J Forensic Sci, May 2004, Vol. 49, No. 3
Paper ID JFS2003168
Available online at: www.astm.org

CASE REPORT

Marija P. Djurić,[1] *M.D., Ph.D.*

Anthropological Data in Individualization of Skeletal Remains from a Forensic Context in Kosovo—A Case History

ABSTRACT: There are many reports relating to victims and mass graves in the former Yugoslavia. They emphasize the importance of creating local skeletal identification standards. In this paper we deal with the first mass grave examined since the Kosovo crisis started and discuss problems regarding the identification process, especially the coincidence of antemortem with postmortem data. Twelve persons out of 39 bodies were identified using interviews with relatives and correspondence of biological data with personal effects and/or documents. Previous pathology was of crucial importance in the identification of three persons.

KEYWORDS: forensic science, mass graves, sex, age at death, stature estimation, forensic anthropology, identification

At the beginning of the Kosovo crisis, on September 8, 1998, during the conflict between the Serb security forces and the Kosovo Liberation Army, the police showed a group of journalists several corpses in an advanced state of decomposition; they had been found in a canal supplying water to Radonjicko Lake, in the region between the villages of Glodjane and Jablanica. On 9 September, the official investigation of the crimes near Glodjane began, and the forensic experts from the Medical Faculty in Belgrade performed the autopsies and the identification of corpses. The team of three forensic pathologists and one anthropologist (also medically trained), working under the authority of the District Court in Peć, found that the minimal number of individuals in the mass grave was 39. Twelve of them were positively identified using traditional means, e.g., correspondence of biological data with personal effects and/or documents. Seven of the victims were Serbs, one belonged to a Romany population, and four were Albanians.

Material and Methods

The corpses were found in September 1998 on the ground surface and in a canal which supplies water to Radonjicko Lake. The police, based on the information collected from eyewitnesses, concluded that the victims were massacred between May and early September of the same year. The remains comprised 39 individuals in an advanced stage of decomposition, which made the identification of causes of death rather difficult. Considering the physical environment in which the bodies were found (exposed bodies on the ground surface and bodies in the water) and the advanced stage of putrefaction with partial adipocere and skeletonization, the estimated time since death was 2 to 6 months.

After recognition of associated material (clothes and personal belongings) by the family of the victims, and comparison of antemortem and postmortem data by the anthropologist, the 12 positive identifications were made.

For this study we chose eight of the best preserved individuals (labeled as R3, R10, R15, R17, R18, R20, R22, and R23). Methods for sexing and aging the individuals were based largely on the criteria recommended by the Workshop of European Anthropologists (1) as practiced in this area when skeletal material derived in both the forensic and archaeological contexts was investigated. Determination of sex basically comprised observation of morphological features of pelvic bones: shape of the pelvic inlet, robustness of the bones, shape of ventral arc, subpubic concavity, presence of ischiopubic ramus ridge, shape of the greater sciatic notch, and the presence of the preauricular sulcus and composite arc; however, additional information (Figs. 1–4) was drawn from the metric traits of pelvic bones (1–4). The five-point scale for each trait was applied. Sex assessment based on pelvic bones was not applied in cases with preserved external genital organs. In cases where the skulls were well preserved (six cases) it was possible to apply sex assessment based on cranial morphologic traits (1,5,6). Following Ascádi and Nemeskéri (7), the degree of development of any sexually differentiated characteristics was scored in one of the following five categories: hypermasculine, masculine, indifferent, feminine, and hyperfeminine by means of scoring grades $+2$, $+1$, 0, -1, -2. Estimation of age at death was based on pubic symphyseal phases (8,9), and cranial suture closure (10). Stature estimation was based on regression formulas introduced by Trotter and Gleser (11). The formulas based on maximum femur length rather than tibia length were applied since it was not clear how the tibia was measured by authors of the method (12). As the recent Balkan study of stature estimation (13,14) had not been

[1] Laboratory of Anthropology, Department of Anatomy, Medical Faculty, University of Belgrade, Belgrade, 4/2 dr Subotića, Yugoslavia.

Received 12 May 2003; and in revised form 1 Nov. 2003, 10 Jan. 2004; accepted 10 Jan. 2004; published 7 April 2004.

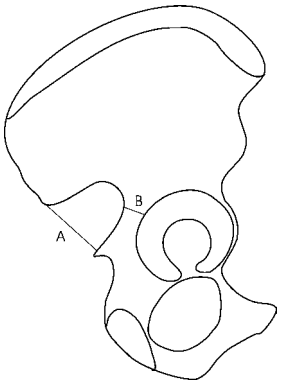

FIG. 1—*Measurements used for cotyloischiadic index after Sauter and Privat (1).* (A) *Height of the notch (perpendicular distance between the anterior border of the great sciatic notch and the point of the posterior inferior iliac spine).* (B) *Cotyloischiadic diameter (direct and projective distance between the anterior border of the great sciatic notch and the adjacent border of the acetabulum).*

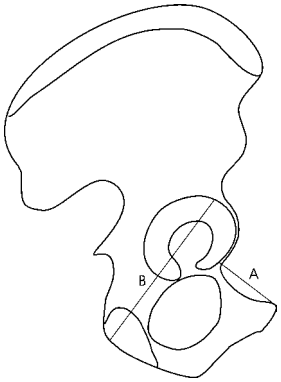

FIG. 2—*Measurements used for ischio-pubic index after Novotný (1):* (A) *Pubic length (distance between the most prominent point of the symphyseal surface and the nearest point of the acetabular rim).* (B) *Ischial length (the greatest distance between the midpoint of the ischial tuberosity and the acetabular rim).*

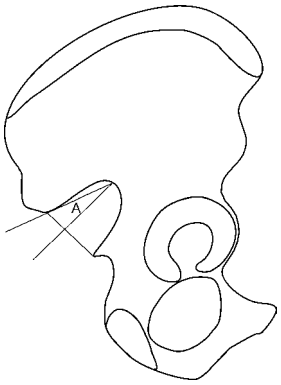

FIG. 3—*Posterior angle (angle between the line connecting the pyriformis tubercle and the deepest point of the notch, and the line running from the deepest point perpendicular to the line between the tubercle of the pyriformis muscle and the tip of the ischial spine) after Singh and Potturi (4).*

published by this time, the comparison with the results drawn from these new formulas has not been discussed until now. Premortem data of stature were obtained from military records and family statements.

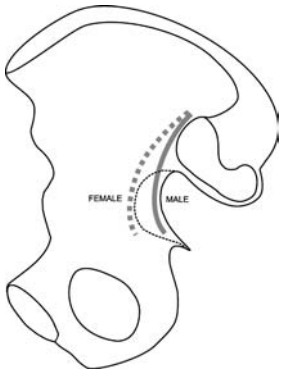

FIG. 4—*Composite arc (arcuate line running through the anterior margin of the auricular surface and anterior edge of the great sciatic notch: single in males, double in females) after the Workshop of European Anthropologists (1).*

TABLE 1—*Sex of identified persons estimated by metric and morphological* characteristics of pelvic bones.*

Method	Case Number				
	R3	R10	R15	R22	R23
Cotyloischiadic index	116.6	102.7	61.9	95.0	85.0
Ischio-pubic index	59.1	68.8	67.3	56.36	62.5
Posterior angle	21	24	7	19	12
Robustness of bones	+1	−2	+1	+1	+2
Pelvic inlet	+1	−2		+2	+2
Sub-pubic angle	+1	−2	+1	+2	+2
Ventral arch	+1	−2	+2	+2	+2
Pre-auricular sulcus	+2	−2	−1	+2	+2
Greater sciatic notch	+1	−2	+2	+1	+2
Composite arc	+2	−2	+1	+1	+2
Obturator foramen	0	+1	−1	+1	+1
Sacrum	+1	−1	+1	+2	+2
Ischiopubic ramus ridge	+1	−1	+2	+2	+2
Known sex	male	female	male	male	male

* − 2 = hyperfeminine; +2 = hypermasculine.

TABLE 2—*Sexual dimorphism in skulls.*

Morphological Traits	Case Number					
	R10	R17	R18	R20	R15	R22
Supraorbital ridges	0	−2	−1	+2	+2	+2
Supramastoid ridges	−1	−1	−1	+1	+1	
Supraorbital margins	−1	−2	+1	−1	−1	0
Robustness of mandible	0	0	+1	+1	0	
Zygomatic arch	−1	+1			+1	
Frontal tubers	−1	−2	0	−1	−1	−1
Mastoid process	−2	−1		+1	+1	
Occipital ridges	−1	−1		+2	+1	+1
Known sex	female	female	female	male	male	male

Results and Discussion

Testing the diagnostic reliability of sex, age, and stature from skeletal material by comparison with antemortem data yielded the following results, presented in Tables 1–4.

The results confirm the well-documented fact that the pelvic girdle provides the most consistently correct guides to sex, while the skull is less reliable (Tables 1 and 2). Almost all morphological sex indicators on pelvic bones corresponded to the sex confirmed in the

TABLE 3—*Known and estimated age of identified persons.*

Method	Case Number						
	R3 Male	R10 Female	R15 Male	R18 Female	R20 Male	R23 Male	R22 Male
Cranial suture closure (Meindl and Lovejoy 1985)	12 (56.2 ± 8.5)	10 (51.9 ± 12.5)	3 (56.2 ± 8.5)	5 (41.1 ± 10.0)	10 (51.9 ± 12.5)	no data	12 (56.2 ± 8.5)
Pubic symphysis (Todd 1920)	9 (45–50)	10 (>50)	10 (>50)	6 (30–35)	10 (>50)	9 (45–50)	9 (45–50)
Pubic symphysis: Suchey and Brooks 1986 (9)	5–6* (45.6–61.2)	5–6 (48.1–60.0)	5–6 (45.6–61.2)	3 (30.7 ± 8.1)	5–6 (45.6–61.2)	5 (45.6 ± 10.4)	5 (45.6 ± 10.4)
Known age	58	61	63	31	54	60	47

*Some cases fall between the phases, and given range presents the mean ages for the two adjacent phases.

TABLE 4—*Estimation of stature by different methods based on femur length.*

Method	Case Number						
	R3	R10	R15	R17	R20	R22	R23
Ross and Konigsberg (2002)	165.03 ± 3.3	no data for females	173.29 ± 3.3	no data for females	170.94 ± 3.3	171.64 ± 3.3	167.39 ± 3.3
Sarajlic (2002)	164.01 ± 4.44	no data for females	173.43 ± 4.44	no data for females	170.73 ± 4.44	171.64 ± 4.44	166.70 ± 4.44
Trotter and Gleser (1958)	163.75 ± 3.27	163.9 ± 3.27	172.08 ± 3.27	161.0 ± 3.27	169.7 ± 3.27	170.41 ± 3.27	166.13 ± 3.27
Sex	male	female	male	female	male	male	male
Femur length	43.0	44.2	46.5	43.0	45.5	45.8	44.0
Known stature	168–176	165	168	155–160	168–176	175–180	170

identification process. Only the triangular obturator foramen, said to characterize females, was found in one male skeleton; in another male skeleton it was indeterminate, and in one female skeleton it was oval in shape, i.e., of the masculine type. Sexing indices were evaluated in the same way. The measuring of the posterior angle (Fig. 3) correctly showed the highest value in one female skeleton, although values for cases R3 and R22 were higher than those originally presented by Singh and Potturi (4) for males. The result probably denotes problems of interpopulation variations and, consequently, differences in sectioning points between the sexes. Three individuals were correctly classified by the cotyloischiadic index (Fig. 1), but one female skeleton (R10) showed a male value. Ischiopubic index (Fig. 2) also classified all individuals as males, although one person was female.

Testing of the morphologic traits of the skull (Table 2) showed that frontal bossing and supraorbital margins misclassified the male specimens. In the female skeletons supraorbital margins, robustness of mandible, and zygomatic arches did not correspond to the actual sex in all cases.

Testing of different aging methods showed that all skeletons were aged correctly within given age spans (Table 3) when all of the criteria were used. The exception was specimen R23, a male skeleton of 60 years, which was underaged using both methods based on pubic symphyseal morphology. In the recent investigation of the applicability of the Suchey-Brooks method on the Serbian population (15) the significant difference between the mean chronological age of the individuals and the age range established by Suchey-Brooks was found in the oldest category (phase 6), in both males and females (i.e., considering the mean age and the age range in the category, the Suchey-Brooks criteria tended to underage the specimens).

For estimation of stature (Table 4), the results of the regression equations of Trotter and Gleser (11) were compared with new local standards introduced by Ross and Konigsberg (13), and Sarajlić (14), but the sample was too small to draw conclusions regarding the reliability of applying different formulas for calculating stature.

Although complete morphological and osteometric data were recorded, osteological evidence of ethnicity was not analyzed because of the small number of skeletons, further reduced by the fragmentary condition of the skeletal material. After comparing antemortem and postmortem data, 12 bodies were positively identified. The positive identification of three persons was facilitated by comparing antemortem data with pathological findings at autopsy.

Case R17

Thorough examination showed complete fusion of the spine in the cervical, thoracic, and lumbar regions, followed by an outstanding deformity of the spine and ankylosis of the sacroiliac joints (Figs. 5, 6). Thick and large osteophytes, especially on the right side, ankylosis of some ribs, and ossification of the anterior longitudinal ligament were suggestive of diffuse idiopathic skeletal hyperostosis. Data obtained from an interview with the family confirmed that the victim had been suffering from spine disease for many years and had had pronounced kyphosis.

Case R10

Several pathological findings were associated with this body (Fig. 7):

— healed depressed skull fracture in the region of the left frontal tuber approximately 1 cm in diameter, caused by blunt impact;
— healed depressed fracture of the right zygomatic bone;
— bone ankylosis of the fourth and fifth lumbar vertebrae with radiological features that correspond to osteoarthritis (Fig. 8);

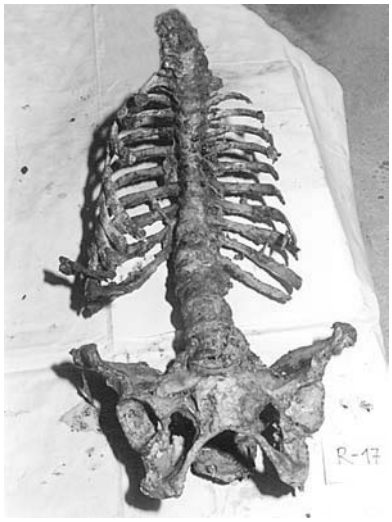

FIG. 5—*Female skeleton (R17) with fused bones of the pelvic girdle and vertebrae in the cervical, thoracic, and lumbar region—anterior view.*

FIG. 6—*Deformity of the vertebral column of the same skeleton (R17)—lateral view.*

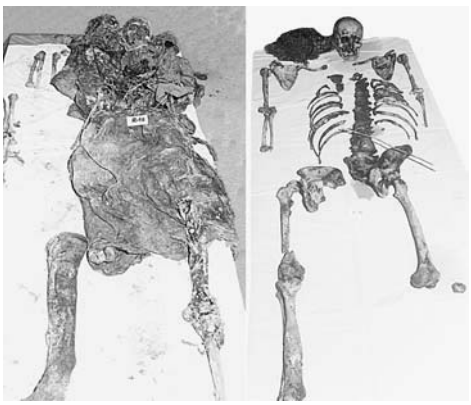

FIG. 7—*Body of female, 61 years old (R10), before and after removal of the soft tissue. Arrow indicates the piercing wound in the left hip bone.*

— osteocartilaginous exostosis on the medial margin of the lower third of the diaphysis of the right femur;
— thickening and deformation of the right tibia, particularly in the lower half;
— thickening and sclerosis of the cortex (shown by radiography), radiolucent areas with poorly defined margins and absence of normal architecture within the bone. Radiological appearance is suggestive of chronic osteomyelitis (Fig. 9).

Antemortem data indicated that the victim had a traffic accident 20 years previously, followed by head and right leg injuries. Victim's family stated that since that time the victim had limped on the right leg and suffered from pain and swelling of the affected leg.

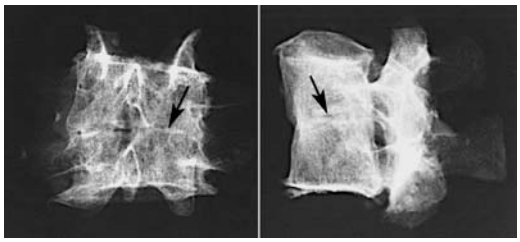

FIG. 8—*Radiography of the fourth and fifth lumbar vertebra showing bony ankylosis, subchondral sclerosis, and osteoporosis.*

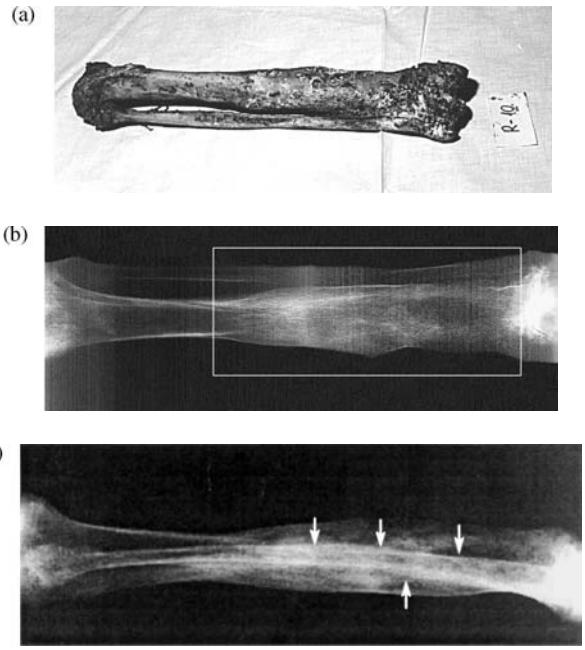

FIG. 9—(a) *Macroscopic features of the right tibia and fibula showing enlargement and deformity of the distal two thirds of tibia.* (b) *Radiography in frontal projection—visible fusiform enlargement of the shaft of the tibia with radiolucent lytic areas irregular in character, with poorly defined borders separated by islands of normal-appearing bone and diffuse homogeneous areas of increased density.* (c) *Radiography of the same bones in lateral projection.*

Case R15

The thoracic part of the skeleton was partially preserved, but we noted deformity of the right seventh rib, corresponding to the healed fracture. Antemortem data indicated that the person broke one rib on the right side, several years previously.

Conclusion

In the identification process we faced several difficulties that could be summarized as follows:

1. Lack of any local identification standards increased the probability of bias in the assessment of sex, age and stature, so we had reservations about making an identification based on anthropological data alone.
2. Dental identification based on dental charts was not available, so dental identification was limited to interviews. It was shown

that even close relatives knew little about the dental status of the victims.

3. The antemortem data regarding the stature of victims were often unreliable when derived from interviews with the relatives. Comparison by the relatives of the victim's height with the height of some individuals present in the identification room often gave more precise results than the data we obtained when they answered the question: How tall was the victim?
4. A multitude of evidence suggests that, in addition to the identified individuals, there were enough elements for the identification of another five or six persons. However, despite the continued media exposure, their relatives have not come forward to give antemortem data and to recognize the characteristics or personal items of the victims. Under the circumstances of different ethnic groups and persons confronted, in a political context, as victims, one can only speculate about the reasons why the relatives of the victims failed to come forward, ranging from the fear that the family will be condemned as "traitorous" to the refusal to cooperate with the "enemy." Rumors spread by the locals make these suspicions more credible.
5. Finally, in the environment of a war, with limited investigation time and equipment, and under the pressure of the media, the excavation of bodies, personal identification of victims, and collection of evidence required total transparency of procedures from the local forensic team and the creation of standards that will meet international concerns for forensic expertise of high quality.

Acknowledgments

The author would like to thank the staff of the Department of Forensic Medicine of Belgrade University, especially Professor Aleksandric B. and Professor Dunjic D. for their support, and Judge Gojkovic R. of the District Court in Peć for his assistance during data collection.

References

1. Workshop of European anthropologists. Recommendation for age and sex diagnoses of skeletons. J Hum Evol 1980;9:517–49.
2. Işcan M, editor. Age markers in the human skeleton. Springfield: Charles C. Thomas, 1989.
3. Sauter M, Privat F. Sur un nuoveau procede metrique de determination sexuelle du bassin osseux. Bull Soc Suisse Anthrop Ethnol 1954/55;31:60–84.
4. Singh S, Potturi B. Greater sciatic notch in sex determination. J Anat 1978;125:619–24. [PubMed]
5. Işcan M, Helmer R, editors. Forensic analysis of the skull: craniofacial analysis, reconstruction, and identification. New York: Wiley-Liss, 1993.
6. Solowiej D. Určovani pohlavi podle lebky—overeni metod doporučovanych ruznymi autory. Prague: Universitas Carolina, 1982.
7. Acsadi G, Nemeskéri J. History of human life span and mortality. Budapest: Akademiai Kiado, 1970.
8. Todd T, Lyon D. Cranial suture closure, its progress and age relationship (I-II). Amer J Phys Anthrop 1924/25;7:325–84;8:23–71.
9. Brooks S, Suchey J. Skeletal age determination based on the os pubis: comparison of the Ascadi-Nemeskeri and Suchey-Brooks methods. Human Evolution 1990;5:227–38.
10. Meindl R, Lovejoy C. Ectocranial suture closure: A revised method for the determination of skeletal age at death and blind tests of its accuracy. Amer J Phys Anthropol 1985;68:57–66.
11. Trotter M, Gleser G. A re-evaluation of estimation of stature based on measurements of stature taken during life and long-bones after death. Amer J Phys Anthropol 1958;16:79–123.
12. Jantz R, Hunt D, Meadows L. The measure and mismeasure of the tibia: implication for stature estimation. J Forensic Sci 1995; 40(5):758–61. [PubMed]
13. Ross A, Konigsberg L. New formulae for estimating stature in the Balkans. J Forensic Sci 2002;47(1):165–7. [PubMed]
14. Sarajlić N. Procjena zaživotne visine na osnovu mjerenja dužine dugih kostiju donjih ekstremiteta ljudskih posmrtnih ostataka. University of Sarajevo, (master degree thesis), 2002.
15. Djurić M, Djonić D, Rakoćević Z, Nikolić S. Evaluation of Suchey-Brooks methods for aging skeletons in the Balkans. Forensic Sci Int 2003;136(Suppl):172.

Additional information and reprint requests:
Marija Djurić, M.D., Ph.D.
Laboratory of Anthropology
Department of Anatomy
Medical Faculty
University of Belgrade
4/2 Dr Subotica
11000 Belgrade, Serbia
E-mail: marijads@eunet.yu