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Virgin Texas: Treponematosis-Associated Periosteal Reaction 6 Millenia in the Past

Bruce M. Rothschild[1], Christine Rothschild[2], Glen Doran[2]
[1]Northeastern Ohio Medical School, Rootstown, USA;
[2]Florida State University, Tallahassee, USA.
Email: bmr@ku.edu
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In bioarchaeology, skeletal biology and paleopathology, periosteal reaction has been variably considered as a non-specific sign of trauma and alternatively as having potentially diagnostic implications. Examination of sixth millennium before present Texas cemeteries falsifies the non-specific trauma hypothesis, while examination of a second millennium before present site reveals a new (at least to Texas) population phenomenon. In contrast to isolated bumps and osteomyelitis, the study of periosteal reaction in early Texas is the study of "virgins," individuals spared the phenomenon that cause such bone alteration. It is only in the second millennium before present that periosteal reaction becomes widespread, both in population penetrance and in extent of skeleton affected. That pattern has previously been documented for the treponematosis yaws, similar to what has been found in other areas of Archaic North America.

Keywords: Treponematoses, Yaws, Periosteal Reaction

Introduction

The tenet of "*in vivo* veritas" directs that the etiology of attributed phenomena be established by comparison of criteria with those established in validated populations. That is especially important for treponemal disease. Repetition of speculative ideas has in the past achieved prominence in the "collective consciousness" of the field, so much so that it is often overlooked that such "diagnostic criteria" simply represent untested thoughts. Will Rogers stated that it ain't so much what we don't know that gets us into trouble, as what we "know" that ain't so (Spodick, 1975).

The suggestion that periosteal reaction has disease specificity as a population phenomenon is well documented (Rothschild & Martin, 1993, 2006; Rothschild & Rothschild, 1996, 1998a). Cook's (1976a-b, 1984) attribution of non-focal periosteal reaction to trauma has been falsified, except in the presence of complicating osteomyelitis or stress fracture (Resnick, 2002; Rothschild & Martin, 1993, 2006).

Pathology can provide valuable clues to population origins and migrations (Rothschild & Rogers, 2010). It is therefore essential that pathology be accurately recognized and that its implications be validated. The concept that periosteal reaction is non-specific apparently had it origins in variable skills of examiners (Byers, 1998; Cook, 1998; Katzenberg, 1992; Powell & Eisenberg, 1998; Rose, 1985; Rothschild & Rothschild, 1995b) and preconceived notions as to its significance/derivation (Goodman et al., 1988) and as to the nature of disease (Buikstra & Cook, 1980; Cook, 1976a-b, 1998; Powell & Eisenberg, 1998; Power, 1992; Sanford et al., 1998; Spirov, 1991). The speculation that current distribution of disease implies climatic restriction was never actually tested by those involved in its promulgation (Cook, 1998; Powell & Cook, 2005; Powell & Eisenberg, 1998). Their attribution of periosteal reaction to trauma has impeded progress in our understanding of peoples and the disease with which they were afflicted. The work described herein further evidences the fallacy of the trauma hypothesis and removes periosteal reaction as simply a stress marker (Cook, 1998; Sanford et al., 1998). *In vivo* veritas replaces speculation with a new opportunity for clarification of the anthropologic record.

Treponemal disease, in the form of Yaws, has been documented on the basis of periosteal reaction in much of North America (Rothschild & Rothschild, 1994, 1998, 2000; Rothschild et al., 1995a). This pattern extends from the Cascade mountains to the east coast of Florida, dating from 8 - 9 millennia before present (bp). Its distribution has been contiguous across North America east of the Cascade mountains, with several notable exceptions (Rothschild & Rothschild, 1998, 2000): The Northwest territories of Canada were unaffected, as was Ontario prior to invasion by the Iroquois. This caveat must considered for some areas (e.g., Saskatchewan, Nebraska, Iowa, Kansas, Oklahoma) which have not had skeleton populations available for analysis in the post-1987 time period for which data-based criteria have been available (Rothschild & Rothschild, 1995).

Texas skeletal populations were therefore examined for evidence of periosteal reaction.

Materials and Methods

The Texas and other North American sites delineated in Table 1 were chosen to assess the population frequency and nature, extent and character of any non-focal (e.g., bump) periosteal reaction present.

Skeletal remains were subjected to visual examination of all articular and cortical surfaces—to identify all occurrences of alterations throughout each skeleton, specify the types of bony alterations at each occurrence, and map the distribution of occurrences in each skeleton. In sites where preservation was fragmentary, the sample size (denominator) was determined on the basis of sufficient tibial preservation for assessment, as the tibia is the sentinel bone for recognition of treponemal disease as a population phenomenon (Rothschild & Rothschild, 1995;

Table 1.
Texas and North American evidence of non-focal periosteal reaction.*

Site	Century BP**	#	Periostitis	Sabre shin
Buckeye Knoll (41VT98) Texas	60	37	0	Absent
Bird Island (8DI52) Florida	45	19	0	Absent
Kamarvik (LeHv-1) NW Territories	8	79		Absent
Kulaituijavik (LaHw-1) NW Territories	8	22	0	Absent
Sadlermuit (KkHh-1) NW Territories	8	25	0	Absent
Port Au Chaux, Newfoundland	34 - 51	124	0	Absent
Glen Williams, Ontario	9	90	0	Absent
Maurice Ossuary (BeHa-1), Ontario	10	50	0	Absent
Hind (AsdHk-1), Ontario	Archaic	18	0	Absent
Fairty Ossuary, Ontario	11	147	0	Absent
Rankin (CK6) Tennessee	Woodland	21	0	Absent
Big Sandy (Hy16), Tennessee	Archaic	35	0	Absent
Oakview Landing (40DR1) Tennessee	Archaic	56	0	Absent
Hatten Mound (23MN275) Missouri	28	23	0	Absent
Anderson Minnesota	30	30	12 (40%)	Present***
Younge, Michigan	10	23	9 (39%)	Present***
Galbreath Mounds (33FR58) Ohio	22	26	7 (27%)	Present***
McMurray (15Fa313) Ohio	Woodland	33	7 (21%)	Present***
Sidner Mound (Franklin County) OH	Woodland	46	10 (22%)	Present***
Palmer (8OS2) Florida	11	92	28 (30%)	Present***
Windover (Titusville) Florida	79	112	30 (27%)	Present***
Grant Mound (8BR56) Florida	18 - 24	12	3(25%)	Present***
Olmos Dam, Texas	11 - 18	8	3 (38%)	Present***
Carrier Mills (11SA86088) Illinois	63	159	57 (36%)	Present***
LU-25 (Alabama)	43	89	36 (40%)	Present***
Ward (15MCL11) Kentucky	43	203	73 (36%)	Present***
Ghost Warrior and Nevada	10 - 90	51	13 (26%)	Present***

Note: * Derived from Rothschild and Martin, 2005; Rothschild and Rothschild, 1998c, 2000; **BP = before present; *** Without visible surface periosteal reaction.

Rothschild & Martin, 2006). Periosteal reaction in treponemal disease invariably affects the tibia (Rothschild & Rothschild, 1995; Rothschild & Rothschild, 1996; Rothschild et al., 1995a).

Results

Examination of the skeletons of 37 (number determined on basis of sufficient tibial preservation) individuals from 6000 year bp Texas revealed evidence of isolated bumps and occasional cases of osteomyelitis, but no diffuse periosteal reaction (Table 1) and no sabre shin reaction. This was similar to observations in the Florida 4500 year bp Bird Island (8DI52) site, in which the 19 individuals present were similarly spared.

This sparing phenomenon contrasted with the east Florida 8000 year bp Windover and 1800 - 2400 ybp Grant mound sites and the 1800 - 2000 year bp Texas Olmos Dam site in which periosteal reaction was common (Table 1). Tibial involvement in the east Florida and Olmos Dam sites was invariable bilateral. Disease was predominantly poly-ostotic (>3 bone groups affected). Hand and foot involvement was common and juveniles, commonly affected.

Actually, most of early North Americans manifested the phenomenon observed in the east Florida sites and Olmos Dam, but with other notable exceptions (Table 1). Periosteal reaction was also rare in the northwest territories of Canada, the Atlantic provinces and eastern Ontario and from Archaic Tennessee and Missouri.

Discussion

Early Texas as a Virgin State for Treponematoses

Absence of periosteal reaction (unassociated with osteomyelitis and exclusive of isolated bumps) from the 6000 year bp Texas site examined documents a greater degree of population virginity, with respect to exposure to the entities that commonly cause periosteal reaction. Periosteal reaction occurring as a population phenomenon (e.g., more 1% of population manifesting diffuse involvement of more than one bone) has only a very limited number of etiologies: Treponematoses and hypertrophic osteoarthropathy (McCarty & Koopman, 1993; Resnick, 2002; Rothschild & Martin, 1993, 2006; Rothschild & Rothschild, 2005). While hypertrophic osteoarthropathy (as a complication predominantly of intrathoracic disease) is actually quite rare in unselected populations (Resnick, 2002; Rothschild & Rothschild, 1998b) and as noted in the populations studied herein, treponemal disease has a unique population signature, if it is present. That population signature is in the form of periosteal reaction, affecting 2% - 13% of skeletons with syphilis and 20-40% of skeletons with yaws or bejel (Rothschild & Martin, 2005, 2006; Rothschild & Rothschild, 1995).

The rarity of periosteal reaction in 191 individuals in a zone extending from western Florida to Texas and North to Tennessee and Missouri, and in 619 individuals from Northern and eastern Canada, clearly documents this region as virgin territory or at least that the local Native Americans were not afflicted by

any known treponematosis in the time periods studied. It also falsifies the speculation (Goodman et al., 1988) that periosteal reaction represents a non-specific stress reaction.

This contrasted with observations in eastern Florida and more recent Texas and outside of the above defined treponematosis-free areas. Periosteal reaction was prominent outside that catchment area (Table 1), in a frequency and pattern indistinguishable from what is seen in yaws (Helfet, 1944; Hudson, 1958; Hunt & Johnson, 1923; Moss & Bigelow, 1922; Rothschild & Rothschild, 1995; Rothschild & Martin, 2005). This disease is easily distinguished from the more pauci-ostotic syphilis (Chi square = 3.973, $p < 0.05$), in which hand and foot and subadult affliction are so rarely observed in skeletal populations (Rothschild and Rothschild, 1994, 1995a-b); Rothschild et al., 1995a). Other evidence for syphilis (in the form of complete saber shin surface remodeling and unilateral tibial disease) was also lacking. This was also easily distinguished from the more pauci-ostotic bejel, which infrequently affects hands and feet (Hershkovitz et al., 1995; Rothschild & Rothschild, 1995b). Sabre shin reaction is not found in hypertrophic osteoarthropathy, predominantly a disease of distal diaphyses (Resnick, 2002; Rothschild, 1982; Rothschild & Martin, 1993). Thyroid acropachy spares the proximal appendicular skeleton, predominantly producing hand and foot bone periosteal reaction (Resnick, 2002; Rothschild, 1982; Rothschild & Yoon, 1982). Infantile cortical hyperostosis is a disorder afflicting clavicles, scapulae, and ribs (Resnick, 2002). Hypervitaminosis A is predominantly an enthesial disease, and fluorosis produces highly characteristic trabecular alterations (Resnick, 2002; Rothschild & Martin, 1993; Seawright & English, 1967).

Possible Reasons for a Treponematosis-Free Zone in Early Texas Native Americans

Although there is clear evidence for treponematosis in North America, in the form of yaws, it is also clear that a zone existed in which the inhabitants were not afflicted. Given that yaws is a population phenomenon (afflicting essentially the entire population) and given the evidence (e.g., Windover and Ghost warrior) that it had a long history, anteceding the Buckeye Knoll and Bird Island sites, it would appear that these were distinct populations. As yaws is contiguous in distribution in Archaic and Woodland North America, it appears to have arrived with an immigrant population from Asia. The absence of Yaws in specific Canadian and Southern zones suggests that these may have derived from a separate immigration (migration).

This report further demonstrates how paleoepidemiology can be used to identify population distinctiveness in paleopopulations.

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