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Case report

The utility of 3D medical imaging techniques for obtaining a reliable differential diagnosis of metastatic cancer in an Iron Age skull

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ABSTRACT

In this report we present a case of neoplastic disease affecting an Iron Age skull that provides some of the earliest evidence of metastatic cancer (MC) in Western Europe. The cranium comes from the indigenous site of Baucina (Palermo, Sicily) and was recovered in a multiple burial context dated to the 6th–5th centuries BCE. The skull was attributed to an adult female and was characterized by numerous perforating lytic lesions. CT and 3D imaging analyses were crucial for obtaining a diagnosis of MC. Based on the morphology of the lytic lesions and the biological profile of our specimen, we can tentatively suggest breast carcinoma as the primary origin of the clinical manifestations recorded on the skull. This work also highlights the importance of utilizing an analytical approach to paleopathology that incorporates up-to-date CT and 3D imaging techniques.

1. Introduction

The antiquity of cancer has been demonstrated by numerous studies (Aufderheide and Rodriguez-Martin, 1988; Capasso and Mariani, 1994; Ortner, 2003). However, taphonomic phenomena, which may simulate a wide range of degenerative pathologies, constitute a major difficulty in the analysis of neoplastic diseases in archaeology (Capasso, 2005; Lieverse et al., 2014). Furthermore, the patterns of different neoplastic diseases on dry bone often overlap (Brothwell, 2008; Marks and Hamilton, 2007; Strouhal, 1991).

Recent advances in technology have greatly enhanced the diagnostic power of traditional radiology (Dougherty, 2009) and can be successfully applied to paleopathological studies (Beckett, 2014). In the analysis of neoplastic diseases in paleopathology, the use of radiological imaging techniques is often crucial because such techniques allow for the display and examination of various lesions, including lesions that have not yet reached the surface of the bone (Mays, 2008; Morse et al., 1974).

In this report, we present a case involving metastatic cancer (MC) in an ancient skull with multiple osteolytic lesions for which the use of modern 3D medical imaging technologies significantly contributed to the formulation of a reliable hypothesis.

2. Materials and methods

The skull described in this study came from the indigenous site of Baucina (Palermo, Sicily), a hilltop archaeological site in a watershed between the Milicia and San Leonardo rivers, approximately 15 km from the Tyrrhenian coast. This settlement was located on the northwestern boundary of Greek territory, next to Carthaginian territories (Fig. 1A). Archaeological excavations have unearthed fifteen tombs positioned side by side without a clear orientation. A large artificial cave tomb was among these graves (Fig. 1B). This burial site, which is distinguished by its monumentality and number of occupants (calculated to be at least fifty individuals), had been used between the late 6th and early 5th centuries BCE. Unfortunately, the tomb had been violated, and disarticulated bones were scattered in the cave. However, the skull examined in this investigation was undisturbed by grave robber activity. It was discovered in an extremely peculiar position immediately beyond the main entrance, with its face oriented toward the inside of the cave (Fig. 1C).

Given that we could not effectively analyze the postcranial skeleton because of the commingled nature of the remains in the cave, both age at death and sex were estimated for the examined individual using the cranium.

In determining the sex of the skull, we applied the regression formulas suggested by Walker (2008). We relied on the degree of ectocranial suture closure to estimate age at death, as proposed by Meindl and Lovejoy (1985).

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Fig. 1. (A) Map of the main Greek and Carthaginian ancient Sicilian cities that includes the location of the Baucina indigenous site. (B) Plan of the large artificial cave tomb. (C) In situ photograph of the skull at the moment of its discovery.

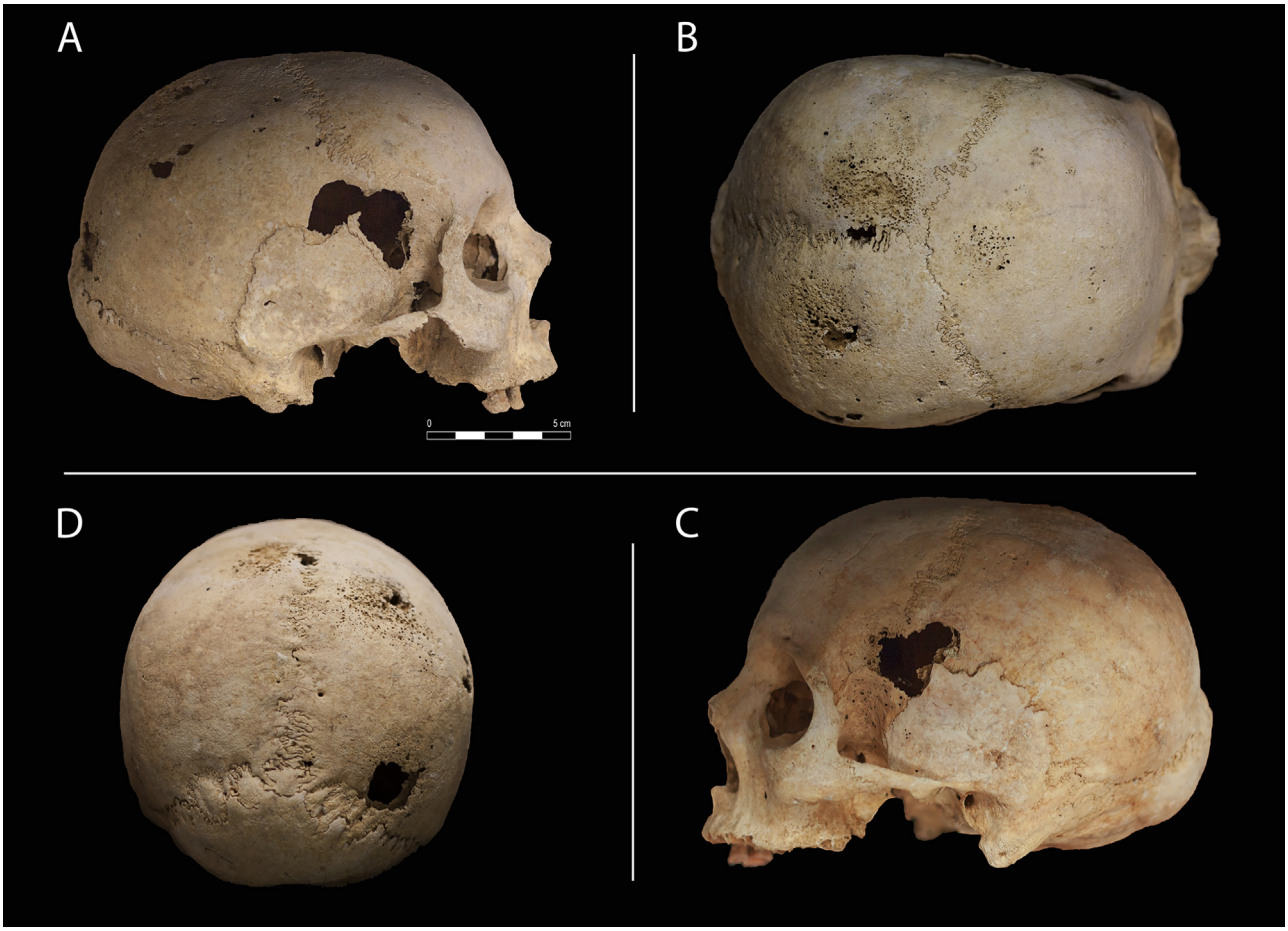

Fig. 2. Right lateral (A), superior (B), left lateral (C) and posterior (D) views of the distribution of the neurocranial lytic lesions on the skull.

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