

5 Histology: An Overview

Hans Henk (<mailto:E.A.F.Mahtab2@lumc.nl>)

As a Dutch student attending the European Meeting of the Palaeopathology Association in August 2010, I was very lucky to present a paper on histology in palaeopathology. I was even more pleased when Christina Cartaciano invited me to write a short article on histology, for a journal on the other side of the world.

Unfortunately, it seems that histology is still a mysterious and somewhat misunderstood technique in archaeology. As a medical student, I would like to present a short overview of histology and the knowledge and techniques of which may find use in archaeology. I know it is impossible to be complete, so I apologise beforehand for the shortcomings of this overview. I will try to provide a ‘quick and dirty’ summary on the methods used and the data that can be derived. However, to start with the conclusion: histology is not by definition a difficult, time-staking technique. Nor does it need expensive machinery or years of experience. Histology is accessible to everyone.

Nonetheless, a basic knowledge on the histology of bone is essential for any potential histologist. Bone is a complex and beautiful tissue; it has the ability to be strong and supportive, whilst being dynamic and versatile in a manner that can hardly be imagined.

In general, bone tissue can be classified in many ways, from the way it is formed (membranous or cartilaginous) or its appearance (being trabecular or compact). Any good histology book or orthopedic handbook can provide the information needed on this. In several great reviews by Frost (for example, 1985) bone is described as a dynamic tissue, continuously adapting to the demands it must meet. These demands can be physiological (increased muscle strength or growth) or pathological (tumors and fractures). There are three ways that bone adapts to the ever changing environment: by resorption, apposition and remodeling (Vigorita 1999). Since all these processes act on the microscopic level, light microscopy becomes an apt instrument for bone investigation.

Discovering light microscopy’s suitability for bone investigation resulted in the development of many histological techniques in palaeopathology. But before we plunge into these techniques, we need to address the production of suitable sections for light microscopy. A few decades ago, decalcification was seen as the best way to produce sections; however, this is now considered obsolete. Archaeological bone consists almost entirely of minerals and if decalcified, little would be left to investigate. Also, in spite of its extensive deployment in previous histology research, the use of a microtome (a sort of knife to cut slices of tissue) is similarly considered obsolete (Wallin 1985). When applied to archaeological bone, the microtome causes the sections to shatter and/or break.

Since the above mentioned methods are now more or less useless for archaeological bone, histologists tried an old technique derived originally from metallurgy: grinding. Again, Frost was an important pioneer in this line of work (1958). In the last decade, many researchers have developed their own variety of grinding techniques. Some use automated grinding machines (An and Martin 2003). Yet a hand grinding technique is a good alternative. Since the majority of archaeological cases will be on a tight budget, a manual was produced to give directions as to how anyone can produce sections by means of some sandpaper

and water (Maat et al. 2001). This method has been tested and deemed fit for cortical tissue (Beauchesne and Saunders 2006). If however the bone material is fragile, an embedding medium is needed for support. I will not bore you with the details on this, since medium choice is quite technical chemistry. Besides, impregnating bone can be a lengthy process and the media used is often costly. Many professional palaeohistologists use a grinding machine subsequent to embedding, making this less accessible to starters. We are currently working on a good manual for anyone interested in producing histological samples that provides a quick and cheap alternative.

Once a section is made, the information that can be derived from it depends strongly on the preservation. Since taphonomic changes due to microbes (Hackett 1981; Hedges et al. 1995) cause destruction of bone micro-architecture, it is essential for a good histologist to understand the degradation of the material he/she is working with. That said, there are many histological techniques available nowadays for suitable bone tissue.

First of all there is histomorphometry. This represents the more quantifiable part of histology. It focuses on the amount of certain aspects of bone tissue. The work on age prediction by histomorphometry is quite well-known in palaeopathological circles (Stout and Paine 1992). The use of polarizing filters is often used, this enhances fiber direction, making differentiation between bone types even better. In the review of Stout and Paine (1992), there is also an interesting paragraph on microradiography, a technique in which x-rays are made of the section, making degree of calcification visible.

In addition to histomorphometry, there are more subjective techniques of histology. These are mostly used for diagnostics (Garland 1989; Schultz 2001). For people interested in the combination of micro-CT and histology, an article by Kuhn (2006) in HOMO can be interesting. For people more interested in the differences between animal and human bone, I can recommend Cuijpers (2009). I could provide a myriad of other envisioning techniques or specialized research lines, but for now I believe this overview should get you started.

Since histology is by definition an invasive technique, many archeologists are cautious with the method. This is understandable. I hope, however, that by reading this overview, histology has become a little bit more understandable and accessible because really, 'the truth is in there'.

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