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Medical conditions observed in osteoarchaeological remains: arthropathies, traumatic lesions, tumours, metabolic diseases and dental pathologies

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Abstract. The purpose of this article is to present which pathologies are recognisable in osteoarchaeological remains, particularly: arthropathies, traumatic lesions, tumours, metabolic diseases and dental pathologies. In addition to explaining in general terms how these diseases occur, we bring in support of the above, examples of pathologies related to our osteological sample. The human remains come from a dozen archeological sites covering necropolises and medieval churches of the province of Varese (dated from the 7th Century to the Modern Age). The findings that we hereby present were analysed according to the methods of physical anthropology and paleopathology.

Key words: paleopathology, traumatic injury, archaeological human remains, North-West Lombardy.

The study of ancient human remains

Through the analysis of archaeological human remains, it is feasible to trace back the knowledge of an ancient medicine i.e. of pathologies present in single individuals or in wider groups. The human skeleton is indeed an important resource for the study of ancient and modern populations, able of answering many questions of biological, medical and cultural order.

Data observed on various districts of the human skeleton is the result of both genetic and environmental factors that arise during the stages of ontogeny and throughout the individual's life. Natural or pathological environmental conditions may modify the bone tissue, which undergoes constant remodelling, and retains traces of metabolic processes of growth and ageing (1). Pathological signs and behavioural processes are also preserved in teeth. The wear and damage observed on them can be related to dietary customs and habits. Paleo-nutritional indicators allow drawing information on diet, food trends and possible pathological disorders derived from the deficiency of certain nutrients (2). Furthermore, occupational markers are visible on bones and can be observed through insertions of muscles and joints. These markers inform about the type of physical activity that the body underwent. Skeletal lesions caused by trauma are often present in osteoarchaeological samples, informing on the traumatic event and on the healing process.

Therefore, osteoarchaeological remains can be considered true biological archives, precious means that enhance and enrich the archaeological and historiographical data.

Arthropathies, traumas, metabolic diseases, tumours and dental pathologies

Arthropathies

Joint diseases, or arthropathies, affect the human skeleton with a high incidence, leaving discernible signs. These pathological changes concern the joints between bones of the post-cranial skeleton. Usually

these lesions occur with progressing age and are related to bio-mechanical stress, causing daily wear of the articular tissue; metabolic and genetic factors are also contributors. The bone surface of the affected joint triggers an inflammatory process that leads to a proliferative or erosive lesion (3). Most widespread are the osteogenic proliferations that modify normal joint profiles, called osteophytes. These bone growths develop with higher incidence on the edges of the vertebral bodies and are highly associated with cartilage damage (4). The osteophytes may even escalate into more serious lesions characterised by osteophytic beaks of continuous vertebrae, resulting in fusion of the vertebral segment affected. Lesions of erosive type cause a thinning of the cortical with exposure of the underlying trabecula, and presents with porosity on articulation's margins or on the articular surface itself (3,5). Osteoarthritis, a degenerative pathology affecting the joints, is the most widespread lesion of erosive type. It is characterised by gradual loss of articular cartilage and it can cause loss of function in the affected limb (6). Heavy occupational activity or minor injury can result in osteoarthritis, although genetic predisposition and old age are the leading causes. Another disease caused by wear and bio-mechanical stress is Schmorl's hernia. This pathology is characterised by an extroversion of the intervertebral disc, which mainly affects the thoracic and lumbar vertebrae. It is accompanied by circular or elliptical depressions of the vertebral body. If the lesion affects more disks, a kyphosis state is reached (7,8).

Traumas

The study of trauma provides precious information regarding physical activity and interpersonal violence. The distinction between *ante-mortem*, *peri-mortem* and *post-mortem* trauma is based on observation of some macroscopic and microscopic characteristics of the bone. It is possible to identify an *ante-mortem* lesion, such as a fracture, from the presence of bone remodelling post-trauma. In cases of complete fractures that affect primarily the long bones, an intervention of realignment and immobilisation of the limb are necessary in order for the callus to form properly. The characteristics of the fracture's margins indicate whether it occurred on a fresh (*peri-mortem*) or dry bone (*post-mortem*) (9). In a peri-mortal trauma, the edge of the fracture has a serrated feature and the bone may appear curved or flexed. In a post-mortal fracture caused by taphonomic agents, such as the pressure of the soil or the intervention of an animal, the border appears net and with a flattened surface. Through a careful analysis of the traumatic evidence, the type of injury can also be identified, whether accidental or inflicted, as the type of weapon used and the mode in which it was used (force used, the direction of the shot). Analysis of inflicted trauma is an important aspect in the study of human remains for historical and social implications that this entails, highlighting isolated violent incidents (murders, ambushes, etc.) or genuine warfare. The skull is the skeletal region most affected by trauma. Three types of fractures produced by different types of weapons can be identified on the skeleton: fractures caused by sharp instruments such as swords and knives, wounds inflicted with thrown weapons like arrows and spears, and trauma produced by blunt weapons such as sticks and stones.

Metabolic Diseases

Metabolic and diet-related diseases are manifested in a inadequate or excessive bone production or in an deossification of the pre-existing bone. These diseases may be caused by deficiency or excess of one or more components of the diet. Traces of the presence of chronic anemia of genetic or nutritional origin can be observed macroscopically on the skeleton in the form of porotic hyperostosis. These lesions are characterised by small perforations of the skull, and often by an increase in thickness of the underlying diploë (2,10). The diameter of the perforations varies from a few tenths of millimetre up to real confluent gaps of few centimetres. The porosity can occur on the cranial vault (cribra cranii) and on the front of the orbital roof (cribra orbitalia) (11).

Tumours

The most widespread tumours found in human remains are osteomas. These benign tumours manifest themselves in the form of a growth of the compact

bone, originating from the periosteum. These growths can affect only a skeletal district such as the cranium, or they can be extended to the entire skeleton. Causes of the pathology can be numerous, such as a mechanical stress, inflammation, vascular etc., whereas for the cranial osteoma the cause is probably idiopathic (12).

Upon radiological examination, thickening areas enable easy diagnosis, and compact bone ensures great preservation of the osteological remains.

Dental Pathologies

Analysis of dental pathologies and stress indicators on teeth can offer important information on the eating habits of the native population. Consider, for example, the study of the location and incidence of caries, or the investigation on the degree of dental wear and analysis of tartar. Paleonutritional studies are aimed, with the support of electronic spectroscopy, at searching for particular elements such as calcium, strontium and zinc contained in bones and dental remains.

Our osteological sample

The skeletal remains of our collection derived from necropolises and medieval churches in the Varese area, dating from the 7th Century until the Modern Age. The most frequent lesions observed on our skeletal sample are degenerative diseases and traumas. We will also bring evidence of metabolic and neoplastic diseases, though observed in a smaller sample.

Arthropaties

In individuals over 40 years of age, osteolytic lesions are macroscopically detectable, together with slight growths at the level of the vertebral bodies and osteophytic beaks in continuous vertebrae. The most affected being the lower thoracic and higher lumbar (Figure 1). Radiological techniques have confirmed the diagnosis of spondylosis and Schmorl's hernia of unknown aetiology in some cases. In one case, a diagnosis of Scheuermann's disease, a rare form of childhood osteochondrosis, was made. This pathology leads

Figure 1. X-ray showing vertebrae with osteophytic formations (Caravate)

to necrosis of bone ends, probably with vascular origin, resulting in malformation of normal anatomical profiles. In several individuals was diagnosed spondilosis, It is a degenerative disease linked to ageing and to a stressful and continuous occupation (13).

Traumas

In our sample there are several injuries to the head region. Here we present three cases of blow injury. The first skull belongs to a 30 year old male, with a fully healed lesion caused by a blow on the right parietal bone. The blow was inflicted from behind with an overhead downward trajectory. The second case is the one of a man of advanced age who has a healed wound at the level of the left orbit (2,4 cm in length). The lesion has a net margin with formation of a callus along the right edge of the wound. The lesion has oblique direction and is localised on the left portion of the frontal bone. The skull was investigated using CT and radiography, allowing the diagnosis of a non-depressed fracture (14). The third cranium shows three clean cuts to the parietal and occipital that led to beheading (15). Several skulls of our collection show blunt injury, most of which present healing processes of the bone, thus indicating their survival to the trauma (Figure 2). We also have few specimens with lesions from piercing

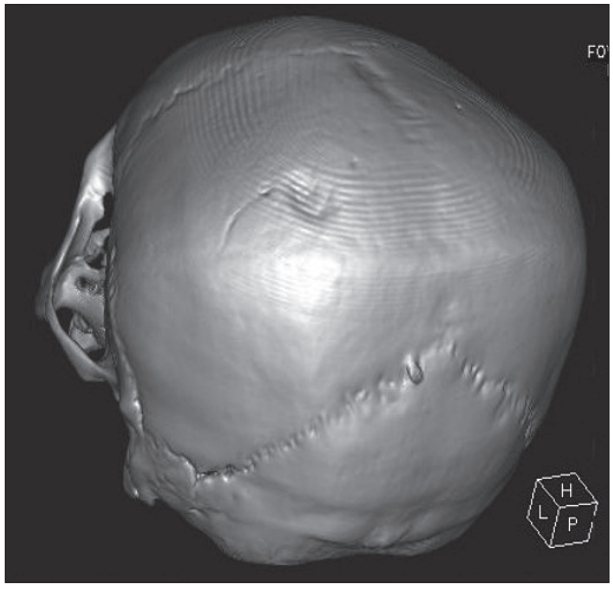

Figure 2. CT image of a skull presenting a depression of the bone plate in the left parietal region, caused by a blunt weapon (Sarigo).

weapon. An example being a female of 40 to 50 years of age, with a quadrangular lesion in the left frontal region, whose bone remodelling indicated the posthumous survival (16,17).

Lesions to the post cranial skeleton were also observed. A case of spinal injury that caused new bone formation leading to the fusion of the third and fourth lumbar vertebrae, was diagnosed in an elder male (14).

Figure 3. CT of femur from the ossuary of Sacro Monte, with an evident callus formation in the proximal third

The radiological investigation suggests a diagnosis of injury compatible with a fall from a considerable height. A femur found in a common ossuary shows a complete and compound diaphysial fracture, in particular to the proximal third (Figure 3). Particular ossification can be observed on the posterior side of the bone, witness of a large tear of the overlying soft tissues caused by the fracture, especially of the enthesis of the adductor inserted in this site. The latter is characterised by an oblique impact fracture, confirmed on CT, probably caused by an occupation at high risk of injury. The fracture was not previously reduced or pulled, since the stumps have overlapped and are not aligned. The subject was, however, immobilised in a supine position, seen that the limb was consolidated rotating outwards, and load was probably prevented. No reduction in bone mass is present nor other possible complications from long-decubitus, allowing us to suggest that the subject has begun to ambulate albeit with major defects in movement, affecting the general posture as well as on the spine.

Tumours

In our bone collection, we have also identified some cases of benign tumours, in particular cranial osteomas (Figure 4). Several skulls, one of which partially mummified, show small osteomas, mainly in the frontal and parietal region. A particular case of multiple osteomas was diagnosed on the skull of a 40 years old female. This pathological condition is perhaps related to Gardner's Syndrome.

Metabolic Diseases

Frequent cases of porotic hyperostosis were found on skulls. These conditions, mainly located on the parietal and occipital bone and on orbital cavity, are caused by chronic, ferropenic or congenital anemia (Figure 5).

Dental Pathologies

We evaluated macroscopically the number of teeth present or lost post-mortem, or any rotations or ectopies, presence of caries or tartar and resorptions

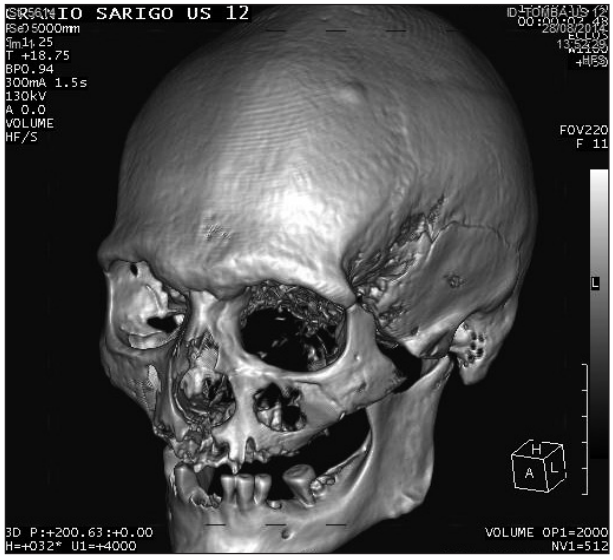

Figure 4. Skull from Sarigo with osteomas in the frontal region

Figure 5. Skull from Sarigo presenting Cribra Orbitalia

due to periodontal diseases. Major acquisitions have been achieved with the support of microscopic analyses. Degree of wear was also evaluated. The presence of moderate dental abrasion and the analyses with a particular scanner, suggested these individuals consumed a mainly proteic diet. Signs of periodontal disease present in our samples are frequent, resulting in tooth loss (18).

Our work reinforces the need to enlarge the anthropological investigation on the ancient skeletal remains recovered by archaeology. The samples retrieved from Varese's province provided good examples of pathologies that are most encountered in osteoarchaeology.

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References

1. Canci A, Minozzi S. Archeologia dei resti umani. Roma: Carocci Editore; 2005.
2. Ortner DJ, Putshar WJ. Identification of Pathological Conditions in Human Skeletal remains. Washington D.C: Smithsonian Instituion Press; 1985.
3. Roger J, Waldron T. A Field Guide of Joint Disease in Archaeology. Chiechster: Wiley; 1995.
4. Van der Kraan PM, Van der Berg WB. Osteophytes:relevance and biology. Osteoarthritis and Cartilage 2007; 15: 237-44.
5. Burt NM, Semle D, Waterhouse K, Lovell CN. Identification and Interpretation of Joint Disease in Paleopathology and Forensic Anthropology. Springfield: Charles C. Thomas Publisher; 2013.
6. Jurmain RD, Kilgore L. Skeletal evidence of osteoarthritis: a paleopathological perspective. Annals of the Rheumatic Diseases 1995; 54: 443-50.
7. Capasso L, Kennedy AR, Wilczack CA. Atlas of Occupational Markers on Human. Teramo: Remains.Edigrafital; 1999.
8. Waldron T. The prevalence of, and the relationship between some spinal diseases in a human skeletal population from London. Int J Osteoarchaeol 1991; 1: 103-10.
9. Ubelaker DH. Perimortem and Postmortem Modification of Human Bone. Lessons from Forensic Anthropology. Anthropologie (Brno) 1991; 123: 333-9.
10. Walker PL, Bathurst RR, Richman R, Gjerdrum T, Andrushko VA. The causes of porotic hyperostosis and cribra orbitalia: a reappraisal of the iron-deficiency-anemia hypothesis. Am J Phys Anthropol 2009; 139: 109-25.
11. Facchini F, Rastelli E, Brasili P. Cribra orbitalia and cribra cranii in Roman Skeletal Remains from the Ravenna Area and Rimini (I-IV Century AD). Int J Osteoarchaeol 2004; 14: 126-36.
12. Capasso L. Osteoma: paleopathology and phylogeny. Int J Osteoarchaeol 1997; 7: 615-20.
13. Steinbock RT. Paleopathological Diagnosis and Interpretation: Bone Disease in Ancient Human Popolations. Springfield: Charles C. Thomas Publisher; 1976.
14. Licata M, Borgo M, Armocida G, Nicosia L, Ferioli E. New paleoradiological investigation of ancient human remains from North West Lombardy archaeological excavations. Skeletal Radiol 2005; 45(3): 323-31.
15. Licata M, Armocida G. Per lo studio paleobiologico delle antiche popolazioni della Valcuvia. Qualche nota sui quin-

dici anni di attività del Dipartimento di Medicina e Sanità Pubblica dell'Università dell'Insubria. Terra e Gente 2014; 20: 31-40.
16. Licata M, Vecchio I, Armocida G. Analysis of ante-mortem injuries in medieval skeletons from the necropolis of Caravate (Varese) Italy. Acta Med Mediterr 2014; 30: 555-9.
17. Licata M, Ronga M, Cherubino P, Armocida G. Different types of traumatic lesions on mediaeval skeletons from archaeological sites in Varese (North Italy): Diagnosis on ante mortal fractures using macroscopic, radiological and CT analysis. Injury 2014; 45: 457-9.
18. Lazzati AM, Levrini L, Rampazzi L, Dossi C, Castelletti L, Licata M, Corti C. The Diet of Three Medieval Individuals from Caravate (Varese) Italy. Combined Results of ICP-Ms Analysis of Trace Elements and Phytolith Analysis Conducted on their Dental Calculus. Int J Osteoarcheol 2015; DOI:10.1002/oa.2458.

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