



A multianalytic investigation of weapon-related injuries in a Late Antiquity necropolis, *Mutina*, Italy

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ARTICLE INFO

Keywords:

Skeletal lesions
Sharp force trauma
3D digital models
Light microscopy
Late Antiquity
North Italy

ABSTRACT

Human skeletal remains from archaeological contexts occasionally present signs of traumatic injuries from weapons, revealing, for example, the degree of interpersonal violence, the type of weapon and the sequence of events of a specific historical context.

Traumatic lesions are generally analyzed using macroscopic and microscopic methods, which are not necessarily integrated in the same study. In this study, we employed a multi-analytical approach to determine if new, or more refined information could be gained compared to traditional analyses. Here, we describe and analyze interpersonal skeletal peri-mortem sharp-force trauma in remains recovered in 2009 during archaeological excavations of a cemetery in the 4th to 6th century AD the city of Modena (Italy). Evidence for sharp force trauma was observed in four of the 13 individuals recovered at site. The traumatic lesions were analyzed using an integrated multi-analytical approach that combines traditional macroscopic examination, light microscopy, and three-dimensional digital modeling. We aimed to determine the number, size, and the position of the lesions, and the direction (angles) of weapon penetration in the bone. In particular, we applied digital protocols for the orientation of the skeletal regions of interest involved in the trauma to provide useful results for future comparisons and investigations.

1. Introduction

Warfare and interpersonal violence are an inherent part of human societies and their skeletal manifestations are frequently found in archaeological and historical contexts. Battle-related injuries including sharp force, blunt force, and gunshot wounds are the most common and clear signs of interpersonal violence (Knusel, 2005; Mariotti and Belcastro, 2017; Martin and Harrod, 2015). The bony remains provide the opportunity to detect violent behavior in human societies, and to possibly investigate the transformation of tactics and weaponry over the centuries (Lovell, 1997; Novak, 2000).

Skeletal signs of violent trauma can be macroscopically evaluated in order to describe main characteristics. Observing the main characteristics of a traumatic lesion such as the edge, colour, shape, anatomical location, presence or absence of related fractures and associated features. This is necessary to understand, for example, timing of injury (ante-mortem, peri-mortem, post-mortem), the types of trauma (blunt-force, sharp-force, projectile trauma) and the type of weapon that caused the insult to the bone (Byers, 2016; Cattaneo and Grandi, 2004; İşcan and Kennedy, 1989; Reichs, 1998). Macroscopic examination is often combined with microscopic analysis mainly performed with a stereomicroscope and/or a Scanning Electron Microscope (SEM) (Love

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et al., 2015; Lynn and Fairgrieve, 2009; Reichs, 1998; Symes et al., 2010) in order to better observe and/or quantify further relevant features, which may be invisible to the naked eye. These include microscopic evidence such as striations, pits, chipping on bone created as a result of sharp force trauma. Finally, digital methods have been exploited in forensic studies. For example, e.g., to test the possibility of determining the timing of cranial fractures by using 3D models from CT data (Fleming-Farrell et al., 2013), to thoroughly analyze the injuries of important or known historical individuals (Ryan and Milner, 2006), and to reconstruct the pattern of complex violent events (Appleby et al., 2015). Despite the complementarity of information derived from the various aforementioned approaches, to our knowledge there are few contributions in the archaeological literature aiming to integrate these approaches in a single case study. The aims of this study are to analyze sharp force trauma in the human remains from the 4th to 6th century AD (Late Antiquity) in *Mutina* (Italy) using an integrated multi-analytical approach that combines traditional macroscopic examination, microscopy, and original virtual imaging techniques. We also applied novel digital protocols for the orientation of the skeletal regions of interest involved in the trauma, in order to provide a more accurate understanding of the dynamics of the violent events which may have produced the lesions. Finally, we compared the lesion morphologies in order to evaluate the type of weapon.

1.1. Historical context

Historians generally agree that, in the Italian region of Emilia Romagna (Fig. 1), Roman history may be divided into six main periods: Pre-Colonial Republican (270 BCE - 191 BCE); Colonial Republican (191 BCE - 27 BCE); Imperial (27 BCE - 293 CE); Late Antiquity, i.e., Late Roman, (293 CE end of the 6th century AD); and early Middle Ages (after the 6th century AD). During the Late Roman phase until the early Middle Ages, the so-called “Roman empire crisis” took place. This period was characterized by a complex economic crisis, which led to the creation of the Tetrarchy during the end of the century (ca. 290 CE). Afterward, the crisis worsened affecting the entire empire. In the middle of the 4th century, many towns were drastically reduced in size (Curina, 1997; Ortalli, 1986), while during the second half of the century (377 CE) foreign populations (i.e., Taifali, Sarmati, Alamanni) arrived from the northern and eastern territories and settled in the cities of Parma, Reggio, Modena and Bologna. The devastating conditions of these movements to the territory between Bologna and Parma in 393–394 CE were described in a letter from Saint Ambrosius (Bollini, 1971), in which he recalled the “corpses of wholly destroyed cities and lands” (“*Semirutarum urbium cadavera terrarumque*”) and the “miserable,

uncultivated lands of the Apennine” (“*Appennini miseratus inculta*”). The decline of the social and military structures typical of the Roman society favored the invasions of Huns, Lombards, Ostrogoths, and Franks, ultimately causing the end of the Western Roman Empire (476 CE).

In Emilia Romagna, a relatively flourishing period followed between 488 and 526 CE during the Goths period under the ruler of Theodoric (Dall’Aglio and Franceschelli, 2011). However, the conflict between the Goths and Eastern Roman Empire (535–553 CE) interrupted this relatively short peaceful phase, ultimately leading to demographic decline, social insecurity and economic collapse (Carile, 1975; Christie, 2006). In 568 CE, waves of Lombard groups (people and armies) reached the Italian peninsula, including Emilia Romagna (Gelichi, 1988). This is also supported by archaeological findings in the district of Modena (Gelichi, 2008).

1.2. Archaeological context

The necropolis of *Ciro Menotti* is located in Modena (northern Italy), between two roads, Bellini Street and *Ciro Menotti* Street (from which it is named), and it was unearthed in 2009 by the Superintendence of Archaeology, Fine Arts and Landscape of Emilia Romagna (a section of the Italian Ministry of Cultural Heritage and Activities and Tourism). The archaeological site was located just outside the eastern borders of the old Roman city of *Mutina* (the modern city of Modena), about 150 m north of the ancient city walls (Fig. 1).

The cemetery yielded 11 graves, arranged in two rows oriented North/East to South/West (Figs. 1, S1). The western row included five burials in earth graves (Burials 7, 12, 15, 16, and 18). All were individual graves, except for two: Burial 16 (B.16) contained two individuals (numbers 1 and 2); Burial 12 (B.12) is a case of re-use in which a previously buried individual (number 1) was moved from one side of the grave to create space for a new burial (individual number 2). Therefore, a total of 13 individuals were found in the site. Four different types of burials were recorded: Burial 12 (B.12) was a “capuchin-type” grave; B.7 was covered by bricks arranged in layers; two other graves possessed a cranial cover made of simple tile (B.15) and a brick coverage (B.18). The eastern row comprised six burials (Burials 4, 5, 6, 11, 13, and 17). Graves B.11, B.13, and B.17 were “capuchin-type” graves, while B.4, B.5 and B.6 possessed covers made of juxtaposed tiles (Table S1). These final six graves had brick roofs, sometimes closed by stone slabs, whose topographical arrangement (alignment and distance between them) appears to be the result of rational space organization. B.11 and B.13 were the only burials containing grave goods, which consisted of two decorated bone combs, in use between the 3rd and 6th centuries AD, respectively. The site probably extends southward, beyond the

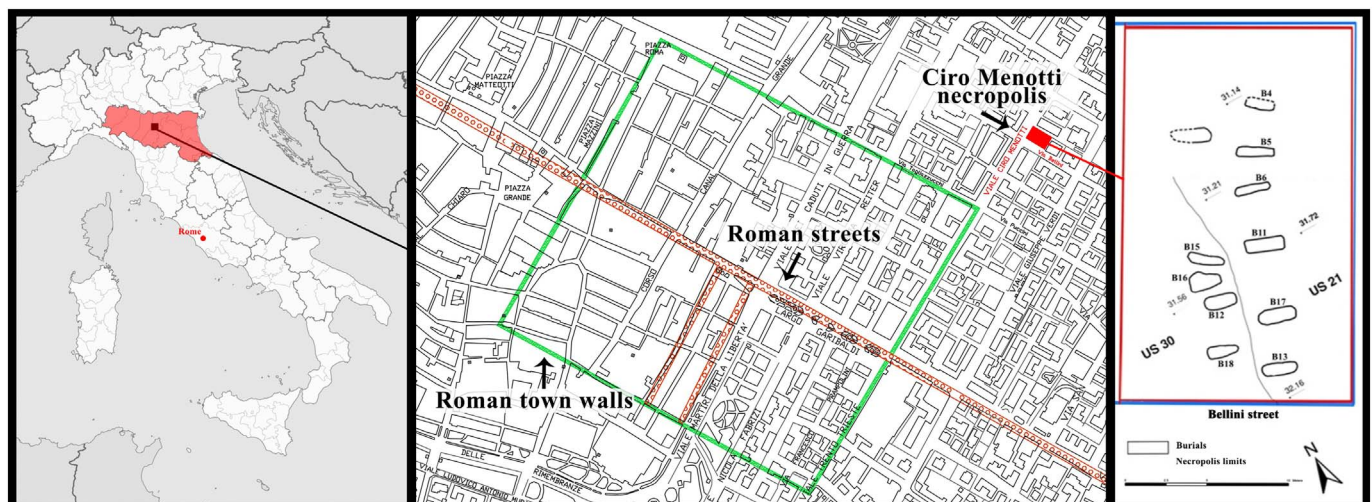


Fig. 1. Location of the Emilia Romagna region and Roman town of *Mutina* (left), and the plan of the necropolis (center and right).

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