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FORENSIC ANTHROPOLOGY RESEARCH CENTRE

F A R C

Physical anthropological analyses of skeletonized human remains recovered from Boikarabelo

Prepared by:

A Meyer

anja.meyer@up.ac.za
Tel: 012 319 2934

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PO Box 14679
Hatfield 0028

Enterprise Building,
140 Lunnon Road,
Hillcrest,
0083

T: +27 (12) 434 2300
F: +27 (12) 434 2305

info@be.up.ac.za

www.be.up.ac.za

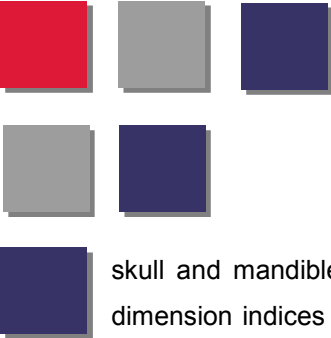**Index:**

1. Human skeletal remains

The remains presented three individuals. The remains were fully skeletonized, and preservation was fair to poor. The remains required cleaning before any inventory could be taken and before the analysis could be conducted. Excess soil on the skeletons was removed using soft brushes, and areas of more visual importance such as bones indicating pathology or trauma, as well as the teeth, were cleaned with water and brushes. Overall the cleaning process was performed in such a way as to prevent any damage to the skeletal remains.

The analysis of the remains entailed a standard physical anthropological analysis and the "*Standards for data collection from human skeletal remains*" by Buikstra and Ubelaker (1994) was used as a basis for this analytical procedure. Standardised osteometric measurements and calculations, together with morphological characteristics were used, where possible, to determine the demographic profile of each individual.

2. Analytical methods

The remains were cleaned and analysed using standard physical anthropological techniques (Buikstra and Ubelaker, 1994). Age at death was estimated by the degree of epiphyseal closure (Krogman and İşcan, 1986; Scheuer and Black, 2004; Schaefer *et al.,* 2009) and tooth development (Loth and İşcan, 2000a; Scheuer and Black, 2004) for possible adolescent individuals. For adult individuals, age was estimated using the following methods: changes in the sternal ends of ribs (Loth and İşcan, 2000a), changes in the face of the pubic symphysis of the pelvis (Brooks and Suchey, 1990), status of cranial suture closure (Acsádi and Nemeskéri, 1970; Krogman and İşcan 1986), and changes in the auricular surface of the ilium (Lovejoy *et al.*, 1985). Any observable degenerative changes and dental wear (Brothwell, 1981; Hillson, 1998) were noted for each individual where present (Loth and İşcan, 2000a; Ortner, 2003) which would suggest an older age. The fragmentary and incomplete nature of some of the skeletal elements however hampered the use of some of these techniques.

Both metric and non-metric techniques were used to determine sex. Non-metric characteristics of the pelvis and the skull were used where discerning features were preserved (Krogman and İşcan, 1986; Loth and İşcan, 2000). Metric assessment of sex was done by canonical discriminant function analyses of the skull and pelvis as well as by comparing single long bone measurements to known standards (Loth and İşcan, 2000, Patriquin *et al.,* 2003a). For the determination of ancestry both non-metric and metric techniques were used where possible. This included the non-metric characteristics observable from the

skull and mandible (İşcan et. al., 2000; Krogman and İşcan, 1986) and metric analysis of the cranial dimension indices and canonical discriminant function coefficients for the skull and mandible (İşcan and Steyn, 1999; Patriquin *et al.*, 2003b). The archaeological context of the remains, however, already suggests an African ancestry for these individuals.

Stature was determined by regression formulae for single long bone measurements where possible (Lundy and Feldesman, 1987).

Several sources were referred to for the pathology observed on the skeleton and teeth (Aufderheide and Rodríguez-Martin, 1998; Hillson, 1998; Ortner, 2003).

3. Results

Skeleton 001:

1.1.   Preservation and inventory

The remains were in a fair state of preservation except for the lower right leg which was completely fragmented. The remains were covered in grey ashy soil, often associated with archaeological burials in ash middens. Almost all of the cranial bones were present except for the right zygomatic bone, orbital bridge and a portion of the maxilla. The mandible was complete except for the left and right condyles which were slightly damaged. Most of the postcranial remains were present however some skeletal elements were fragmented and damaged due to postmortem alterations. Those postcranial elements not present included the left patella, the left ischium and acetabulum, three cervical vertebrae (C2, C5 and C6), three thoracic vertebrae (T2, T11 and T12), the sternum, several ribs (severely fragmented with only three left and two right ribs identified), the distal third/epiphysis of the left radius and ulna, the complete right ulna, the shaft of the right tibia (which was completely fragmented), the proximal and distal epiphyses of the left and right fibula, the right talus, seven left carpals and all eight right carpals, three left metacarpals and all five right metacarpals, twelve phalanges, two left tarsals and six right tarsals, one left metatarsal and all five right metatarsals, and finally all of the phalanges of the foot.

1.2. Age at death

The medial ends of the clavicle, spheno-occipital synchondrosis, and S1 and S2 of the sacrum were completely fused suggesting an age older than 30 years. Changes to the pubic symphyses and the right auricular surface suggested an age range of between 45 and 60 years. The sternal ends of the ribs presented as phase 6 which indicated an age range of between 47 and 55 years. Some degenerative changes could be observed in the vertebrae and pelvis also suggesting an older adult age for this individual. A final age estimate of 45 to 55 was given for this individual.

1.3. Sex

The morphological features observable on the skull and pelvis were consistent with that of a male. The skull presented with a prominent nuchal crest, large mastoid processes, a sloped forehead, a well-developed glabella with a well-defined supraorbital ridge. The pelvis presented with a narrow greater sciatic notch and the absence of a pre-auricular sulcus, a ventral arch, subpubic concavity and an ischiopubic ramus ridge.

Metric assessment of sex was done by using single long bone measurements and comparing these to know standards for males and females. The humeral head diameter, humeral epicondylar breadth, femoral head diameter, femoral midshafts circumference, tibial proximal epiphyseal breadth and the tibial circumference at the nutrient foramen all fell well within the limits indicated for males. (Refer to Table 2 for all postcranial measurements)

This individual was therefore classified as male based on the morphological and metric characteristics.

1.4. Ancestry

The morphological features observable on the skull were consistent with that associated with an African ancestry. The skull was long and low with wide nasal openings and guttered nasal sills and a prognathic facial profile (Figs. 1&2).

Metric analysis revealed the same result with the cranial index (69.94), nasal index (56.88), and gnathic index (104.76) falling within the limits of South African Negroid populations. Canonical discriminant function analysis (Function 1 = -0.389962119) also suggested an African ancestry for this individual (Refer to Table 1 for cranial measurements).

Figure 1: Frontal view of skull (Skeleton 001)

Figure 2: Profile view of skull (Skeleton 001)

1.5. Stature

Stature was calculated using the physiological length of the tibia. A stature of 167.16 ± 2.78 cm was obtained. According to Steyn and Smith (2007) this is an average stature for this population group.

1.6. Dentition

Teeth that were present included the upper left canine, first and second premolars, the first, second and third molars, the lower right first molar, first premolar, the canine, and the lower left central incisor, canine, first premolar and third molar.

The upper right first and second molars, first and second premolars, canine, lateral and central incisors, the left central incisor, the lower right second and third molars, the second premolar and the lower left second premolar and first and second molars were lost antemortem. All other teeth were lost postmortem.

Dental pathology included antemortem tooth loss (Fig. 3) as already mentioned above. In the region of the upper right first premolar and the lower right second premolar as well as the second and third molars the antemortem tooth loss may be attributed to abscess formation visible in the alveolar bone. Another abscess was observed in the region of the upper left first and second molars on the buccal side and within the alveolar bone. These teeth were however not yet shed. Severe occlusal weathering (Fig. 3) was observed on the upper left canine, premolars and molars, as well as the lower right first molar, first premolar and canine, and the lower left third molar. These areas presented with severe dentine exposure. Dental calculus deposits were observed on most of the teeth. Alveolar regression in the areas still containing teeth indicated the possible presence of periodontal disease. (Refer to Table 3 for dental measurements)

Figure 3: Antemortem tooth loss and occlusal wear on the mandible (Skeleton 001)

1.7. Trauma and pathology

No trauma could be observed. Degenerative pathology could be observed in the form of osteoarthritis in the clavicle, pelvis and cervical vertebrae. The lumbar vertebrae presented with osteophytes (Fig. 4). Slight periostitis could be observed on the distal third of the left and right fibula as well as on the medial aspect of the left tibia shaft.

**Figure 4: Osteophytes on L5
(Skeleton 001)**

1.8. Summary

The remains were that of an adult male individual between the ages of 45 and 55 at the time of his death. He was of African ancestry with an estimated stature of 167.16 ± 2.78 cm. Antemortem tooth loss, dental abscesses, dental calculus and periodontal disease were observed along with degenerative pathology to the upper joints and vertebrae. Periostitis was also observable on the lower extremities.

Skeleton 002:

2.1. Preservation and inventory

In general the remains were in a fair state of preservation except for the skull which was completely fragmented. The remains were covered in grey ashy soil, often associated with archaeological burials in ash middens. Even though the skull was fragmented most of the cranial bones were present. Portions of the frontal and parietal bones, the sphenoid and zygomatic bones were missing. The palatine was absent due to postmortem weathering. Almost all of the postcranial remains were present except for the right patella, portions of the sacrum, the right pubic bone, one thoracic vertebrae (T8), one right rib, the proximal epiphysis and proximal third of the right humerus shaft, the distal third and epiphysis of the right radius, the complete left ulna, six left carpals, seven right carpals, three left and right metacarpals, nine phalanges of the hand, two left tarsals, five right tarsals, two left and right metatarsals and ten phalanges of the foot.

2.2. Age at death

The upper and lower third molars were in almost full occlusion and showed no signs of wear suggesting a young adult age. The medial ends of the clavicles were fused but still presented with a fusion line suggesting an age younger than 29 years. S1 and S2 of the sacrum were completely unfused suggesting an age younger than 25 years. The iliac crest still presented with a fusion line suggesting an age range of between 20 and 23 years. The humeral head also presented with a very faint fusion line suggesting that fusion had recently occurred. The fusion time for the proximal humerus is 16-21 years which indicates that this individual was around the age of 21 when he died. A final age estimate of 20-23 years at the time of death was therefore given here.

2.3. Sex

The morphological features observable on the skull and pelvis were consistent with that of males. The skull presented with a prominent nuchal crest and a well-defined mental eminence. The mandible was square shaped and presented with some gonial flaring. The pelvis presented with narrow greater sciatic notches and the absence of ventral arches and pre-auricular sulci.

Metric assessment was done by using single long bone dimensions and comparing those with known standards for males and females. The humeral head diameter, femoral epicondylar breadth, femoral head diameter and tibial distal breadth (refer to Table 2) were consistent with measurements obtained for male individuals. The humeral epicondylar breadth and tibial proximal breadth measurements however showed some overlap with female standards. This may however be due to this individual's young age.

Based on morphological and metric assessment this individual was classified as male.

2.4. Ancestry

The morphological features observable on the skull were consistent with someone of African ancestry. The orbits were square shaped and the nasal opening was wide with guttered nasal sills. Due to the fragmented nature of the skull and pelvis no metric analysis could be done to confirm the morphological findings. The archaeological nature of the remains however already suggests an African ancestry for these individuals.

2.5. Stature

Stature was determined by using the physiological length of the femur and tibia combined. A stature of 162.93 ± 2.371 cm was obtained for this individual. This stature is regarded as being short for this population group (Steyn and Smith, 2007).

2.6. Dentition

Almost all the teeth were present except for the upper left central incisor which was lost postmortem. Slight occlusal weathering was observed on the upper and lowers left and right first molars. Dental pathology that could be observed included dental calculus deposits on almost all the teeth except the third molars. These deposits presented as thin bands on the buccal surfaces of the teeth. Some alveolar regression (Fig. 5) was observed possibly suggestive of periodontal disease. Dental modification was also observed on the upper central and lateral incisors (Fig. 6). The medial and lateral surfaces of each tooth were filed down to create a sharpened appearance (Fig. 7).

Figure 5: Alveolar regression (Skeleton 002)

Figure 6: Dental modification of the upper central and lateral incisors (Skeleton 002).

Figure 7: Medial and lateral edges of central and lateral incisors filed down (Skeleton 002)

2.7. Trauma and pathology

No trauma could be observed. Pathology that could be observed included slight cribra orbitalia in both the left and right orbital roofs (Fig. 8). Slight periostitis was also observed on the medial surfaces of the tibia.

Figure 8: Possible cribra orbitalia in left orbital roof (Skeleton 002)

2.8. Summary

The remains were that of a young adult male between 20 and 23 at the time of his death. He was of African ancestry with an estimated stature of 162.93 ± 2.371 cm. Dental pathology included dental calculus and possible periodontal disease. The individual also presented with dental modifications to his upper central and lateral incisors. Skeletal pathology that could be observed included slight cribra orbitalia and periostitis on the medial surfaces of the tibiae.

Skeleton 003:

3.1. Preservation and inventory

The remains were in a poor state of preservation and were mostly fragmented and incomplete. The only cranial remains present were the occipital bone and portions of the zygomatic bones. Post cranially the following skeletal elements were present: the left clavicle, portions of the left and right scapula, the sacrum, a portion of the left ischium, the complete right os coxa, three thoracic vertebrae, two lumbar

vertebrae, five left ribs, two right ribs and eleven fragments, the left and right humerus, the right radius, the proximal and middle third of the right ulna, the proximal and middle third of the right femur, the distal and middle third of the left tibia and the proximal epiphysis of the right tibia, the distal thirds of the left and right fibula, two right metacarpals (first and third), one phalange from the hand (middle), one left calcaneus, and one distal phalange from the foot.

3.2. Age at death

The medial end of the clavicle was not yet completely fused, suggesting an age younger than 30. S1 and S2 of the sacrum was also not fused suggesting an age younger than 25. A slight fusion line was still visible on the distal radius suggesting that fusion was recently completed and suggesting an age older than 19. A final age estimate of 20 – 25 years at the time of death was given here.

3.3. Sex

The morphological features observable on the pelvis were consistent with those associated with females. The pubic bone presented with subpubic concavity and an ischiopubic ramus ridge. The greater sciatic notche was wide along with the subpubic angle. The pelvic inlet also seemed to be oval shaped. A preauricular sulcus was also present with multiple scars suggestive of child bearing (Fig. 9).

Figure 9: Pre-auricular sulcus with multiple scars

3.4. Ancestry

Due to the poor preservation of the skull no discernable features indicative of ancestry could be observed. Canonical discriminant function analysis of pelvic dimensions (Function 4) revealed a Black ancestry for this individual. Based on the metric analysis and the archaeological nature of the remains this individual was classified as African.

3.5. Stature

The stature was determined by using the length of the radius. A stature of 167.47 ± 3.387 cm was obtained which is quite a tall stature for someone of this population group.

3.6. Dentition

No teeth were recovered.

3.7. Trauma and pathology

No trauma or pathology could be observed.

3.8. Summary

The remains presented that of a young adult female between the ages of 20 and 25 at the time of her death. She was of African ancestry with a stature of 167.47 ± 3.387 cm. No trauma or pathology could be observed.

4. Conclusion

The remains presented that of three individuals. Skeleton 001 was that of an adult male between 45 and 55 at the time of his death. He presented with antemortem tooth loss, dental abscesses, dental calculus and periodontal disease. Degenerative pathology was also noted to the upper joints and vertebrae consistent with someone of older age. Skeleton 002 presented the remains of another adult male between the ages of 20 and 23 at the time of his death. This individual presented with tooth modifications to his upper central and lateral incisors. Pathology that could be observed included possible periodontal disease, cribra orbitalia and slight periostitis which are often associated with a vitamin C deficiency (Ortner, 2003). In this case the pathology does not seem to be active, suggesting a possible vitamin deficiency during childhood. The remains of skeleton 003 were that of an adult female between the ages of 20 and 25 at her time of death. She did not present with any pathology. The presence of a pre-auricular sulcus indicates child birth. Multiple scarring may suggest that she had more than one child.

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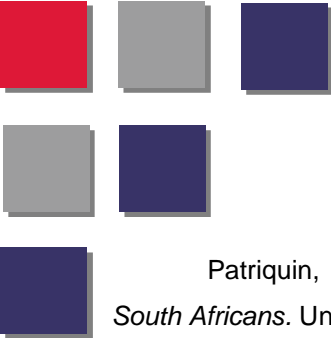
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Table 1: Cranial measurements

All measurements in mm.

- skeletal element was absent or damaged and therefore measurements could not be obtained

* indicates right side

Skeletal dimension	Skeleton 001	Skeleton 002	Skeleton 003
Max. cranial length	193	-	-
Max. cranial breadth	135	-	-
Bizygomatic diam.	-	-	-
Basion-bregma height	145	-	-
Cranial base length	105	-	-
Basion-prosthion length	110	-	-
Maxillo-alveolar breadth	-	-	-
Maxillo-alveolar length	-	-	-
Biauricular breadth	135	-	-
Upper facial height	67.48	-	-
Min. frontal breadth	99.57	-	-
Upper facial breadth	111	-	-
Nasal height	50.98	-	-
Nasal breadth	29	-	-
Orbital breadth	42.59	-	-
Orbital height	36.38	-	-
Biorbital breadth	-	-	-
Interorbital breadth	24.23	-	-

|			
Frontal chord	120	-	-
Parietal chord	117	-	-
Occipital chord	104	-	-
Foramen magnum length	40	-	-
Foramen magnum breadth	33.48	-	-
Mastoid length	38.75	22.39	-
Chin height	37.93	42	-
Height of mandibular body	-	39.57	-
Breadth of mandibular body	13	14.15	-
Bigonial width	95	102.33	-
Bicondylar breadth	-	119.49	-
Min. ramus breadth	42	38.89*	-
Max. ramus breadth	-	45.37*	-
Max. ramus height	-	54.51*	-
Mandibular length	-	117	-
Biasterionic breadth	115	-	-

Table 2: Post-cranial measurements

All measurements in mm.

**- skeletal element was absent or damaged and therefore measurements could not be obtained**

* indicates right side

Skeletal dimension	Skeleton 001	Skeleton 002	Skeleton 003
Clavicle max. length	-	-	152
Clavicle ant.-post. diameter midshaft	9.76	8.51	7.13
Clavicle sup.-inf. diameter midshaft	12.49	10.51	11.03
Scapula height	180	-	-
Scapula breadth	-	-	-
Humerus max. length	320	322*	326*
Humerus epicondylar breadth	62	55.74*	52*
Humerus vertical diameter head	45	43.15*	38.20*
Humerus max. diameter midshaft	22	20.61*	21.47*
Humerus min. diameter midshaft	17	15.69*	14.21*
Radius max. length	-	255	264*
Radius ant.-post. diameter midshaft	-	10.48	12.06*
Radius med.-lat. diameter midshaft	-	14.19	13.52*
Ulna max. length	-	272*	-
Ulna ant.-post diameter	-	13.76*	15.96
Ulna med.-lat. diameter	-	14.92*	10.37
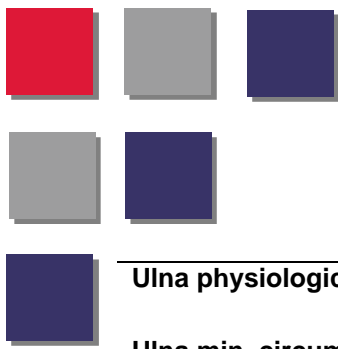
Measurement			
Ulna physiological length	-	245*	-
Ulna min. circumference	-	37*	-
Sacrum anterior length	-	-	120
Sacrum ant.-sup. breadth	-	-	-
Sacrum max. transverse diameter base	50.72	-	50.31
Os coxae height	-	-	201
Os coxae iliac breadth	-	-	151
Os coxae pubis length	-	-	75.59
Os coxae ischium length	-	-	84.86
Femur max. length	-	461*	-
Femur bicondylar length	-	457*	-
Femur epicondylar breadth	-	77*	-
Femur max. diameter femur head	46	43.52*	41.90*
Femur ant.-post. subtrochanteric diameter	27.16	24.63*	21.91*
Femur med.-lat. subtrochanteric diameter	32.55	29.92*	30.22*
Femur ant.-post. midshaft diameter	31.07	25.23*	25.04*
Femur med.-lat. Midshaft diameter	26.51	22.07*	25.76*
Femur midshaft circumference	90	81*	80*
Tibia length	410	383	-
Tibia physiological length	395	369	-
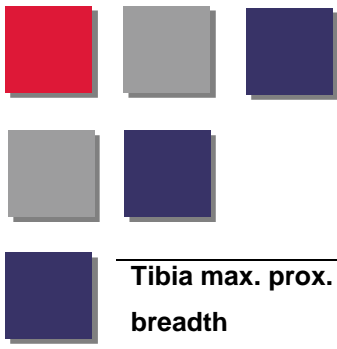
Tibia max. prox. epiphyseal breadth	80	70	-
Tibia max. distal epiphyseal breadth	50	50	-
Tibia max. diameter nutrient foramen	36	32.13	-
Tibia med.-lat. diameter nutrient foramen	26	22.76	-
Tibia circumference nutrient foramen	98	88	-
Fibula max. length	-	370*	-
Fibula max. diameter midshaft	13.59	19.19*	-
Calcaneus max. length	90	76	81
Calcaneus middle breadth	-	45	-

Table 3: Dental measurements

All measurements were taken in mm.

- dentition was absent or damaged and therefore measurements could not be obtained

* indicates right side. MD=mesiodistal, BL = buccolingual

Maxilla	Skeleton 001	Skeleton 002	Skeleton 003	Mandible	Skeleton 001	Skeleton 002	Skeleton 003
MDI1	-	-	-	MD I1	-	5.24	-
BL I1	-	7.50*	-	BL I1	-	6.08	-
MD I2	-	-	-	MD I2	-	5.69	-
BL I2	-	6.86	-	BL I2	-	6.23	-
MD C	-	8.03	-	MD C	6.73	7.04	-
BL C	-	8.37	-	BL C	8.24	8.62	-
MD PM1	-	6.87	-	MD PM1	7.91	7.11	-
BL PM1	-	9.62	-	BL PM1	8.47	8.52	-
MD PM2	7.19	6.65	-	MD PM2	-	7.20	-
BL PM2	9.25	8.87	-	BL PM2	-	8.12	-
MD M1	-	10.85	-	MD M1	10.86*	11.75	-
BL M1	11.30	11.91	-	BL M1	11.64*	11.52	-
MD M2	-	10.26	-	MD M2	-	10.52	-
BL M2	12.05	11.15	-	BL M2	-	10.71	-
MD M3	9.79	9.16	-	MD M3	-	11.62	-
BL M3	11.65	11.59	-	BL M3	10.68	10.68	-