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The Role of Forensic Anthropology in the Recovery and Analysis of Branch Davidian Compound Victims: Recovery Procedures and Characteristics of the Victims

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ABSTRACT: Anthropological contributions to the investigation of the events at the Branch Davidian Compound near Waco, Texas in early 1993, were of two major types: the recovery of human remains from the site and the analysis of most of those individuals at the Medical Examiner's Office in Fort Worth, Texas. This paper describes the role of forensic anthropology in the recovery and analysis of Branch Davidian Compound victims and the recovery procedures and characteristics of the victims.

KEYWORDS: physical anthropology, Branch Davidian, human identification

Anthropological contributions to the investigation of the events at the Branch Davidian Compound near Waco, Texas in early 1993, were of two major types: the recovery of human remains from the site and the analysis of most of those individuals at the Medical Examiner's Office in Fort Worth, Texas, following the fire that commenced on April 19, 1993. Immediately following the incident, many isolated victims were discovered and recovered by personnel from the Fort Worth Medical Examiner's Office.

Recovery

The recovery of human remains from the Branch Davidian compound (Mt. Carmel) was problematic because of several factors, including the effects of intense heat on the remains, fire debris, the collapse of the upper story of the building, an unknown number of buried individuals in and around the compound, and the presence of an unknown number of individuals in the "bunker," a concrete structure used to store foodstuffs, weapons and munitions (Fig. 1).

Traditional crime scene/surface collection search methods revealed bodies located above ground and throughout the complex. However, anthropological techniques and assistance were required to locate and recover remains from the bunker and in the grave sites. The personnel included staff from the Tarrant County Medical Examiner's Office, the Smithsonian Institution, and the Federal Bureau of Investigation working as a team, with each individual contributing unique skills and experience.

A variety of factors, including concerns for the health and safety of the recovery team, impeded recovery of individuals from the bunker. The bodies were encased in a matrix of building materials, food storage items, weapons, and a mixture of expended and live ammunition, creating a difficult and potentially dangerous working environment. Many items (containers and expended ammunition, for example) in the bunker were metal with sharp or rough edges. The time between death and recovery was approximately six days, allowing significant decomposition. Rain and cool temperatures during this time retarded some decomposition, but most remains within the bunker were soft and pasty. The overlapping nature of the remains and the heavy dense matrix made discrimination of bodies difficult at best. One grouping was so commingled that all individuals were removed together in three sections, given a series of numbers, and sent to the Medical Examiner's Office in Fort Worth where three anthropologists required three days to separate all of the individuals. Insect activity, mostly flies, was intense and the bunker was fumigated nightly to reduce the population. Communication was difficult during this operation since most personnel were equipped with respiratory protection devices. Explosives experts and others were present to assist in the removal of particularly dangerous ordnance and to document the positions and condition of important artifacts.

As each body was located, it was assigned an "MC" (for Mount Carmel) number, photographed, and its position mapped. The body was then removed and placed in a body bag for shipment to the Medical Examiner's facility in Fort Worth. Two and one-half days were required to recover all of the individuals from the bunker.

Once all individuals from the surface of the compound and bunker were recovered, effort then shifted to locating and recovering individuals killed during the initial raid and thought to be

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FIG. 1—*Location of units within the Branch Davidian Compound:* A. *Bunker;* B. *burial site in front of compound;* C. *burial site in underground room.*

buried at the site by surviving Branch Davidians. Burial of one individual in front of the compound had been videotaped. The burial site was located by the Texas Rangers involved in the clean up of the compound. Staff from the Medical Examiner's Office, the Smithsonian Institution, the FBI, the Texas Rangers, and the Department of Public Safety were involved in this phase of the recovery. This individual, MC 76, was in an extended position (head to the north), fully clothed and wrapped in a sleeping bag. Once the body was found, its location was recorded, photographed, and mapped. Both the body and sleeping bag were placed into a body bag to preserve any trace evidence that may have been associated with it. Well-preserved shoe prints were still evident in the damp soil under the sleeping bag.

It had been suggested that other individuals were buried in one underground room in the compound. The room was approximately 30 feet by 100 feet, with walls and ceiling of hand-poured concrete and a soil floor. The soil was heavy reddish-brown clay. A grave was located in the NW corner of the room within 45 minutes by probing with a metal rod. Four individuals occupied this grave, all in extended positions, stacked on top of each other, fully clothed. The final grave opening measured 8.0 feet long by 3.5 feet wide by 3.0 feet deep. The bodies were placed in body bags and carried to a waiting front end loader for transfer to a hearse. Because of the health hazards associated with this room (infectious waste materials), protective clothing and equipment, such as respirators, were worn. Three hours were required to remove all four bodies.

Procedures

Anthropological analysis of the remains at the Medical Examiner's facility in Fort Worth employed a system based on the expertise available yet allowed for changing personnel throughout the duration of the project. Owsley and Ubelaker accepted supervisory responsibility for the data collection and interpretation, but because of other commitments, they worked together at the medical examiner's office only one day. Houck provided continuity in data collection, ensuring that protocol was properly followed and that resources were utilized effectively. Fram assisted in the removal of soft tissue, data collection, and compilation of sampling records. Craig, Grant, Woltanski, and Sandness prepared specimens for anthropological analysis, recorded data, prepared drawings of bones displaying evidence of trauma, and generally assisted in processing. Peerwani and other medical examiners provided autopsy perspective when needed. A photographer and radiologic technologists produced photographic and radiographic documentation. Owsley and Ubelaker independently studied and reported on 68 individuals (Owsley 17, Ubelaker 51). Study of an additional 15 individuals was begun by Owsley and finished by Ubelaker.

Summary Statistics

Assessments of the exact number of victims in such a situation are difficult. Of necessity, the estimates continually evolved during the course of analysis. At the time of completion of the autopsies in May 1993, the estimated number of individuals present was 88. This figure includes the four ATF agents, five Branch Davidians who died prior to the fire, and two fetuses. Eighty-three individuals were examined anthropologically, and 41 were positively identified by comparison with antemortem records. By October, 1994, positive identifications increased to 82. Of these, 35 were identified by odontology, four by fingerprint analysis, one by pathology, 1.5 by anthropology and 40.5 by DNA. The half values were utilized in this summary if identification was accomplished through two specialities. These numbers are difficult to evaluate, since in some cases an "individual" studied anthropologically consisted of isolated bones or body parts that were later united with other components of the same individual. Four individuals were recovered sufficiently intact to allow conventional autopsies, and anthropological examination was not needed.

Of the 83 individuals examined by anthropologists, 25 were male, 47 were female, and 11 were of undetermined sex. In many cases, external genitalia were present or sex had previously been established through positive identification, but even identified remains were examined anthropologically to independently confirm the sex. In the absence of external genitalia, skeletal indicators, especially those of the pelvis, were examined using standard techniques [*1,2*].

Age at death was estimated utilizing standard procedures [*1,2*], with specific techniques largely dictated by the condition of the individual. Radiographic assessment of dental development was the preferred technique for immature remains, but when teeth were not available, long bone length and size and the extent of epiphyseal union were used.

For adults, the techniques used were largely dictated by the bones available. For many of the extensively charred remains, radiographic assessment of vertebral osteophyte formation and the morphology of the auricular areas of the ilia were emphasized because other age indicators were missing. In many of the charred remains, much of the cranial vault, the anterior portions of the pelvis, and the bones of the arms and legs were too fragmented to offer useful age information. Because of its location deep within the pelvis, the auricular surface was usually protected from extensive heat alteration and was available for age assessment once the soft tissue was removed.

Figure 2 documents the age distribution of the 83 individuals studied by physical anthropologists. The data include those positively identified for whom age at death was known, as well as those with estimated ages. Nearly all age categories are represented, with greatest frequency in that of birth to five years.

Ancestry was either known from records of positively identified individuals or estimated from external features such as hair or

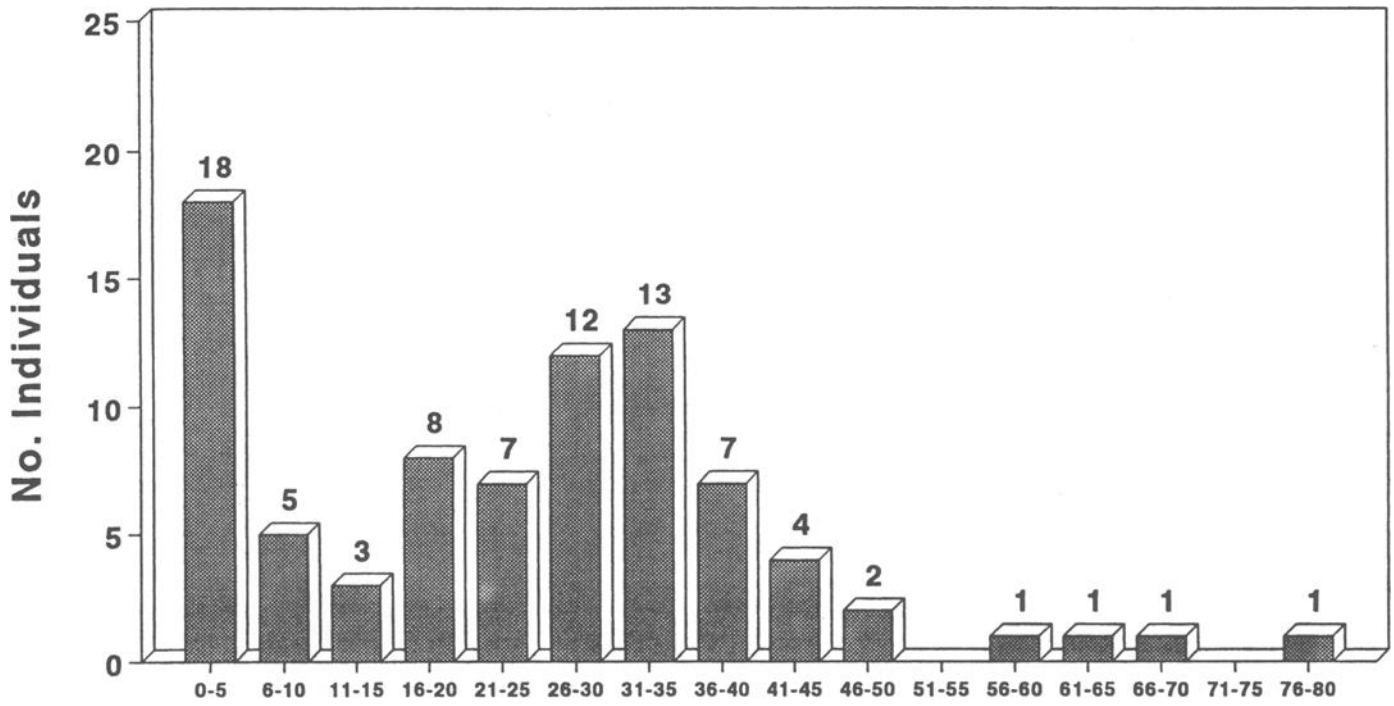

FIG. 2—*Age distribution of individuals analyzed anthropologically.*

skeletal (usually facial) morphology [*1,2*]. Figure 3 indicates that although all major racial groups were represented in the sample, most of the individuals for whom ancestry could be determined were of European background. The largest category (42 individuals) was of unknown ancestry, reflecting the extensive destruction of the bones of the face in many individuals.

Condition

The condition of the individuals examined anthropologically varied extensively. Forty-seven individuals (57%) displayed minimal charring but extensive decomposition. An additional 31 individuals (37%) were extensively charred, but consisted of a recognizable torso, usually missing the anterior portion of the thorax and abdomen and much of the arms and legs, as well as the superior aspect of the cranium. The remaining five individuals (6%) were very fragmentary, with only skeletal fragments and associated charred soft tissue present.

For the adults (age greater than 15 years), males showed slightly less severe heat effects than females. Male adult remains were equally divided between the decomposed and charred categories. Of the adult female remains, 33% were decomposed, and 60% were charred; all of the adult fragmentary remains were female (7% of the adult female sample).

Overall, immature individuals dominated the decomposed and fragmentary categories, and adults comprised the majority of the charred remains. The mean age at death of the entire decomposed sample is only about 18 years; that of the charred sample is nearly 34 years. The mean age of the fragmentary sample is about 16 years.

Spatial Variability in Preservation

The variability in the correlation of age at death with condition reflects the greater likelihood of fragmentation of immature individuals when exposed to heat, but mainly that most immature individuals were recovered from more protected areas of the site. Individuals found within the bunker generally displayed less severe heat-related alterations than those found outside. Although much of the bunker clearly burned, many of the individuals inside were found buried within the largely ordnance matrix. In addition, most individuals within the bunker were found layered on top of one another. In such cases, individuals near the surface usually displayed extensive heat alteration, but those lower in the matrix displayed much less. Since the bunker was among the last areas of the compound targeted for individual recovery, individuals not heavily charred displayed extensive decomposition, usually accompanied by extensive insect larvae activity. Of all individuals recovered at Waco, excluding the four ATF agents, 28 (85%) of those inside the bunker were in a decomposed condition, but only 20 (39%) of those outside were decomposed. In contrast, only two (6%) of the bunker individuals were charred, compared with 29 (57%) of those outside. Note that the decomposed individuals from outside the bunker include the five Branch Davidians who died during the initial raid, and were buried prior to the fire. Three

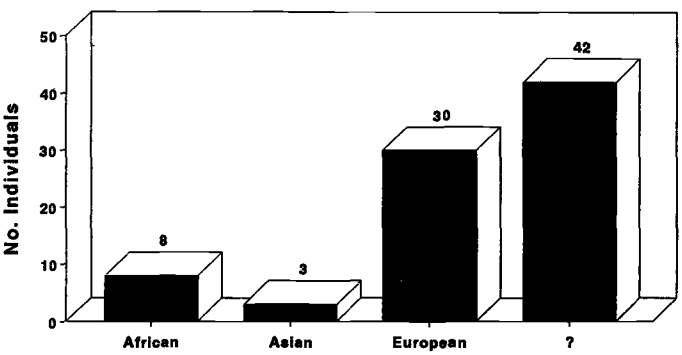

FIG. 3—*Ancestry distribution of individuals analyzed anthropologically.*

TABLE 1—*Comparison of ages of individuals inside and outside the bunker.*

	No.	Mean Age	Age Range	No. <10 Years	% <10 Years
Inside Bunker	33	11.4	fetus–42 years	20	60.6
Outside Bunker	51	31.3	1 month–76 years	4	7.8

(9%) of the bunker individuals were fragmentary compared to only two (4%) of those found outside the bunker.

Although individuals of all ages were found both inside and outside the bunker, most of those found within were immature. The much younger mean age at death (11.4 years) of those within the bunker compared with the age of those outside (31.3 years) (Table 1) reflects the clustering of young individuals within the bunker. Figure 4 compares the distribution of ages at death of individuals inside and outside the bunker. The distributions further document the clustering of young people inside the bunker and of adults outside. Clearly, the young age at death of the sample within the bunker is the major factor explaining the younger mean age at death of the decomposed sample.

As noted in Table 2, females were found much more frequently (70%) than males (9%) within the bunker. No significant clustering by ancestry was apparent.

Taphonomy

The inventory sheets filled out for each body at autopsy were the basis for evaluation of the taphonomy of the remains. The University of Tennessee Forensic Anthropology Database form was used throughout for consistency and to facilitate data exchange. On this form, if a bone was present and whole, it was scored as a "1," if present but fragmentary, it was scored as "2," and if absent postmortem, it was scored as "3." The information was entered into a database program and summary statistics were generated through a spreadsheet program. Both base counts and percentages are reported for 77 individuals for ease of interpretation and comparison (Tables 3 and 4). Categories for survival were complete, fragmentary, and absent (postmortem).

In general, more massive or better protected bones had a better survival rate than smaller bones, especially those of the extremities. The bones of the pelvic region had the best survival rating, probably due to the protection of the surrounding gluteal and abdominal muscle mass. The jaw, comprised of the mandible and maxillae, fared worst of all regions. In spite of this, nearly half of the Mt. Carmel (42) individuals were identified through dental comparison. Of individual bones of major anthropological interest, the os coxae and femora had the best survival rating followed in order by the tibiae, humeri, ulnae/radii, ribs and frontal.

Most ribs had lost their sternal ends, precluding age estimation by this technique. The frontal was more often partial or fragmented than were the other bones of the cranial vault. The sphenoid was most often intact, and the parietals most often damaged. A paired two-sample t test returned values accepting the hypothesis that no difference in taphonomic survival for any category exists between right and left bones. The critical region for all categories was plus or minus 2.07; critical ratios for pooled estimates of complete was 0.15, fragmentary 0.28, and absent postmortem 0.02.

Taphonomic data from the Mt. Carmel disaster will aid researchers in developing new techniques and improving existing methods of estimating biological parameters. By concentrating on those areas of the skeletal anatomy that have a higher rate of survival, forensic anthropologists can increase the likelihood of providing qualitatively and quantitatively more nearly accurate results and continue to derive the maximum information from the minimal samples that we often encounter.

Trauma

An important contribution of anthropological analysis is the detection and interpretation of trauma. Because of the extensive loss and/or alteration of soft tissue due to decomposition and/or heat exposure, interpretation of trauma through conventional autopsy procedures was difficult. Each set of remains was carefully inspected for evidence of trauma. When likely areas of injury were encountered, any soft tissue in the immediate area was carefully removed, more detailed radiographs were obtained, and the area was reconstructed. If examination revealed evidence for non-heat-related trauma, especially possible gunshot wounds, the alterations were photographed and sketched.

A major problem in the interpretation of trauma in the Mt. Carmel victims was distinguishing heat-related trauma from gunshot wounds and shrapnel-type alterations. Anthropological analysis detected evidence for non-heat-related trauma in 31 (37%) of the 83 individuals examined. Of these, eight represented possible gunshot wounds, two probable gunshot wounds, eight definite gunshot wounds, and 13 other unusual perforations or fractures that were not heat-related.

The eight definite gunshot wounds presented characteristics such as beveling and fracture patterns that are caused only by bullets or similar projectiles. Ten other individuals displayed alterations that, with varying degrees of probability, could be associated with gunshot wounds, but other causes could not be ruled out on the skeletal evidence alone. The remaining 13 individuals presented unusual perforations and fractures that did not seem typical of gunshot wounds but also did not appear to have been produced by heat exposure. The unusual shapes and locations of these fractures indicate they likely were produced by shrapnel.

The eight definite gunshot wounds occurred in four males and four females, ages 6 to 45 years (mean age 31 years). Six of the victims were of European ancestry and two of African ancestry.

TABLE 2—*Comparison of location of individuals of different sex and ancestry (inside and outside the bunker).*

	Sex						Ancestry							
	Male		Female		?		European		African		Hispanic		?	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Inside Bunker	3	9	23	70	7	21	15	45	2	6	3	9	13	39
Outside Bunker	22	43	25	49	4	8	15	29	6	12	1	2	29	57

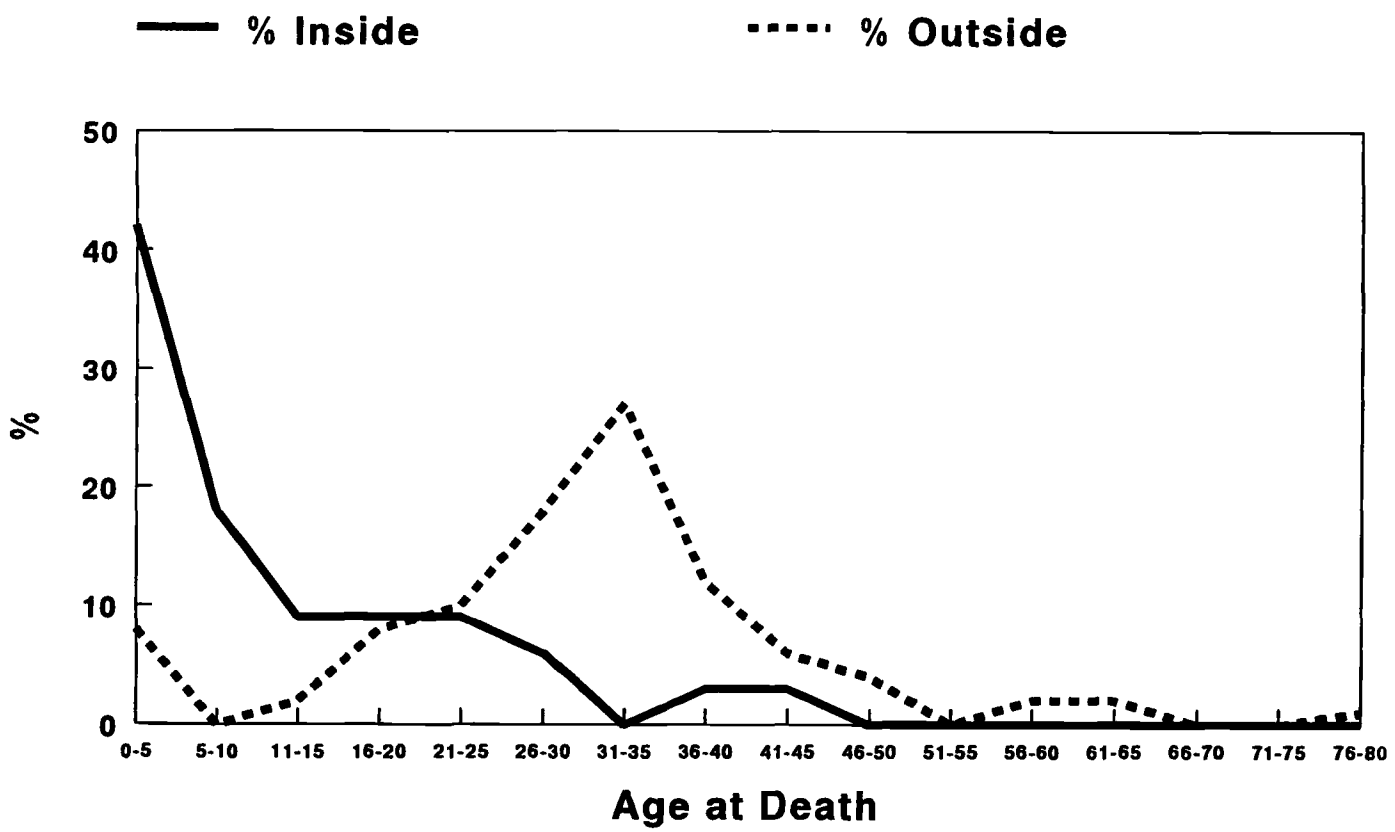

FIG. 4—*Comparison of age distribution of individuals found inside and outside the bunker.*

Seven of the entrance sites were cranial, and one was in the chest. Of the seven cranial entrance sites, one was facial, two frontal, three occipital, and one of unknown specific site.

Seven of the eight gunshot wounds discovered through anthropological analysis were located in individuals found outside of the bunker. Thus of the 33 individuals found within the bunker, only one (3%) revealed anthropological evidence of a gunshot wound.

TABLE 3—*Bone preservation by body region.*

	Complete		Fragmentary		Absent Postmortem	
	No.	%	No.	%	No.	%
Head and Neck[a]	474	25	526	27	1002	48
Arm and Shoulder[b]	187	24	208	27	375	49
Hands[c]	25	16	18	12	111	72
Chest[d]	102	28	127	27	156	45
Pelvis[e]	294	47	187	30	135	23
Leg[f]	204	33	122	20	290	47
Feet[g]	33	21	5	3	116	75

[a]Includes frontal, parietals, occipital, temporals, zygomatics, palatines, maxillae, nasals, ethmoid, lacrimals, vomer, sphenoid, mandible, and cervical vertebrae.

[b]Includes clavicles, scapulae, humeri, radii, and ulnae.

[c]Includes carpals, metacarpals, and phalanges; each hand recorded as a single unit.

[d]Includes sternum, thoracic vertebrae, and ribs; all ribs were recorded as a unit for each side.

[e]Includes lumbar and sacral vertebrae and the os coxae.

[f]Includes femora, patellae, tibiae, and fibulae.

[g]Includes tarsals, metatarsals, and phalanges; each foot recorded as a single unit.

Seven (14%) of the 51 individuals outside the bunker had evidence of a gunshot wound. Additional gunshot injury was detected by pathologists through soft tissue analysis at autopsy.

Summary

Working with teams of odontologists, fingerprint analysts, forensic pathologists, and criminalists, forensic anthropologists contributed significantly to the analysis of the Mt. Carmel victims. These contributions included recovery of the human remains at the site, with the maximum amount of information about their positions and condition, assessment of biological characteristics of each individual to assist in identification, and interpretation of the skeletal evidence for trauma. Analysis revealed variability in the condi-

TABLE 4—*Preservation of major bones.*

	Complete		Fragmentary		Absent Postmortem	
	No.	%	No.	%	No.	%
Frontal	13	17	30	39	34	44
Ribs[a]	29	19	88	57	37	24
Humerus	36	23	60	39	58	38
Radius	33	21	33	21	88	57
Ulna	34	22	31	20	89	58
Ilium	71	46	58	38	25	16
Pubis	78	51	41	27	35	23
Ischium	75	49	45	22	34	22
Femur	58	38	74	48	22	14
Tibia	54	35	24	16	76	49

[a]Not individual ribs, but number of "rib sides."

tion of the remains largely reflecting their locations within the site and the timing of their recovery. Remains of women and children displayed significantly less severe heat-related alterations because of their disproportionate presence within the bunker where the heavy concentration of ordnance and clustering of the people offered greater protection from heat exposure. The Mt. Carmel experience also showed that standardized procedures can produce continuity in analysis in spite of the rotation of personnel as well as demonstrating the ways in which forensic anthropology can contribute to a multidisciplinary investigation.

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