

RECOGNITION OF TREPONEMATOSES IN POST REPATRIATION X RAY AND CD ROM NEBRASKA RECORD

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Repatriation has compromised the opportunity to directly examine skeletons and to apply new diagnostic criteria and techniques. Pre-repatriation approaches to non-metric data acquisition, must make a number of assumptions: (1) Phenomena must be correctly identified and segregated; (2) Criteria for severity must be specific to the phenomena studied; and (3) As criteria for disease recognition may change with time, it is valuable only as long as the raw data is also recorded. As part of data preservation, x-rays and CD-ROM images were recorded for skeletons from Nebraska sites undergoing repatriation. This report concentrates on four of them: 25DK13 and slightly more recent 25DK2B, 25DK10, and 25KX1. 28% of individuals from 25DK13 manifest polyostotic periosteal reaction, and sabre shin reaction was invariably associated with visible surface periosteal reaction. 8-14% of individuals from the other sites also had periosteal reaction. Sabre shin reaction, when present in skeletons from those sites, was associated with such complete remodeling that surface periosteal reaction was no longer visible. The patterns of periosteal reaction in the examined sites were indistinguishable from those observed on direct examination of skeletons with yaws and syphilis. The Nebraska transition from yaws to syphilis apparently took place approximately 800 years ago.

Key words: Paleopathology, bejel, yaws, syphilis

La repatriación ha interferido en la oportunidad de examinar directamente esqueletos y aplicar nuevos criterios y técnicas diagnósticas. Los métodos de pre-repatriación para la colección de datos no métricos deben hacer varias presunciones: (1) Los fenómenos deben ser correctamente identificados y segregados; (2) Los criterios para severidad deben ser específicos en relación a los fenómenos estudiados; y (3) Como los criterios para el reconocimiento de enfermedades cambian a través del tiempo, esto sólo es válido mientras los datos crudos son registrados. Como parte de la preservación de la data, se tomaron imágenes de CD-ROM y rayos x de los esqueletos de los sitios bajo repatriación de Nebraska. Este trabajo se concentra en cuatro de ellos: 25DK13 y los ligeramente más recientes 25DK2B, 25DK10, y 25KX1. El 28% de los individuos de 25DK13 manifiestan una reacción periosteal poliostróica, y "tíbias en sable" estaba invariablemente asociado con una visible reacción periosteal en la superficie. El 8-14% de los individuos de otros sitios también tenían una reacción periosteal. La reacción de "tíbias en sable", cuando se hallaba presente en esqueletos de esos sitios, estaba asociada con una reconstrucción tan completa que la reacción periosteal de superficie no era visible. Los patrones de la reacción periosteal en los sitios examinados no se podían distinguir de los observados por examinación directa en esqueletos con pían y sífilis. La transición de pían a sífilis en Nebraska, aparentemente tuvo lugar aproximadamente 800 años atrás.

Palabras claves: Paleopatología, bejel, yaws, sífilis

Native Americans have experienced a wide array of disease episodes prior to and post European occupation of the Americas in 1492. Certain of these disease are expressions of the post-1492 European disease experience. Others are expressions of the pre-1492 American disease experience. Some were common to both areas prior to European contact. One goal of paleopathology is to identify which diseases fell into these categories. However, much of our perceptions of European and American derived diseases and those common to both are defined by historical documentation without direct evidence of the pathogens involved. Examples of what are probably pre-1492 European diseases include bubonic plague, anthrax, and smallpox. Examples of what are probably pre-1492 American diseases are leishmaniasis and trypano-

somiasis. Examples of diseases common to both regions include tuberculosis and human-specific parasitic diseases. As further analysis of prehistoric corporeal remains is completed, the list of prehistoric American diseases and common diseases will undoubtedly increase. As little as 25 years ago, tuberculosis and human-specific parasitic diseases were thought to be European in origin. They were only recognized as common diseases relatively recently.

The identification of prehistoric American, European, and common diseases has relevance to existing Indian tribes. Once diseases can be placed in proper origin, then individual tribes can evaluate whether or not the diseases were part of their specific history or prehistory. This has both historical and medical relevance. Smallpox and lead

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poisoning figure prominently in the tribal lore of the Omaha Tribe of Nebraska. These maladies had an impact on the Tribe, comparable to Plague in defining European traditions. Therefore, the discovery of the diseases has an important role in confirming tribal lore. Past disease experience of Native Americans has a direct influence on modern disease states in most tribes. Therefore, the definition of disease history and prehistory has significance from the tribal perspective.

Treponemal infection is an important disease with significance to Tribal history. Certain tribes believe that venereal syphilis was spread by contact with Europeans. The issue with venereal syphilis is related not so much to its origins as a European, American, or common disease. The venereal syphilis issue relates to whether European colonization spread the disease into regions where it was previously absent. Syphilis does not figure into Omaha oral traditions. However, the presence of the disease has noted in the early 1800's in the northern Plains. Among the Lakota, the disease is presented as a cause of low fecundity and short female life span. Similar observations of low fecundity and short female life spans have been noted for Omaha skeletal series dating after 1800 (O'Shea and Ludwigson 1992; Reinhard et al. 1994). This demographic anomaly for the Omaha is enigmatic. Could venereal syphilis introduced into the Omaha have contributed to it? We analyzed radiographs and archived images of tibiae taken in 1990 from prehistoric and historic sites to address the question as to whether venereal syphilis was present pre-contact and historically in the region.

Methods

This report concentrates on four such sites: 25DK13 (AD 1200) and the more recent 25 DK2B (AD 1801 to 1820), 25DK10 and 25KX1 (AD 1780-1800) (Blakslee 1994). The comparison sample for Yaws comprised 40 individuals from the Gognga Gun Beach Locale (Guam) dated at 500 years before present (Rothschild and Heathcote 1993). Yaws was the only treponemal disease present in Guam prior to 1668 (Heathcote 1991; Howells 1973; Rothschild and Rothschild 1995; Stewart and Spoehr 1952). The comparison sample for syphilis comprised one hundred and thirty five individuals selected from the 2906 skeleton Hamman-Todd Collection (Cleveland) on the basis of

autopsy diagnosis of syphilis (Rothschild and Rothschild 1995). Absence of hands and feet and incomplete collection precluded application of the all criteria, but sufficient were present to distinguish syphilis and yaws.

Radiography of the Omaha skeletal series was completed in the spring of 1990 as part of a Harris line study by Susan K. Moorhead (Dept. Biology, UNL) under the supervision of Tom Underhill (School of Dentistry, University of Nebraska Medical College) (Sandness and Green 1993).

Results

28% of individuals from 25DK13 manifest polyostotic periosteal reaction. No periosteal reaction was present in the distal diaphyses in 22% of affected individuals. Sabre shin reaction was invariably associated with visible surface periosteal reaction.

8-14% of individuals from the other sites (11% from 25 DK2B, 8% from 25DK10 and 14% from 25KX1) also had periosteal reaction. Sabre shin reaction, when present in skeletons from those sites, was associated with such complete remodeling that surface periosteal reaction was no longer visible.

Discussion

Projects that are stimulated by repatriation/reburial policies are inherently different and more challenging than research projects. Research projects are focused on hypotheses that are tested with relatively restricted data sets or analyses. This contrasts with physical anthropologists who are faced with imminent reburial of large collections and must develop broad scale data collection programs, incorporating as many different analyses as possible. Since analysis time is often constrained, data collection must be executed prior to development of research questions. One especially troublesome aspect of reburial analysis is the fact that the skeletal remains will never be accessible for future study. Therefore the ability to replicate analysis is impossible. Since science is based on reproducible analyses, it is important to collect as much physical documentation as possible, in the form of archived casts, radiographs, photographs, drawings, etc. for other researchers to examine. In our opinion, it is also necessary to open the collections to simultaneous examination by other researchers so

that multiple data recovery programs can be achieved. By archiving physical documentation and encouraging outside researchers to examine the collections, it is possible to obtain a certain degree of replicable analyses by multiple researchers.

Radiography has multiple roles in paleopathology. Steinbock (1976), Ortner and Putschar (1981) and Rothschild and Martin (1993) have demonstrated its value in paleopathological diagnosis, as had Owsley (1991) for insights into activity patterns.

The osseous reaction to treponemal infection, although reproducible for each variety, is not uniform among them (Rothschild and Rothschild 1995). Examination of population frequency, demography, character, and skeletal distribution of osseous treponemal impact provides clear, reproducible clues to the identity of the underlying treponemal infection (Rothschild and Rothschild 1995, 1996; Rothschild et al. 1995). High population frequency and frequent subadult affliction in yaws contrasts with what has been observed in syphilis (Table 1).

Contrasted with the sabre shin reaction in syphilis, that in Yaws is invariably associated with sur-

face evidence of periosteal reaction. The patterns of periosteal reaction in the examined sites were indistinguishable from those observed on direct examination of skeletons with yaws (for 25DK13) and syphilis (for 25DK2B, 25DK10 and 25KX1). Confidence can be placed in these diagnoses, as there are no other diseases that have population frequencies of periosteal reaction in the 20-40% range of yaws (McCarty and Koopman 1993; Rothschild 1982; Resnick and Niwayama 1988; Rothschild and Martin 1993). Hypertrophic osteoarthropathy is easily distinguished as distal diaphyseal sparing occurs in less than 1% (Rothschild and Rothschild 1998). Sabre shin reaction without surface signs of periosteal reaction is essentially pathognomonic for syphilis (Resnick and Niwayama 1988; Rothschild and Rothschild 1995). There clearly was a change in the post-European contact character of periosteal reaction among the Omaha of Nebraska.

The Nebraska transition from yaws to syphilis apparently took place with European contact. This study validates retrospective analysis of CD-ROM and x-rays for recognition of periosteal reaction-related disorders.

Table 1. Characteristics of Treponemal Disease in Nebraska, Contrasted with Document Syphilis and Yaws

Site/Diagnosis	Yaws*	25DK13	Syphilis*	25DK2B**	25DK10**	25KX1**
Site Age (years b.P.)	500	800	70	200	200	200
Population size - total	40	64	2906	10	26	40
Youth affected > 5%	Yes	Yes	No	No	No	No
Sabre shin without Periostitis	No	No	Yes	No	No	No
Frequency perspective						
Percent of at risk						
Population affected	33%	28%	5%	11%	8%	14%
Percent of youth affected	14%	21%	< 1%	0%	0%	0%

*Derived from Rothschild and Heathcote (1993); Rothschild and Rothschild (1995)

**Post-European contact.

References Cited

- Blakslee, D.T.
1994 The archaeological context of human skeletons in the Northern and Central Plains. In *Skeletal Biology in the Great Plains: Migration, Warfare, Health, and Subsistence*, edited by D. W. Owsley, and R.J. Jantz, pp. 94-105. Smithsonian Institution Press, Washington D.C.
- Crosby, A.W.
1993 *Ecological Imperialism: The Biological Expansion of Europe, 900-1000*. Cambridge University Press, Cambridge.
- Heathcote, G.
1991 *Report on the Human Osteology of the Gognga-Gun Beach Locale*. University of Guam, Guam.
- Howells, W.W.
1973 *The Pacific Islanders*. Charles Scribner Press, New York.
- McCarty, D.J., and W.J. Koopman
1993 *Arthritis and Allied Conditions*. Lea and Febiger, Philadelphia.
- Ortner D.J., and W.G. Putschar
1985 *Identification of Pathological Conditions in Human Skeletal Remains*. Smithsonian Institution Press, Washington, D.C.
- Owsley, D.W.
1991 Temporal variation in femoral cortical thickness of North American Plains Indians. In *Human Paleopathology: Current Synthesis and Future Options*, edited by D.J. Ortner and A.C. Aufderheide. Internat Congr. Anthropol

- Symposium, Zagreb, Yugoslavia, 24-31 July, 1988, pp. 105-110. Smithsonian Institution Press, Washington D.C.
- Resnick, D., and G. Niwayama
1988 *Diagnosis of Bone and Joint Disorders*. 2nd edition. Saunders, Philadelphia.
- Rothschild, B.M.
1982 *Rheumatology: A Primary Care Approach*. Yorke Medical Press, New York City.
- Rothschild, B.M., and G.M. Heathcote.
1993 Characterization of the skeletal manifestations of the treponemal disease Yaws as a population phenomenon. *Clinical Infectious Disease* 17: 198-203.
- Rothschild, B.M., and L. Martin
1993 *Paleopathology: Disease in the Fossil Record*. CRC Press, London.
- Rothschild, B.M., and C. Rothschild
1995a Distinction des maladies treponemiques: Syphilis, Pian et Bejel a partir des differences de leurs atteintes osseuses respectives. In *The Origin of Syphilis in Europe*, edited by O. Dutour, G. Palfi, and J. Berato, and J.P. Brun, pp. 68-71. Centre Archeologique du Var, Toulon, France.
- Rothschild, B.M., and C. Rothschild
1995b Treponemal disease revisited: Skeletal discriminators for Yaws, Bejel, and venereal syphilis. *Clinical Infectious Disease* 20: 1402-1408.
- Rothschild B.M., and C. Rothschild
1996 Treponemal disease in the New World: A tale of two seeds. *Current Anthropology* 37: 555-561.
- Rothschild, B.M., and C. Rothschild
1998 Recognition of hypertrophic osteoarthropathy in skeletal remains. *Journal of Rheumatology* 25: 2221-2227.
- Rothschild, B.M., C. Rothschild, and M.C. Hill
1995a Origin and transition of varieties of treponemal disease in the New World. *American Journal of Physical Anthropology Suppl* 20:185.
- Sandness, K.L., and G.R. Green,
1993 Lines of arrested growth in long bones of prehistoric and historic Native Americans. *Plains Anthropologist* 38:211-216.
- Stewart, T.D., and A. Spoehr.
1952 Evidence on the paleopathology of Yaws. *Bulletin of the History of Medicine* 26:538-541.
- Steinbock, R.T.
1976 *Paleopathological Diagnosis and Interpretation*. Charles C. Thomas, Springfield.