Macro-anatomical investigations of the skeletons of the African giant rat (*Cricetomys gambianus* Waterhouse 1840) II: Fore limb

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SUMMARY

In this study, 7 African giant rats (*Cricetomys gambianus* Waterhouse 1840) were used to investigate the bony fore limb. It was observed that the supraspinous fossa was larger than the infraspinous fossa. The slender, curved clavicles were about 2.53 cm long. The humerus was peculiar and the ridges and the tuberosities were well developed. There was a supracondylar foramen in the mediodistal region of the humerus in all the rats, while 3 of the rats (42.9%) had a supratrochlear foramen. The radius and ulna were distinct but appeared fused in most of the African giant rats used in this study. In the carpal proximal row, radial carpal and intermediate carpal bones were fused to form the Os carpi intermedioradiale. The manus was complete, with five digits. There were two phalanges in the first digit and the other four digits were composed of three phalanges. On the palmar face of the manus there were radial and ulnar sessamoids (ossa sessamoidea palmaria) with an irregular surface. In conclusion, there were some prominent features in the forelimb bones of the African giant rat that typifies them as fast running, burrowing and shoveling rodents.

Key words: African giant rat – Bony forelimb – Supracondylar foramen – Supratrochlear foramen

INTRODUCTION

African giant rats belong to the family Cricetidae and the order Rodentia. These rats have been found to be fairly tame and docile in captivity even though shortly after being captured, they tend to exhibit such escape reactions such as violent struggles by scratching with their nails and hitting their heads and tail against their cages (Oke, 2009). They are nocturnal rodents, omnivorous; they feed on vegetation and invertebrates, and use their extremities for burrowing and shoveling (Ajayi, 1977a; Happold, 1987). The literature on the macro-anatomical features of the skeletal system is scarce. There are many macro-anatomical investigations on the skeletal system of mammals, including the rabbit, the guinea pig, the rat (Özkan et al., 1997), the mink (Dursun and Tipirdamaz, 1989), the badger (Hidaka et al., 1998; Dinç, 2001) the porcupine (Yilmaz et al., 1998), the hedgehog (Özkan, 2005), the mole rat (Özkan, 2007). Recently, we studied the skeleton of the neurocranium and pelvic limb of the African

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giant rat (Olude et al., 2009a, b), but the skeleton of the forelimb of this species have not been investigated in detail. The aim of the present study was to investigate the skeletal anatomy of the forelimb in the African giant rats as an added contribution to on-going research into the osteometrics of African wildlife.

Materials and Methods

The bones examined were obtained from 7 adult African giant rats caught in the wild and euthanized using chloroform inhalation. Maceration of bones was carried out by the method described by Onar et al. (2001) and Olude et al. (2009). Morphometric descriptions of the forelimb bones were then undertaken

Results

Scapula

The vertebral border of the scapular was curved downwards towards the supraspinous fossa of the cranial border. The spine arose gradually from the dorsal 1/4th to the about the distal 2/3rds, where it continued distally as a dorsolaterally flattened acromion and a distal metacromion or hamate process, which projected slightly ventral over the glenoid angle, with an average length of 2.50 mm. The lateral surface of the supraspinous fossa bore a slight depression mid-sagitally, which appeared as a distinct crest on the costal surface. The supraspinous fossa was larger than the infraspinous fossa. The cranial border was strongly convex in profile; the caudal border was wide and concave and bore a slightly raised outer ridge-like lip. The neck was distinct, a tuber scapulae was present with a distinct glenoid notch and coracoid process (see figs. 1 and 2).

The sternal end of the clavicle articulating with sternum was rounded while the acromial end articulating with the cranial side of the shoulder joint was flattened and spoon-like. The slender, curved clavicles had an average length of 2.53 cm.

Humerus

The humerus had slightly curved expansions at the proximal and distal ends. The deltoid tuberosity (tuberositas deltoidea) was well developed, tapering towards the cranial projection (Fig. 3). The teres tuberosity was present on the medial surface, but not as prominent as the deltoid tuberosity. The tubercles on the proximal end of the humerus were placed craniomedially and separated by a groove (intertuberal groove). There was a lateral epicondyloid crest (crista epicondyli lateralis) extending along the lateral aspect. At the distal epiphysis, cranial to the medial epicondyle there was a spicule extending craniomedially from the distal fifth of the shaft forming the supracondylar foramen, which transmited a branch of the brachial plexus (n. medianus). The supratrochlear foramen was observed in 3 of the African giant rats used in this study.

Antebrachium

The radius and ulna were distinct with the shaft of the ulna being more prominent and

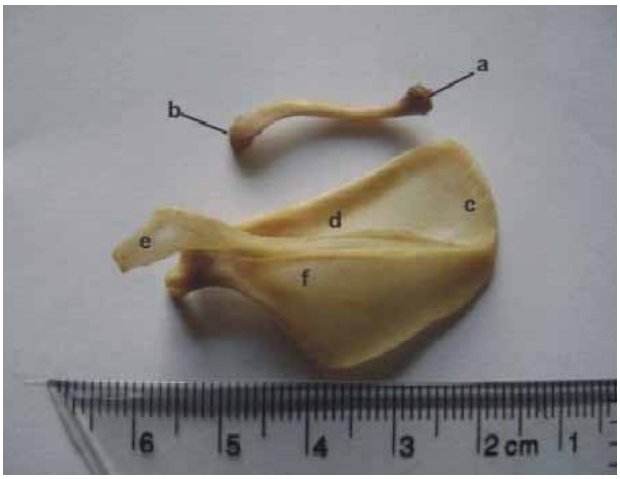

Figure 1. Lateral surface of the scapula and the clavicle of the African giant rat. a: proximal end of clavicle; b: distal end of clavicle; c, d: infraspinous fossa; e: hamate process; f: supraspinous fossa.

Figure 2. Medial surface of the scapula and clavicle of the African giant rat. a, b: coracoid process; c: proximal end of clavicle; d: distal end of clavicle.

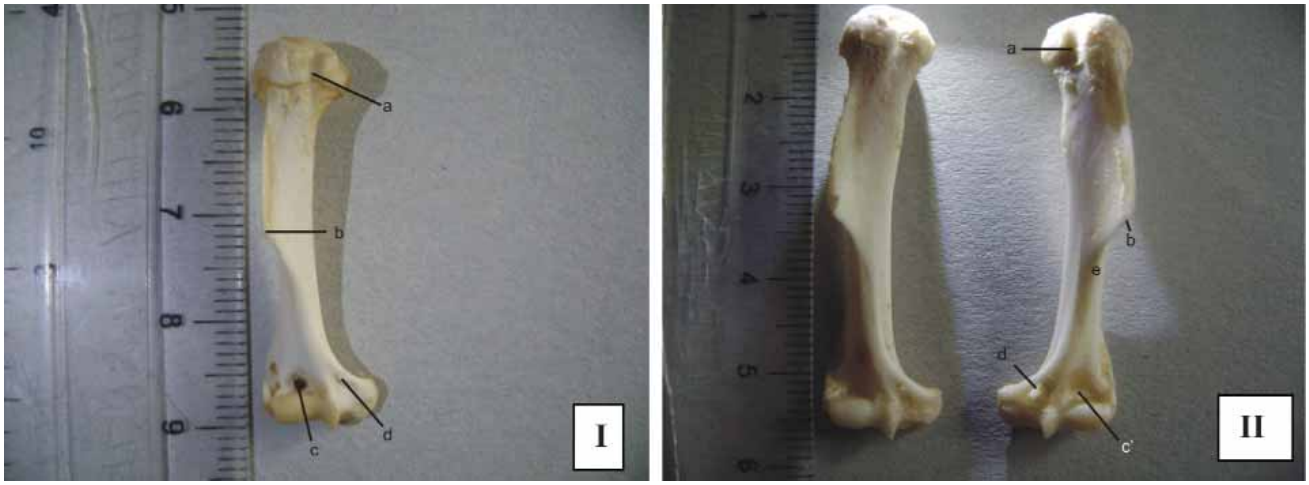

Figure 3 I, II. Humerus of the African giant rat. Note the biccipital groove (a), deltoid tuberosity (b), supratrochlear foramen (c) in 3I and absence of the supratrochlear foramen (c') in 3II. See also the supracondylar foramen (d).

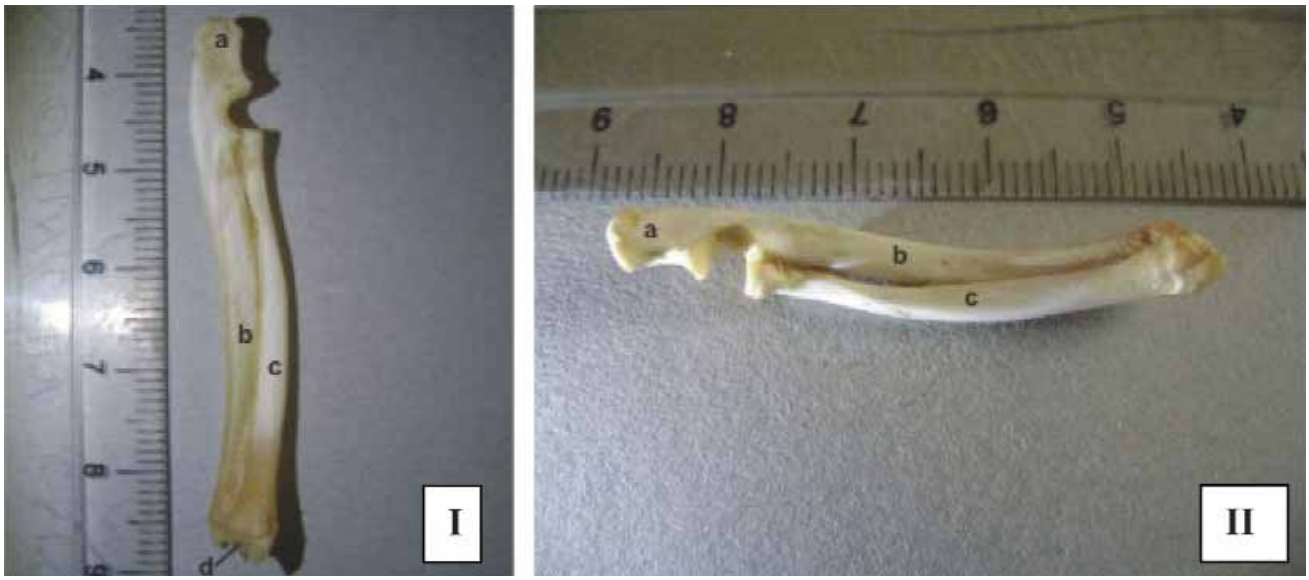

Figure 4 I, II. Radius (b) and ulna (c) of the African giant rat. Note the false appearance of fusion in 4I.

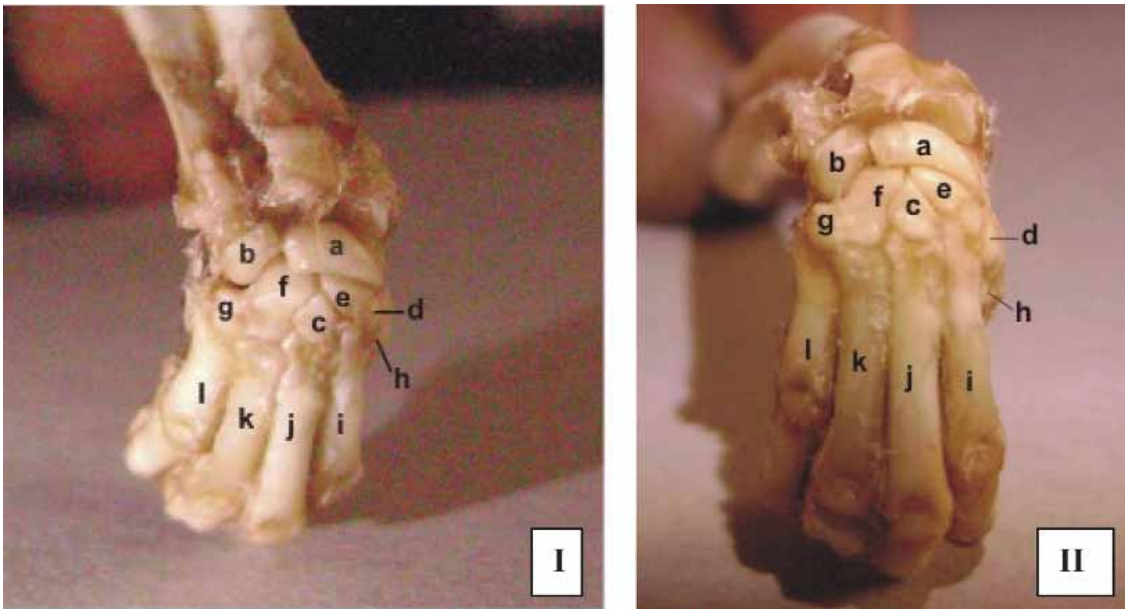

Figure 5 I, II. The manus of the African giant rat (Ossa digitorum manus). a) intermedioradial carpal, b) ulna carpal, c) carpal II, d) carpal I, e) central carpal, f) carpal III, g) carpal IV, h) metacarpal I, i) metacarpal II, j) metacarpal III, k) metacarpal IV, l) metacarpal V.

about 1/5th longer than the radius because of the prominent olecranon process. Owing to a narrow but continuous separation, the radius and ulna could move in relation to each other. The strong ligamentous attachments between these two bones gave them the appearance of being fused. The head of the radius had an oval articular surface to accommodate the ventral surface of the trochlea of the humerus. The coronoid process of the ulna (processus coronoideus) was prominent. The distal ends of radius and ulna had styloid processes (processus styloidei) and the carpal articular surface of the radius (facies articularis carpea) was concave.

Ossa carpi

There were two bones in the proximal row. On the medial side, the radial carpal (os carpi radiale) and intermediate carpal (os carpi intermedium) bones were fused, forming the intermedioradial carpal bone (os carpi intermedioradiale), while on the lateral side there was an ulna carpal (os carpi ulnare). In the distal row, carpal I (os carpale I), carpal II (os carpale II), carpal III (os carpale III), carpal IV (os carpale IV) were distinct, and there was a central carpal (os carpi centrale) in the distal portion of the os carpi intermedioradiale. Carpal IV was larger than other distal row bones. Two sessamoid bones were found on either side of the carpal bones I and IV embedded in the carpal pads.

Manus

The manus was complete, with five digits with five metacarpal bones lying between the carpal bones and phalanges. The shortest one was metacarpal I (os metacarpale I), and the longest was metacarpal III (os metacarpale III). The metacarpal lengths, in order, were I< V< II< IV<III. On the palmar surface of the manus there were 2 sessamoid bones.

Ossa digitorum manus

There were two phalanges in the first digit, while the other four digits were composed of three phalanges. The distal phalanges were in the form of claws.

Discussion

Acromion and metacromion or hamate processes are present in Wistar rats (Hebel and Stromberg, 1976; Özkan et al., 1997), in guinea pigs (Özkan et al., 1997), in rabbits (Özkan et al., 1997) and the metacromion process is the smallest (Wells, 1964). The hamate process has mainly been described in carnivores, and a suprahamate process is only found in the cat (Dyce et al., 2002). Similar findings were observed in this study, but there was no suprahamate process in the African giant rat. The humerus, ulna and radius of the rats had no variations from the general mammalian type (Greene, 1968), but the presence of the supracondylar foramen in the African giant rat has not been reported in rodents and has been observed only in cats, in which it transmits the median nerve and the brachial artery (Dyce et al., 2002); similar functions occur in the African giant rats. Saunders and Manton (1969) reported that the ridges and tuberosities are better developed in all burrowing forms than in others. Similarly, in our study there was a peculiar humerus, with prominent ridges and tuberosities. The deltoid ridge (crista tuberculi majoris) in the humerus was prominent, as reported for the Muridae family (Saunders and Manton, 1969) and the tuberositas deltoidea was well developed, as in rats (Çalitlar, 1978; Özkan et al., 1997), but less so than that of the mole rat (Özkan, 2002).

The clavicles, about 2.53 cm long, were small and cylindrical, as reported for guinea pigs (Wagner and Mannýng, 1976), and with slender curved bones, as in rats (Wells, 1964), rabbits (Uçar et al., 1985) and the mole rat (Özkan, 2002).

Romer (1970) described that among mammals in particular the shaft of the ulna may fuse with the radius. In the present study, most of the radii and ulnae were not fused, although in 2 African giant rats were.

It has been stated that in Rodentia the manus nearly always has five digits (Saunders and Manton, 1969; Demýrsoy, 1997; 1998). Similarly, five digits were observed in African giant rats. In the manus of some rodents, e.g., the mole, there is a radial sessamoid, which increases the breadth of the hand and increases its efficiency in shoveling the earth to a considerable extent (Saunders and Manton, 1969). In this study, radial and ulnar sessamoids (ossa sesamoidea palmaria) were observed in the African giant rats. A central bone is present in some forms, but the os carpi radiale and os carpi intermedium are always fused in the Rodentia (Saunders and Manton, 1969); four proximal carpal bones have been reported in porcupines (Yilmaz et al., 1998).

Here, the carpus os carpi radiale and os carpi intermedium were fused (os carpi intermedioradiale) and there was a central bone in the distal portion of os carpi intermedioradiale as in mole-rats, cats and dogs (Özkan, 2002; Dyce et al., 2002), and this pattern is specialized for fast running (Dyce et al., 2002).

In conclusion, there were some prominent features in the forelimb bones of the African giant rat, classifying them as fast running, burrowing and shoveling rodents.

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