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SYMPOSIUM

Paleopathological changes in the Carpathian Basin in the 10th and 11th centuries+

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ABSTRACT The existence of skeletal materials and accompanying archaeological subsistence data recording the shift from nomadic animal husbandary to sedentary agriculture during the 10th and 11th centuries in the Carpathian Basin offers the opportunity to document shifts in the frequencies in various disease categories. On the basis of the data from the literature of the paleopathological cases, skeletal samples representing 714 tenth and 970 eleventh century individuals are grouped for indications of environmental stress: specific disease stress (porotic hyperostosis), infections, traumatic lesions, degenerative arthritis and genetic and/or environment indicators (developmental anomalies). The frequency of lesions in the samples should not be extrapolated to the larger population, but may only be used as an indicator of a trend in the appearance of the diseases. The results suggest some significant shifts for some disease and little change for other diseases during the transition from a nomadic to a more sedentary way of life. **Acta Biol Szeged 46(1-2):95-99 (2002)**

KEY WORDS

paleopathology
subsistence patterns
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Carpathian Basin
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The Hungarian tribes settled down in the Carpathian Basin at the end of the 9th century. The nomadic lifeways of the Hungarians rapidly transformed to sedentary living within the timespan of a few decades. Although the biogeography of the Carpathian Basin, having much in common with the forested steppeland of Eastern Europe, is basically unsuitable for the nomadic life; this homeland offered superb possibilities for intensive stockbreeding and agriculture. Not only did their lifeways change to sedentary agriculture, but their political organization changed and the foundation of the state began. Their pagan beliefs survived until the reign of King St. Stephan (11th century) when they were supplanted by Christianity.

The ethnic groups of the Hungarian Conquest period were heterogenous. They included communities of ancient nomadic pastoralists interspersed with a large number of agriculturists (who had come to the new homeland with a tradition of sedentism from the east as well as the indigenous peoples living in the Carpathian Basin; László 1986; Fodor et al. 1996).

The Hungarian Coquest period and the later centuries have long been investigated according to anthropological and paleopathological aspects. In order to determine whether land use and cultural changes in the 11th century are reflected in the frequency and type of pathological lesions in human remains, the results of paleopathological analysis of human skeletal material dated to the 10th and 11th centuries are presented.

The paleopathological cases have been classified into two groups: 1) diseases indicative of the environment (porotic hyperostosis, infectious diseases, trauma, osteoarthritis; Goodman et al. 1984), and 2) lesions caused by genetic and/or environmental indications (developmental anomalies; Barnes 1994). Some of these lesions might be characteristic of the sedentary changes in life styles between the 10th and 11th century.

Environmental indicators

Specific disease stress: porotic hyperostosis

The adoption of sedentary farming was apparently accompanied by a decline in the overall quality of nutrition. The clearest indicator of this may be provided by the increased incidence of porotic hyperostosis/cribra orbitalia. This is considered indicative of an anemia or nutritional deficiency and its expressive pathological symptom in the bones is porotic hyperostosis. It is manifested as a widening of the spongy diploe with a corresponding thinning of the outer cortical bone table resulting in the appearance of surface porosity. In severe cases there is a total obliteration of the bone surface with a lattice of trabecular overgrowth (Ortner and Putshar 1981; Goodman et al. 1984). These lesions either first appear or show a frequency increase with sedentary farming suggesting that anemia is primarily a disease of these agricultural groups (Goodman et al. 1984).

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Infections

The clearest major trend in the collected data concerns the incidence of infections as measured by the frequency of nonspecific skeletal lesions of infectious etiology as well as by the frequency of certain specific diseases categories.

Infections were a more common and more serious problem for sedentary than for nomadic peoples, and most researchers suggest that this is a result of some combination of increasing sedentary, larger population aggregates and the well established synergism between infection and malnutrition. Infectious diseases are now among the most significant selective factors acting on human populations. Syphilis, tuberculosis, leprosy and osteomyelitis occasionally produce significant bone reactions in advanced stages of the disease. Infections and most other health problems are more commonly found in later farming sites than in either earlier or later nomadic groups (Goodman et al. 1984).

Traumatic lesions

Traumatic lesions have been classified by Steinbock (1976) into four types: fractures, crushing injuries, bone wounds caused by sharp instruments and dislocations. These occur as a result of violent encounters with environmental hazards and inter- and intraspecies conflicts. Of these lesions, fractures and bone wounds by intentional instrument use (trephination) are mainly significant in archeological populations (Manchester 1983). Fractures' rates may also be studied relative to settlement patterns and means of subsistence. As a microtraumatic fracture, spondylolysis was also studied (Merbs 1995), but its etiology is not clear. Trephination is caused by the intentional use of a sharp instrument for the removal of part of the skull vault, generally without damaging the underlying meninges and brain. This dangereous operation was performed for a variety of reasons: to alleviate the intracranial pressure produced by compressed fractures of the skull vault, to clean the wounds caused by fractures, to treat headaches, epilepsy, or other forms of mental illness and so on (Ortner and Putshar 1981). The trephination may also have been symbolic or ritualistic in its type. The symbolic trephination (without opening the cranial cavity) is an operative intervention when a small fragment of the cranial bone is removed from some area of the calvaria after death (Marcsik and Szalai, in manuscript).

Degenerative arthritis

Degenerative arthritis is a common condition in all skeletal populations. Bone changes are most visible around the margins of vertebral body surfaces or either on or peripherial to the margins of the articular surfaces of appendicular joints. These degenerative changes may result from the activities that produce mild chronic, single acute or repeated severe functional stress (Steinbock 1976; Ortner and Putshar 1981).

The most informative approach to the study of degenerative arthritis is to compare frequencies of involvement in different populations, controlling for the demographic variables of sex and age. The frequency of degenerative arthritis is correlated with age (Goodman et al. 1984).

Genetic and/or environmental indicators

Developmental anomalies (malformations)

The alterations due to developmental anomalies may be grouped into several broad classes: disorders of congenital, traumatic, metabolic, inflammatory, and neoplastic origin have been reported in the paleopathology literature. Some anomalies are indentifiable in the newborn, but not all defects are detectable at birth. The majority of such defects remains undetected until exacerbated by growth and development, and appears in childhood or later in adolescence. The range of expression varies, based on a combination of genetic and/or environmental factors which usually interfere with the timing of developmental events. Attempts to categorize these developmental anomalies have been made by a number of authors: "errors" (Zimmerman and Kelley 1982), "failures" (Manchester 1983), or "morphogenetic" (Barnes 1994).

Developmental anomalies are localized on the skull (for example, cleft-formations, premature fusion of the sutures), in the spine (mainly spina bifida occulta, sacral spina bifida, block-vertebra, sacralization, lumbarization), and in the appendicular skeletons (clubfoot deformity, hip dysplasia, etc.). The incidence of developmental anomalies appears to be highest in the spine, lower in the skull and lowest in the appendicular skeleton (Ortner and Putshar 1981; Barnes 1994).

Materials and Methods

The skeletal collections of the Department of Anthropology, University of Szeged, Hungary, served as source material for the paleopathological studies by the different authors. The cemeteries of Szegvár-Oromdűlő (Marcsik 1997), Magyarhomoróg-Kónyadomb (Csányi 2001; Szigeti 2001), Püspökladány-Eperjesvölgy (Pauditz 1995; Finnegan et al. 1997; Spigelman et al. 1999) were chosen as each has components of both the 10th and 11th centuries. The samples involve a total of 374 individual skeletons dated to the 10th century and 970 dated to the 11th century. Since the number of specimens dated to the 10th century was far less than those dated to the 11th century, we also took into the investigation the paleopathological results from two single 10th century samples: Algyő (Marcsik and Szalai, in manuscript) and Sárrétudvari-Hízóföld (Oláh 1990; Pálfi et al. 1996). These paleopathological investigations were carried out *via* gross and radiographic observations of skeletal remains and some cases were analysed for DNA of *Mycobacterium leprae*. The total number of individuals is 1,684, as seen in Table 1.

Results

It is important to emphasize that the frequency of the lesions in our samples should not be extrapolated to the larger population, but may only be used as an indicator of a trend in the appearance of the diseases.

Szegvár-Oromdűlő

Based on this paleopathological investigation of the 10^{th} and 11^{th} century, the main trends of the various diseases and lesions are as follows. Mild types (porotic and cribrotic) of porotic hyperostosis, and its most serious form (trabecular or hyperostosis spongiosa orbitae, cranii), traumatic lesions displayed as fractures and symbolic trephination, sacralization, spina bifida and sacral bifidum as developmental anomalies, and degenerative arthritis were considered both in the 10^{th} and 11^{th} century samples of this cemetery. However, the frequency of each is higher in the 11^{th} century sample. Among infectious diseases, the nonspecific infectious category was unimportant, but osseous tuberculosis was only found in the 11^{th} century sample (Marcsik 1997).

Magyarhomoróg-Kónyadomb

There is a large difference between the 10^{th} and 11^{th} century samples because only a smaller part of the cemetery is from the 10^{th} century and its larger part is from the 11^{th} century. Thus, the occurrences of pathological deformations mainly relate to the 11^{th} century. In a few instances, scaphocephaly, other developmental malformations, osseous (spine) tuberculosis, osteomyelitis (mild type) and the symbolic trephination can be observed while the occurrences of traumatic lesions (fractures), porotic hyperostosis and degenerative joint diseases (osteoarthritis in the hip, spondylitis) are more frequent, and there are no signs of osseous leprosy at all (Csányi 2001; Szigeti 2001).

Püspökladány-Eperjesvölgy

There is a small difference between the 10^{th} and 11^{th} century samples in this material. Mild types of porotic hyperostosis have a higher frequency in the 11^{th} century sample. Of the infectious diseases, osteomyelitis and osseous leprosy were only found in the 10^{th} century sample. *Mycobacterium leprae* DNA was detected in two cases by Spigelman et al. (1999). However, serious skeletal tuberculosis was only seen in the 11^{th} century sample. A higher frequency of fractures was found in the 11^{th} century, although surgical and symbolic trephinations are known from the 10^{th} century. Degenerative arthritis and developmental anomalies were seen in both 10^{th} and 11^{th} century samples with the higher frequencies recorded in the 11^{th} century sample (Pauditz 1995; Finnegan et al. 1997).

Table 1. Distribution of the number of specimens.

Sites and authors	10^{th}	11^{th}	Total
Szegvár-Oromdűlő (Marcsik 1977)	93	259	352
Magyarhomoróg-Kónyadomb (Csányi 2001; Szigeti 2001)	23	345	368
Püspökladány-Eperjesvölgy (Pauditz 1995; Finnegan et al. 1997; Spigelman et al. 1999)	258	366	624
Algyő (Marcsik and Szalai, in manuscript)	77	-	77
Sárrétudvari-Hízóföld (Oláh 1990; Pálfi et al. 1996; Pálfi et al. 1999)	263	-	263
Total	714	970	1,684

Algyő

In this 10^{th} century sample, different types of porotic hyperostosis and the more serious osteomyelitis were seen at relatively high frequencies. There was no sign of any specific infectious disease. Similarly to porotic hyperostosis, higher frequencies of fractures, degenerative arthritis and symbolic trephination were seen. Two special diseases, polyostotic fibrous dysplasia and ankylosing spondylitis were also observed (Marcsik and Szalai, in manuscript).

Sárrétudvari-Hízóföld

The most frequent paleopathological lesions observed in the series can be divided to entesopathies and traumatic lesions (various types of fractures, the signs of chronic strains, surgery and symbolic trephination) and degenerative joint disease (arthritis, spondylosis, spondylarthrosis). The numerical occurrences of bone-joint disorders of non-specific infectious (osteomyelitis, periostitis) and porotic hyperostosis are also relatively high. However, osteonecrosis, osteoporosis, tumors, developmental malformations, spondylarthritis and diffuse idiopathic skeletal hyperostosis can be demonstrated in smaller numbers. It is important to mention that certain signs of deformations caused by osseous leprosy were found in one individual and a most likely occurrence in another one (Pálfi et al. 1996). In these specimens, the results of the molecular biological analysis are negative for the *Mycobacterium leprae* DNA (Pálfi et al. 1999).

Discussion

It seems that the porotic hyperostosis is observed in both 10^{th} and 11^{th} century samples. The more serious types were found during the childhood period in the 10^{th} century sample. Its incidence can vary from site to site in the same general area and time period, and appeared to be dependent on ecological and environmental conditions. A number of etiologies have been suggested as being responsible for the development of these lesions, including anemia or nutritional deficiencies (poor diet), parasitic infections and weaning diarrhea (Stuart-Macadam 1989). Since available protein or other food nutrients appear to be adequate in the 10th century, it is supposed that 10th century populations might be more susceptible to bacterial infections and/or had reduced iron absorption (due to weaning diarrhea and/or other infections).

Among the nonspecific infectious diseases, cases of chronic osteomyelitis (caused by staphylococcus or streptococcus) are only seen in the 10th century samples. The most serious cases were published by Marcsik and Oláh (1991). Based on the present data, leprosy seems to be more widespread in the 10th century than in the 11th century. There is no evidence of osseous tuberculosis in the 10th century sample: this disease was apparently spread only during the 11th century. It may be supposed that the host-resistance of the Hungarian tribes was reduced against certain bacteria (*Mycobacterium tuberculosis* and/or *bovis*) during the early occupation of this new territory. After the establishment of settlements during the 11th century, when skeletal tuberculosis was widespread, the host-resistance may have been reduced, the tuberculosis bacillus may had become more virulent or there have been a closer relationship (sedentary living) between the vector and the host. The Hungarian plain was well suited for sedentary agriculture and animal husbandry, and its associated human lifestyle could be compatible with the development of tuberculosis. The spread of leprosy in the 10th, of tuberculosis in the 11th, centuries corresponds to the earlier results (Marcsik and Pálfi 1999).

Tuberculosis and leprosy continued to increase in frequency with continued sedentary living, and high frequencies are found in the middle ages in Hungary (Marcsik 1998).

Degenerative arthritis, fractures, and developmental anomalies did not increase significantly during the change from a nomadic to a sedentary life style in the Carpathian Basin. The incidence of both degenerative arthritis and fractures are high in each of the 10th and 11th century samples, but the etiology of each may be different: riding and hunting in the 10th century versus sedentary agriculture and higher population density during the 11th century.

Symbolic trephination in Hungary (apart from four chronologically uncertain cases) can be demonstrated among the populations of the 10th and 11th centuries (Nemeskéri et al. 1960). Even in ethnical respect, the symbolic trephination also relates to the conquering Hungarians of the 10th century. These skulls and their infracranial bones have no other lesions except only one case (grave 242 of Sárrétudvari-Hízóföld with serious osteomyelitis on the femurs and tibias), and there are symbolic trephinations on the infant skulls. The types of symbolic trephination on skulls found in Hungary usually correlate with the symbolic trephination of the 9th and 10th century skulls found in Bulgaria (Boev 1968; Jordanov 1988). Similar interventions are described by Éry (1987, 1988) on skulls found in the Volga region (Tankejevka site, 9th and 10th centuries), while Fóthi at al. (2001) reported 14 skulls with symbolic trephination from the Bolsie Tarhani series (7th -9th centuries).

The examinations of series involving large number of individuals have proved that the practice of symbolic trephination vanished with the consolidation of Christianty in the 12th century (Lipták 1983; Szathmáry 1983). The rate of decline (if there was any decline) in the practice of symbolic trephination (as a pagan trait characteristics) in the 11th century right after the adoptation of Christianity will be answered by further studies regarding the 10th and 11th century samples.

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