Periosteal Lesions:
A Non-specific Index of the History of Health in Europe

AAPA Symposium
Reconstructing Health and Disease in Europe: The Early Middle Ages through the Industrial Period

Background

Proliferative periosteal lesions on long bones are commonly reported on ancient skeletal remains, from diverse chronological periods and geographic sites.

Many events may stimulate the periosteum, such as mechanical injury (e.g. trauma, leg ulceration), metabolic or neoplastic conditions, circulatory insufficiency or infectious processes (Weston, 2008). In most cases, the underlying pathological process causing proliferative periosteal lesions (PL) is not easily established, but these lesions are most commonly attributed to the impact of infection or trauma (Larsen, 2002; Ortner, 2003).

Although these pathological changes are not pathognomonic for a particular disease, they suggest a health disruptive process often as an outcome of environmental constraints. Therefore, this parameter is of great importance in the assessment of the health history of Europe and can be used as an indirect and non-specific health indicator.

The scarcity of large-scale bioarchaeological analysis of PL often precludes a full understanding of its role in exploring living conditions of past populations. Consequently, analysis of the Global History of Health Project (GHHP) data can be an important tool for establishing general prevalence as well as geographical and chronological trends.

Objectives

- Evaluation of the prevalence of periosteal lesions (PL) in the GHHP European sample, serving as a non-specific index of temporal-spatial variation in the health status of European populations.

Methods

- A sample of (N = 7896) adult individuals were surveyed for the presence of periosteal bone formation on long bones.
- The severity of PL was scored using an ordinal scale (see Table 1).

Table 1: Standards for scoring periosteal lesions (from the GHHP Codebook).

Score	Definition
1	No osteoperiostitis present
2	Markedly accentuated longitudinal striations
3	Slight, discrete patch(es) of reactive bone involving less than one quarter of the long bone surface
4	Moderate involvement of the periosteum, but less than one-half of the long bone surface
5	Extensive periosteal reaction involving over half of the diaphysis, with cortical expansion, pronounced deformation
6	Osteomyelitis (infection involving most of the diaphysis with cloacae)
7	Osteoperiostitis associated with a fracture

Results and Discussion

Overall Frequency

- Signs of PL were present in 15.3% of the adult individuals studied.
- Bones of the lower limb were far more affected by PL than the bones of the upper limb, with highest values obtained for the tibia (18.4% in males) and lowest for the clavicle (0.3% in females) (Fig. 1).

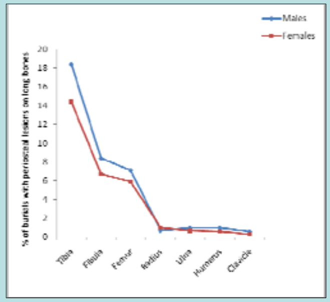

Figure 1: Percent of individuals with periosteal lesions on long bones according to sex.

Results and Discussion, cont.

Despite the scarcity of studies addressing this observed anatomical pattern, different physiological and anatomical factors can concomitantly be involved in tibial PL predominance, such as differences in circulatory flow, soft tissue mass involvement, and the location of the bone closer to the skin (Ortner, 2003). The lower leg also suffers more physical trauma. Significant sex differences were only observed for the fibula (χ^2=4.5411, p=0.03) and more strongly the tibia (χ^2= 16.1158, p<0.0001), with higher rates in males (Fig. 1).

Differences observed can reflect both a more effective immune response of women to pathogens, and differences in activity patterns between sexes.

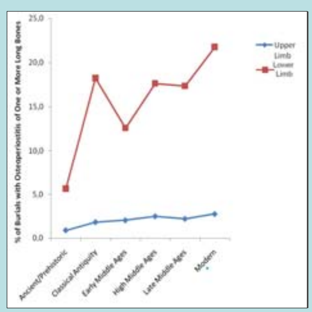

Figure 2: Percent of individuals with periosteal lesions on the upper and lower limb by chronological period.

Periosteal Lesions Temporal Trends

- A marked decrease in PL prevalence was observed from Classical Antiquity to the Early Middle Ages (EMA) with a subsequent rise after this period (Fig. 2). These two shifts are statistically significant (χ^2=31.4, p<0.0001 and χ^2=19.0, p=0.0001). Lower frequency is seen for the EMA, with Classical Antiquity, the High Middle Ages and Late Middle Ages presenting steady frequencies (18.2%, 17.6%, and 17.3%, respectively).
- Inferences about the marginal values for the Prehistoric and Modern periods are limited due to sample constraints.
- The chronological pattern is mainly the result of variations in the lower limb rates (χ^2= 84.5, p<0.0001), specially the tibia. The upper limb maintains a uniformity of PL values through time (χ^2=4.5, p=0.474) (Fig. 2, Fig. 3).

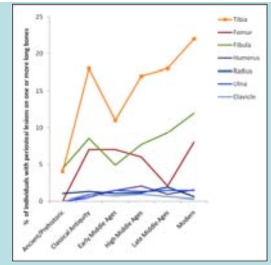

Figure 3: Number of individuals with periosteal lesions on one or more long bones by time period.

Chronological fluctuation in lower limb lesion frequency raises the questions: 1) why don't upper limb lesions frequencies also change, and 2) to what extent is temporal fluctuation in tibial PL indicative of major health changes? The answer is not straightforward and further scrutiny of the data is necessary.

Moreover, the temporal prevalence of PL may reflect a close synergistic interaction between hypertrophic osteoarthropathy (Fig. 4) and specific disease (e.g. tuberculosis), and also trauma to limbs or leg ulcers (Fig. 5).

One of the most important outcomes of the PL analysis is that these skeletal data reflect an important historical shift, the transition between Classical Antiquity and the EMA. This period is generally characterized by demographic, economic and socio-cultural changes after the collapse of the Roman Empire, and was also accompanied by famines and epidemics (e.g. the Justinian plague).

We can hypothesize that the spread of acute deadly epidemics could reflect a decrease in skeletal signs of long standing chronic diseases, associated with other factors such as a steep population decline and more rural living during the EMA. This contrasts with the higher population density and urbanization of Classical Antiquity and the High Middle Ages. Additionally, changing patterns of warfare, mobility, provision of labor (extensive slave labor and military involvement during Classical Antiquity), and changes in economic systems (Scheidel, 2007; Woods, 2007; Davis & McCormick, 2008) could also have played an important role.

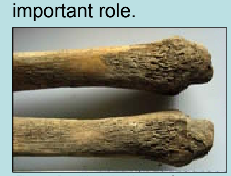

Figure 4: Possible skeletal lesions of hypertrophic osteoarthropathy, in both tibiae. From Amiens, France.

Figure 5: Localized bone changes on a tibia, possibly as a result of a leg ulcer. From ISCMB, Portugal.

Conclusions and Future Prospects

Overall, chronological variation in periosteal lesions in skeletons from the GHHP can be related to demographic trends and changing social, cultural, economic and environmental factors. Future comparisons of these data with other health indicators from the GHHP, and a more in-depth scrutiny of the patterns of periosteal lesions, will help clarify questions raised by this preliminary analysis and consequently improve our health assessment of European populations through history.

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Acknowledgements: Supported by the U.S. National Science Foundation (BCS-0527658, SES-0138129, BCS-0117958). Special thanks to Kimberly Williams for her assistance in the development of this research, and Ohio State University for continued institutional and facilities support.

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