ANTHROPOLOGIE * XXVI/3 * 1988

MILAN THURZO, JÁN LIETAVA, MÁRIA VONDRÁKOVÁ

DIFFERENTIAL DIAGNOSTICS OF TWO CASES OF ANKYLOSED WRISTS FROM THE EARLY MIDDLE AGES IN SLOVAKIA

ABSTRACT — The first case is concerned with the skeletal remains of a 40—60 years old male from grave No. 709 in Čakajovce, Nitra District, (10th century A. D.). The pathologically changed right wrist consisting of fused carpals and metacarpals and of isolated corresponding forearm bones is a remarkable find. It is characterized by an extensive carpometacarpal ankylosis showing minimal productive changes, carpal sequestration and possible osteoporosis.

Small osteophytes can be seen on the radioulnar articulation. There is a sinus drained through an orifice on the articulation surface of the distal radius. This part shows marks of discrete periosteal reaction.

The rest of the skeleton does not offer any valuable diagnostic information, and as to pathological changes only a degenerative sponylosis can be identified. However, the inflammation process on the wrist is diagnostically not univocal and possible tuberculous etiology can be presumed.

The second find of ankylosed wrist and forearm of an adult male from grave No. 39 in Modrany, Komárno District, (10th—13th centuries A.D.) is marked in a similar way by extensive synostosis with small productive changes, but the presence of an unambiguous traumatic injury in the carpometacarpal region points to a diagnosis of posttraumatic arthritis.

The morphological and radiological similarities between both pathological processes make a correct diagnosis difficult. A definite solution of the problem requires further study as well as comparison with analogical findinjs.

KEY WORDS: Palaeopathology — Skeletal remains — Macroscopic and radiographic data — Central Europe

INTRODUCTION

The etiology of ankylosed wrists presents a complex differential-diagnostic problem, both for medicine in general, and for palaeopathology in particular. While in human medicine further orientation is facilitated by the overall clinical picture, a radiograph — the main means of the palaeopathological diagnostics — is non-specific to a great extent and has common features for several diseases.

The differential diagnostics include pathological conditions of various etiologies: traumatic lesions, non-specified arthritides and related atypical forms, specific processes and tumours.

Up to now, the Czechoslovak specialized literature has published only a single case of ankylosed wrist of tuberculous origin (Stloukal 1964). Finds affected with bone tuberculosis are rare in palaeopathology. A survey of pathological finds in the territory of Czechoslovakia up to 1979 (Hanáková and Vyhnánek 1981) mentions only 11 cases. In addition, Stloukal and Vyhnánek (1976) announced a further (unpublished) case of an ankylotic wrist excavated in the Mikulčice site (the fifth cemetery).

At the Days of Osteological Anthropology

This paper was presented at the workshop on "New Finds and Novel Opinions in Palaeopathology" held in Brno, Anthropos Institute on October 26, 1987.

held in Prague in April 1987, the ankylosed right wrist of a male from grave No. 39 in Modrany, Komárno District, was presented (Thurzo, Gomolčák and Lietava, in print). In this case the authors presume traumatic etiology. Since the find was described in detail we shall mention it here only in connection with the differential diagnostics of the recent Čakajovce find.

BASIC CHARACTERISTICS OF THE ČAKAJOVCE FIND

The ankylosed wrist of the individual from Čakajovce, Nitra District, was discovered during the archaeological research of the Kostolné site realized by M. Rejholcová in 1982. The skeletal remains of the affected individual come from the grave No. 709 dated to the 10th century A.D.

The skeletal remains are incomplete and severely damaged by natural influence of the soil conditions. The skeleton belonged to a brachymorphic probably male individual of above-the-average to high stature. From the skull only a medium robust calvaria bearing moderate muscle relief has been preserved. The sexual-diagnostic characters of the skull are of indistinct, ambivalent character. Among the cranial discontinuous traits the sutural bones located in lambdoid and squamous sutures should be mentioned. As far as pathological changes of the skull are concerned, there is evidence of dental caries and cysts following periapical inflammations.

The postcranial skeleton has been preserved in either damaged or fragmentary state. The trunk skeleton and the bones of the upper limbs are gracile to medium robust, while the diaphyses of the preserved long bones of the lower extremities show moderate to pronounced robusticity.

From pathological changes let us mention the moderate degree of osteophytosis of vertebral fragments and osteocartilaginous exostoses in the preserved right sternoclavicular joint.

It is rather problematic to determine the sex of the individual found in grave No. 709. The allophic shape of the skull and the absence of all sexual-diagnostic characters of the pelvis make it impossible to determine the sex reliably. The prevailingly gracile proximal skeleton suggests it may be female, while the robusticity of the lower limbs indicates the male sex. As complementary criteria for the sex determination the discriminatory functions basing on the metric characters of the diaphyses of long bones (Van Gerven 1972, DiBennardo and Taylor 1979, Černý 1980, DiBennardo and Taylor 1983, Iscan and Miller-Shaivitz 1984, Mac-Laughlin and Bruce 1985, Dittrick and Suchey 1986) were used. Discriminant analysis of humerus indicates that the individual was perhaps a female; on the other hand, the discriminant analysis of the femur and tibia unequivocally point to male sex.

The height of the individual was assessed on the basis of the reconstructed maximum lenght of the femur and tibia by comparing the preserved diaphyses with undamaged specimens; the approximate length values are 445 mm in case of femur and 375 mm in the tibia. If we are inclined to accept it was male skeleton, than the body height is between 165—171 cm (Trotter and Gleser 171 cm, Manouvrier 164.8 cm, Breitinger 168.2 cm); if the skeleton belonged to a female, the body height is between 163—167 cm (Trotter and Gleser 167 cm, Manouvrier 162.7 cm, Bach 166.2 cm.)

The robusticity of the lower limbs and the relatively high stature, however, show that the individual probably was a male. The degree of skull sutures closure places the individual between the 40—60 age bracket. The traces of arthrosis and spondylosis are quite in line with the age estimate.

The affected wrist consist of the fused carpometacarpal part and of isolated radius and ulna (*Fig. 1*). Due to considerable postmortal damage a number of bones or their parts are missing: the entire first metacarpal, the distal epiphyses of the second, fourth and fifth ones, parts of the capitate and lunate, a substantial part of the facies articularis radii, the entire articulation surface of the carpals, portions of the distal epiphyses and entire proximal epiphyses of the radius and ulna.

DESCRIPTION OF THE PATHOLOGICAL FIND

Wrist

The carpals and metacarpals are ankylosed, approximately in physiological position. The angle between the wrist and the longitudinal axis of the forearm cannot be determined.

The diaphyses of the metacarpals have normal shape, without evident pathological changes. On the radiograph and also by visual assessment there can be well seen the porosity of the cancellous tissue, but in view of the postmortal changes it is impossible to determine either the origin or the extent of this seeming porosity. The Barnett-Nordin index (0.41), measured on the third metacarpal, suggests a slight osteoporosis. (Under normal circumstances, the index for the metacarpal ranges from 0.43 to 0.48 [Debrunner 1978]). On the lateral side of the only preserved distal epiphysis (the third metacarpal), the productive changes have been expressed in the form of marginal osteophytes.

There are productive changes to be seen also at the carpometacarpal joints. The intermetacarpal areas between the third and fourth metacarpals are obliterated. The apposition of the new bone between the second and third metacarpals, as well as between the fourth and fifth ones, is less perceptible.

The carpometacarpal articulation is macroscopically obliterated, but it is still recognizable on the radiograph. In the metacarpals we can radiographically localize only the partially preserved triquetrum (*Fig. 2*).

The area of the anatomical articulation of capitate and lunate is destructed by a triangular orifice with a distally situated base, with a length of about 15 mm and with a height of 8 mm (*Fig. 1a, Fig. 2*). Its proximal part has been secondarily damaged, but the continuous compact bone in the distal part of the opening, and partially also at the vertex, indicate the healing of the process and very probably also the sequestration of a part of the bone tissue.

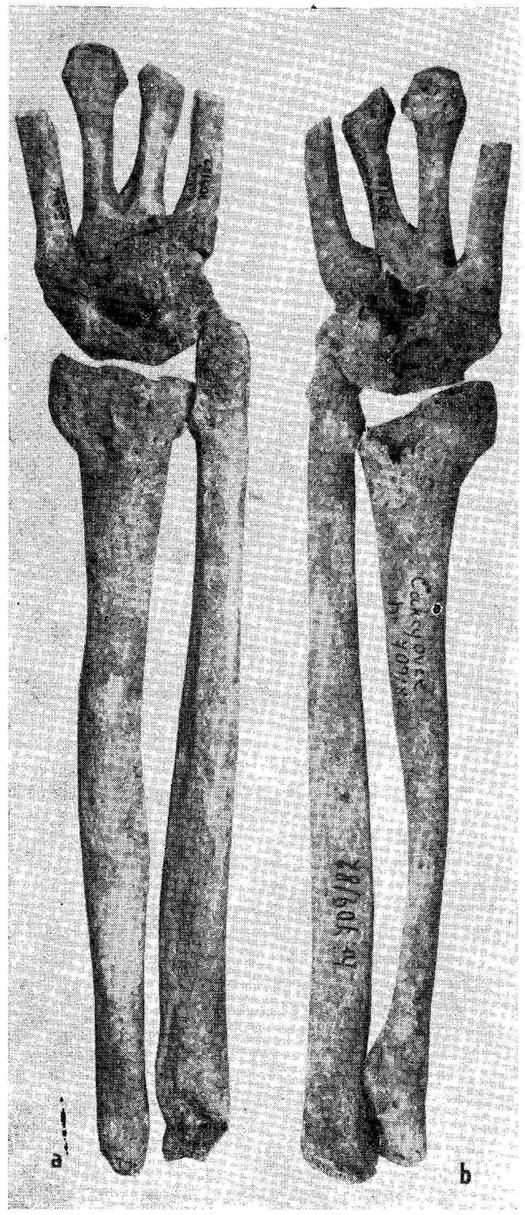

FIGURE 1. *Synostozed right wrist and isolated correspondina forearm of an individual found in grave No. 709 at Čakajovce. a — dorsal view, b — palmar view. Photo M. Červeňanský.*

There are numerous small orifices reaching to a maximum diameter of 1.25 mm on the preserved bone appositions, they indicate the process of reactive hypervascularization. The productive changes are documented by discrete bone appositions (in places in the course of intercarpal ligaments) and by traces of bone remodelling easier detectable on the dorsal side.

Due to extensive postmortal damage a considerable portion of the spongy tissue is visible (*Fig. 1b*). The diagnostic value of the spongioporosis, and of the presence of cystic and/or pseudocystic changes, cannot be determined in view of the degree of bone damage. Macroscopically and radiographically one can see a large number of small cavities of a diameter of 2—3 mm, but the absence of circumscribed dense bone or sharply defined boundary refutes their cystic character.

A shifting of the articulation surface for the first metacarpal in palmar direction does not exclude the possibility of retraction of the palm.

Radius

Only part of the distal articulation surface has been preserved (*Fig. 3*). There are several orifices and sinuses leading into the medular cavity, while the more continuous layer of the compact bone in one of the openings (indicated by the arrow) arises our suspicion that there was a penetrating inflammatory process. The damaged structure of the cancellous tissue in the other openings clearly indicates their secondary origin. In the proximal part of the styloid process there are well recognizable minor exostoses. More obvious exostoses have been formed in the incisura ulnaris.

The distal third of the right radius is slightly thicker, in all possibility due to periosteal apposition. With regards to the contralateral side, the cross-section of the distal metaphysis is extended by 3 mm (measured on a radiograph). An increased concentration of small openings on the surface of this part documents the accentuated vascularization of the periosteum. On the radiograph this changes appear as increased density of the osseous tissue (*Fig. 2*).

The entire right diaphysis is at least ca. 1 cm (about 5%) shorter in comparison with the contralateral bone. The flatter bicipital tuberosity suggests that the right forearm was used less actively.

Ulna

The styloid process and the articular circumferentia of the right ulna have been pathologically changed, they bear marginal osteophytes. There are no particular features on the diaphysis, the proximal epiphysis is missing. In spite of the left ulna being damaged, it seems that both ulnae have the same length and shape.

DISCUSSION

The most characteristic feature of the Čakajovce find is the fusion of the carpals and of the firmly

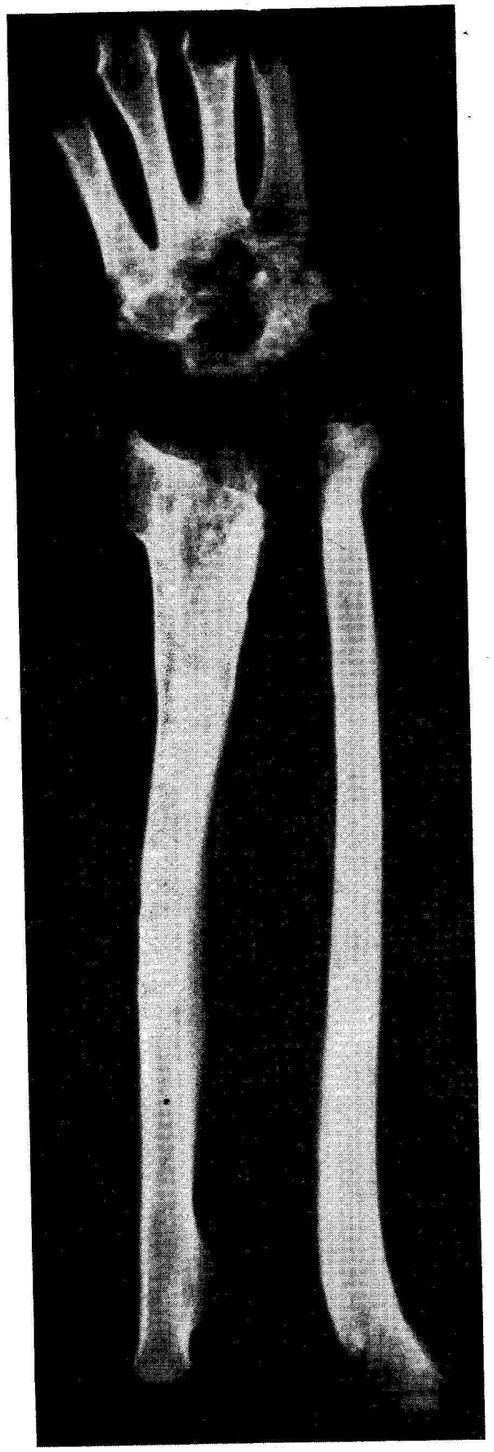

FIGURE 2. *Radiograph of the deffected wrist joint of an individual from grave No. 709 at Čakajovce. Reproduction by M. Červeňanský.*

FIGURE 3. *Detail of the distal articulation surface of the radius belonging to the individual from grave No. 709 at Čakajovce. The arrow indicates a drained sinus. Photo M. Červeňanský.*

ankylosed metacarpals into an almost amorphous conglomerate. A striking trait of the wrist is the opening in the area of capitate with only a minimum number of productive changes in its environs. This opening was probably formed by sequestration of bone tissue. The shortening of the radius indicates that the inflammatory process started prior to the epiphyseal union of the distal radius. The absence of pronounced appositions, possible osteoporosis and the presence of ankylosis point to the chronical character of the disease. The pathological changes on the third metacarpal epiphysis and in the radioulnar connection suggest the hypothesis of parallel inflammatory and degenerative processes in the individual.

It would be rather interesting to follow closely the processes that took place in the radiocarpal articulation, however, some doubts are raised by the absence of a part of the distal articulation surface of the radius, and the total postmortal destruction of the proximal carpal parts. A possible diagnostic analysis is thus limited by the fragmentary state of the find, rendering it impossible to study the rest of the heavily damaged skeleton.

As the most plausible nosological units causing the ankylosis, a non-specific inflammatory or post-traumatic arthritis, bone tuberculosis, rheumatoid arthritis and similar atypical forms, as well as degenerative diseases of the joints might be taken into consideration. Nevertheles, the two latter nosological units can be excluded. In spite of the above-mentioned degenerative changes on the third metacarpal epiphysis and possible degenerative changes of the radioulnar joint, the given ankylosing process has a definite inflammatory character. Moreover, the presence of both the sequestration and sinuses does not fit into the picture of either the rheumatoid arthritis or a degenerative joint disease.

Differentiation between a specific and a non-specific inflammation constitutes a complicated problem. Both processes are characterized by osteoporosis and by varying degree of reactive periostosis with productive appositions, sequestration, deformation and/or disappearance of the articulation surfaces of individual bones, and gradual ossification of the trabeculae between the bones resulting in final ankylosis. This is especially characteristic of the chronic processes (Blažek 1980, Ortner and Putschar 1981, Kolář and Zídková 1987).

In case of the ankylosed wrist from Modrany, the firm point for the diagnosis has been the univocal trauma of the third metacarpal affecting also the proximal epiphysis of the second one. Moreover, one can observe several suspect characters of further traumas of the wrist, including a possible palmar dislocation of the proximal set of carpals (*Fig. 4*).

The hypothesis of traumatic origin of this ankylosis is supported also by some indirect features — limited furrows on the dorsal surface of the wrist as possible traces of penetrating injuries, flexed position of the metacarpals as a probable result of disturbance of the integrity and function of extensors. The productive changes were explained as gradual ossification of both the proliferated granulation and the hypervascularized periosteum.

The specimen from Modrany lacked the characters of typical osteomyelitic process — such as massive sequestration, alternating zones of resorption, sclerotization and proliferation of bone tissue. An important symptom was also the absence of conspicuous periosteal proliferation, regarded by many authors as characters of osteomyelitis (Hoppe and Polívka 1968, Kricun and Eideken 1973, Ortner and Putschar 1981, Kolář and Zídková 1987).

The absence of both the spongiosclerosis and the more acute periosteal reaction, which are very typical of a chronic form of a non-specific arthritis

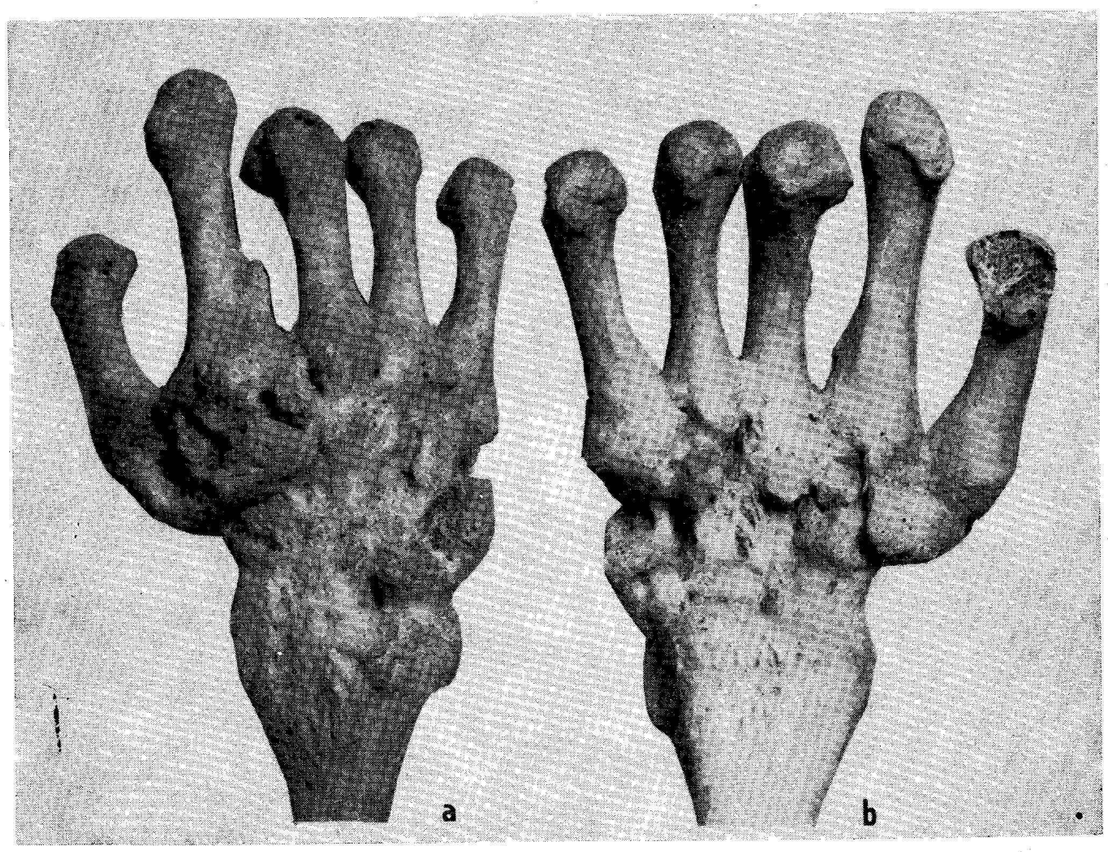

FIGURE 4. *Ankylosed wrist and forearm of the individual from grave No. 39 at Modrany. a — dorsal view, b — palmar view. Photo M. Červeňanský.*

(Blažek 1980), can be used in both cases as an argument against the presence of this disease.

The small degree of periosteal changes, absence of excessive productive processes, characteristic affection of the capitate and the fact that the atrophic and "necrotic" areas — i.e. the sinuses — do not differ in density from the surrounding areas (Kolář and Zídková 1987) all suggest that the Čakajovce find was caused by tuberculosis. Despite the fact that the carpal sequestration and the cavity in the radius which suggest a harm of the radiocarpal joint do not communicate directly, they indicate the possible existence of a bilateral process or of so-called "kissing sequesters".

The low frequency of pathological changes caused by tuberculosis is almost certainly conditioned by a lower degree of penetration of mycobacteries into the bones — at the present conditions we count with 3% incidence of bone tuberculosis in all types of tuberculoses. And in bone tuberculosis the incidence of wrist affection is of very low value. Sommerville and Wilkinson (1965) indicate 2.3%, Hope and Polívka (1968) have found 4.6%, and Ortner and Putschar (1981) quote various sources with estimated frequencies varying between 1.2—6.0%.

The Moravičany find (Stloukal 1964) indicates, perhaps, similar diagnostic complications: Grave No. 26 contained the remains of a male aged 40—50 years bearing complete synostosis of the right radiocarpal joint — probably of tuberculous origin. The presence of the callus on the fifth metacarpal, however, does not exclude possible trauma.

The absence of traumatic insult on the ankylosed wrist from Čakajovce offers a unique occassion to study synostosis of inflammatory origin.

The univocal diagnosis and the differential diagnostics between the tuberculous and non-specific process on the wrist will remain, without doubt, an open question. On the basis of the study of palaeopathological materials and data published in the specialized literature we are inclined to think that diagnostics of the wrist tuberculosis could be based on a complex evaluation of the following symptoms:

1. Presence of spina ventosa as a pathognomonic character for juvenile tuberculosis;
2. Existence of minimum productive changes as well as of smaller extent of periosteal affection and reaction — eventually their total absence;
3. Sequestrations of slight extent (contrary to cases of osteomyelitis);
4. Absence of marked sclerotization and of spongiosclerosis;
5. Presence of destructive changes blurring the outline of the bones, with free transition of trabeculae between the bones;
6. Possible presence of minor abscess cavities (following caseation) and of sinuses lined with the dense bone;
7. Absence of traumatic changes.

Point No. 7 is of facultative character, direct inocculation with mycobacteria following trauma has been repeatedly described. The probability of a specific process in the wrist can be increased by the presence of affection of further skeletal parts, namely those of axial ones.

CONCLUSION

We are well aware of the fact that both the specific and non-specific affections of the wrist produce similar or almost identical morphological and radiographic picture. Although the ankylosed wrist from Čakajovce has more characters in favour of tuberculous etiology — and we are inclined to accept this diagnosis —, a possibility of infectious or posttraumatic arthritis cannot be excluded with full certainity.

This study should not be understood as the definite solution of the investigated problem. The ankylotic finds from Modrany and Čakajovce should be subjected to further study as well as comparison with other finds of analogous character. One also may hope that the suggested diagnostic criteria of the specific process will release more profound discussion.

REFERENCES

BLAŽEK O. et al., 1980: *Klinická rádiodiagnostika* (Clinical X-ray diagnostics). Avicenum, Prague. 419 pp.

ČERNÝ M., KOMENDA S., 1980: Sexual diagnosis by the measurements of humerus and femur. *Sbor. Prací Pedagog. Fak. Univ. Palack. Olomouc — Biologie* 2: 147—167.

DEBRUNNER H. U., 1978: *Orthopädisches Diagnostikum*. 3rd ed. Georg Thieme Verlag, Stuttgart. 204 pp.

DIBENNARDO R., TAYLOR J. V., 1979: Sex Assessment of the Femur: A Test of a New Method. *Amer. J. Phys. Anthropol.* 50(4): 535—538.

DIBENNARDO R., TAYLOR J. V., 1983: Multiple Discriminant Function Analysis of Sex and Race in the Posteranial Skeleton. *Amer. J. Phys. Anthropol.* 61(3): 305—314.

DITTRICK J., SUCHEY J. M., 1986: Sex Determination of Prehistoric Central California Skeletal Remains Using Discriminant Analysis of the Femur and Humerus. *Amer. J. Phys. Anthropol.*, 70(1): 3—9.

HANÁKOVÁ H., VYHNÁNEK L., 1981: Paläopathologische Befunde aus dem Gebiet der Tschechoslowakei. *Sbor. Nár. Múz. Praha, Řada B — Přírod. Vědy* XXXVII(1): 1—76.

HOPPE V., POLÍVKA D., 1968: *Tuberkulósa pohybového ústrojí* (Tuberculosis of locomotore organs). Státní zdravot. Naklad., Prague. 125 pp.

ISCAN M. Y., MILLER—SHAIVITZ P., 1984: Determination of Sex From the Tibia. *Amer. J. Phys. Anthropol.* 64(1): 53—57.

KOLÁŘ J., ZÍDKOVÁ H., 1987: *Nárys kostní rádiodiagnostiky* (Outline of bone radiodiagnostics). Avicenum, Prague. 419 pp.

KRICUN M. E., EIDEKEN J., 1973: *Roentgenologic Atlas of the Hand and Wrist in Systemic Disease*. The Williams Wilkins Company, Baltimore. 324 pp.

MACLAUGHLIN S. M., BRUCE M. F., 1985: A Simple Univariate Technique for Determining Sex From Fragmentary Femora: Its Application to a Scottish Short Cist Population. *Amer. J. Phys. Anthropol.* 67(4): 413—417.

ORTNER D. J., PUTSCHAR W. G. J., 1981: *Identification of Pathological Conditions in Human Skeletal Remains*. Smithsonian Institution Press, Washington. 480 pp.

SOMMERVILLE E. W., WILKINSON M. C., 1965: *Girdlestone's Tuberculosis of Bone and Joints*. 3rd ed. Oxford University Press, London. 220 pp.

STLOUKAL M., 1964: Výzkum koster ze středověkého pohřebiště v Moravičanech (Research of the skeletons from the medieval cemetery at Moravičany). *Přehled výzkumů* (Brno), 63—65.

STLOUKAL M., VYHNÁNEK L., 1976: *Slované z velkomoravských Mikulčic* (Slavs from the Great-Moravian Mikulčice). Academia, Prague. 208 pp.

THURZO M., GOMOLČÁK P., LIETAVA J., in print: Pokus o diferenciálnu diagnózu zápästia jedinca zo stredovekého pohrebiska v Modranoch, okres Komárno (An attempt at differential diagnosis of the wrist of an individual from a medieval cemetery at Modrany, Komárno District). *Čas. Nár. Múz. Praha.*

VAN GERVEN D. P., 1972: The Contribution of Size and Shape Variation to Patterns of Sexual Dimorphism of the Human Femur. *Amer. J. Phys. Anthropol.* 37(1): 49—60.

RNDr. Milan Thurzo, CSc.
Slovenské národné múzeum
Vajanského nábrežie 2
814 36 Bratislava

MUDr. Ján Lietava
Hanulova 7
841 01 Bratislava

RNDr. Mária Vondráková
Archeologický ústav SAV
949 21 Nitra — Hrad