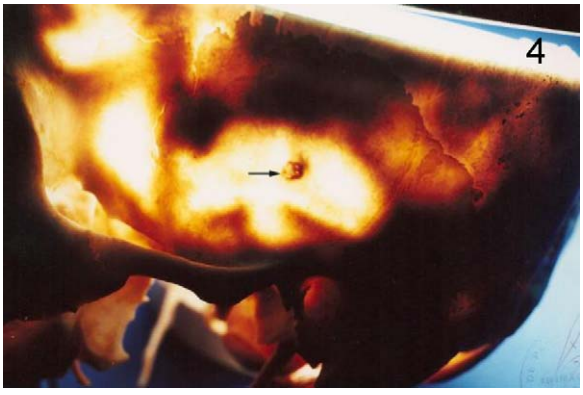

Fig. 4. Transillumination of the left temporal bone of the skull of the victim showing a darker circle around the orifice (external profile view).