EDITORIAL

Palaeomicrobiology meets forensic medicine: time as a fourth-dimension for the crime scene

A. Bazaj[1], **S. Turrina**[2], **D. De Leo**[2] **and G. Cornaglia**[1]

1) *Department of Pathology and Diagnostics (Microbiology)* and 2) *Department of Public Health and Community Medicine (Forensic Medicine), University of Verona, Verona, Italy*

Abstract

The unrelenting progress of laboratory techniques is rapidly unleashing the huge potential of palaeomicrobiology. That bodies are often found in poor condition is common to both palaeomicrobiology and forensic medicine, and this might stimulate them towards a joint quest to extract reproducible data for reliable specimens.

Keywords: Forensic dentistry, forensic medicine, metagenomics, palaeomicrobiology, specimens

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Corresponding author: G. Cornaglia, Department of Pathology and Diagnostics, University of Verona, Strada Le Grazie, 8, Verona, Italy

E-mail: giuseppe.cornaglia@univr.it

The increasing body of evidence stemming from palaeomicrobiology gives us insights into forgotten peoples, the diseases from which they suffered and how those influenced their living conditions and migrations [1]. Comparison of pathogens from different ages can also trace microbial genome evolution, with special reference to lineages responsible for various epidemics [2], hence filling gaps that before one could only infer by hypothetical modelling.

The unrelenting progress of laboratory techniques is likely to further unleash the huge potential of palaeomicrobiology. Various techniques can be used in palaeomicrobiology, with most data being obtained using PCR-based molecular techniques [3]. Mass spectrometry has also successfully identified specific bacterial proteins of *Mycobacterium tuberculosis* from archaeological bone samples [4], confirming ancient proteins as more resistant than ancient DNA (aDNA), and possibly becoming a promising approach to complement aDNA analysis in palaeomicrobiology.

Metagenomics has bypassed the need to isolate and culture the targeted organism and allowed systematic characterization of microbial diversity [5,6]. The huge potential of metagenomics is not only its formidable technological breakthrough but its capability of considering microbial and human genetic data combined, so enlarging the field of palaeomicrobiology to a wider community of scientists and scholars.

The strong correlation between palaeomicrobiology and forensic medicine has seldom been highlighted.

Some facts are obvious even to superficial observers, such as: (i) both disciplines deal with human remains, often well past their prime and often unburied for the examination; (ii) burial sites typical of many palaeomicrobiology investigations are strongly reminiscent of a crime scene, and (iii) very small amounts of biological specimens are usually available for investigation, often found in poor condition and hard to enucleate from the rest of the remains.

Palaeomicrobiology investigates frozen bodies, mummies and sometimes fixed tissues, but skeletons are the main source of human specimens. Major limitations of these studies include the degradation and fragmentation of aDNA, and contamination by modern DNA or external sources. In 1998, dental pulp collected from ancient teeth was first introduced as a suitable tool for the diagnosis of ancient infectious diseases [7]. This is a further contact point with forensic medicine techniques.

Forensic dentistry as a science has now evolved to a new era of genetic and serological investigations. Teeth are obtained

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from anthropological surveys and from disaster/crime sites, and pulp tissue is most commonly used. Vertical or longitudinal splitting of the tooth is often performed. This method provides for easy excavation of the entire pulpal tissue with minimum chance of contamination [8].

Tooth pulp represents an almost ideal situation for the retrieval of both ancient and modern DNA, because bodies are often found in conditions that make obtaining suitable specimens to analyse problematic. This is a problem common to both palaeomicrobiology and forensic medicine, and might stimulate the two disciplines towards a joint quest for reliable specimens from which to extract reproducible data even under standard conditions.

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