

Analysis of skeletal trauma in modern skeletal collections

M Steyn¹, M de Kock¹, MY Iscan², M Michalodimitrakis³

¹Department of Anatomy, University of Pretoria, School of Medicine, Faculty of Health Sciences

²Adli Tip Enstitüsü, University of Istanbul ³Medical School, University of Crete
e-mail: msteyn@medic.up.ac.za

Introduction

Traces of injuries sustained during life are often preserved in the human skeleton after death. These traumatic lesions include healed and perimortem fractures, spondylolysis, dislocations, subluxations, avulsions and amputations. The assessment of trauma is an integral part during the investigating of skeletal remains. In archaeological contexts, especially, the frequencies of various fractures are often used to gain information on the lifestyle and culture of the people represented by the remains.

Trauma and fractures in populations can result from violent or accidental encounters with animals, other people or cultural hazards found at home or work. They can also be the result of therapeutic procedures, and bone may fracture due to an underlying disease such as malignancy or osteoporosis. The study of the prevalence and patterns of trauma within a population can help to reconstruct their occupational and environmental stresses. It can also give information as to their cultural behaviour, such as the level of medical care, technology used and the level of interpersonal violence.

The purpose of this study was to describe the occurrence of trauma in three modern skeletal populations from different areas of the world, from different socio-economic backgrounds. Notwithstanding several limitations such as the differences in mean age between the populations and the question of how much they actually represent the living population, data can be obtained that will assist in the interpretation of traumatic lesions from other areas in the world. For the purpose of this study, remains of modern Greeks living on Crete, South African blacks and South African whites were studied.

Materials and Methods

Skeletal remains of individuals from Crete as well as black and white South Africans were analyzed for signs of healed trauma. Details of the sample are shown in Table 1. It can be assumed that most individuals were of lower socio-economic status, and many of the skeletons belonged to older individuals. All bones were macroscopically assessed, and no X-rays were taken. For the vertebrae only spondylolysis were assessed, and for the crania only cranial vault fractures. Frequencies of trauma between groups were assessed by means of an Equality of Proportions test.

Table 1: Sample sizes with age ranges and mean ages indicated. (n) is the total sample size, while the number of individuals with known ages are shown in parentheses

Population	n	Age range	Mean age	SD
Greek male	99 (62)	34 - 94	68.9	13.721
Greek female	100 (60)	19 - 100	71.8	17.157
South African white male	100 (93)	28 - 94	67.7	13.030
South African white female	100 (98)	19 - 94	69.7	12.145
South African black male	100 (100)	16 - 96	59.3	13.387
South African black female	100 (99)	20 - 82	45.8	14.217

Results

In the Greeks, 42 (42.4%) of the males and 47 (47%) of females had at least one fracture ($z=-0.64769$; not significantly different). Of these, 23 (54.8%) of males and 30 (63.8%) of females had more than one fracture. Cranial trauma was observed in one individual only. Fractures of the proximal femur (6.4% of all femora; Fig 1) and distal radius (Colles fractures, 6.2% of all radii; Fig. 2) were the most common, with the females affected more than the males. More than 3% of all ribs observed were fractured.

In the South African white group, significantly more males (61%) had fractures than females (41%; $p<0.01$). Of the individuals with trauma, 43 (70.5%) of the males had more than one fracture, and 27 (65.9%) of the females. Cranial fractures were fairly common (Fig. 3), and occurred in 8.1% of males and 3.3% of females. Four individuals had mandibular trauma. Aside from the cranium and ribs, the most commonly fractured bone in females was the right radius (8.1%) followed by the femur (5% left, 4% right). In the white male population, the right clavicle was the most common long bone fractured (7.4%) followed by the right radius (6.2%). Three females had hip replacements and one female and one male a knee replacement. Four males had various other orthopaedic devices (pins and metal plates) and another four had surgical trauma on their crania.

In the South African black group, 77% of the males and 69% of females had fractures (not significantly different). More than one fracture occurred in 79.2% of the males who had fractures, and 69.6% of the females. Once again rib fractures were very common, occurring in 9.5% of left ribs and 7.1% of right ribs. Cranial fractures were very common, and occurred in 15% of males and 19.4% of females. Aside from cranial and rib fractures, the most commonly involved bones in males were the left ulna (14.3%) and left fibula (9.1%), while in females both ulnae (left 14.1% and right 11.5%), the left radius (8.2%) and fibulae (6.1-7.0%) were most frequently broken.

Table 2 shows the comparison of trauma frequencies between the populations (sexes and left and right sided bones combined). Cranial trauma is the most common in SA blacks (17.2%), followed by the SA whites (5.8%) and then the Cretes (0.5%). The SA black group also has the most ulna (parry) fractures (11.2%), with frequencies of just more than 1% in the other two groups. Rib fractures are also the most common in SA blacks (8.3% of all ribs), followed by SA whites (5.5%) and Cretes (3.7%). Femur fractures are the most common in the older Cretes (6.4%), followed by the SA whites (3.3%) and SA blacks (1%). Radial fractures are common in all populations, but are also most common in the Cretes (6.2%).

Table 2: Comparison of trauma frequencies between all three populations (bones of both sides and both sexes combined). Npr = number of bones present; Naff = number of bones fractured

Bone	Cretes			SA white			SA black		
	Npr	Naff	%	Npr	Naff	%	Npr	Naff	%
Skull	199	1	0.5	191	11	5.76	198	34	17.2
Mandible	197	0	0	175	4	2.29	173	4	2.3
Scapula	383	1	0.26	394	6	1.52	383	4	1.0
Clavicle	365	3	0.82	310	8	2.58	235	10	4.3
Humerus	388	9	2.32	394	7	1.78	396	6	1.5
Radius	385	24	6.23	395	18	4.56	396	18	4.5
Ulna	379	5	1.32	394	5	1.27	393	44	11.2
Femur	391	25	6.39	399	13	3.26	398	4	1.01
Tibia	393	5	1.27	397	7	1.76	394	10	2.5
Fibula	380	7	1.84	395	10	2.53	394	31	7.9
Os coxa	381	2	0.52	398	10	2.51	389	4	1.0
Ribs	3463	127	3.67	4335	237	5.47	3966	330	8.3
Vertebrae	3254	14	0.43	4570	9	0.20	4302	0	0

Fig. 1 Surgically repaired proximal femur fracture in a specimen from Crete



Fig. 2 Fractured distal radius



Fig. 3 Fracture of frontal bone in a South African individual



Discussion

These incidences of trauma are high, also when compared to other reported figures (e.g., Jurmain 2001; L'Abbé 2005). However, the composition of the samples (mostly of lower socio-economic origin) should be kept in mind. It seems that the fractures in Greeks are mostly related to old age due to falls and accidents (e.g. Colles and hip; Black & Cooper 2000; Mays 2006), while the SA black sample reflects a high incidence of interpersonal violence (e.g., cranial vault and parry fractures). Surprisingly, many of the cranial vault fractures occurred in females. The SA white sample follows an in-between pattern with many fractures that could be related to older, osteoporotic individuals, but also many cranial fractures. These comparative figures may be useful when assessing trauma in other skeletal populations.

Acknowledgements

We would like to thank Dr E Kranioti for her hospitality, as well as the NRF and UP for funding.

References

- Black DM & Cooper C. 2000. Epidemiology of fractures and assessment of fracture risk. *Clinics in Laboratory Medicine* 20:439-453.
- Jurmain R (2001) Palaeoepidemiological patterns of trauma in a prehistoric population from central California. *American Journal of Physical Anthropology* 115: 13-23.
- L'Abbé EN. 2005. A palaeodemographic, palaeopathologic and morphologic study of the 20th century Venda, Ph.D. University of Pretoria.
- Mays SA. (2006) A palaeopathological study of Colle's fracture. *International Journal of Osteoarchaeology* 16:415-428.