Radiological Investigation of the African Brush-tailed Porcupine (*Atherurus africanus*) Appendicular Skeleton

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ABSTRACT

The present study aimed to describe the normal radiographic anatomy of the healthy African Brush-tailed Porcupine appendicular skeleton to fill a gap in the field of comparative anatomy and to establish an anatomical basis for diagnosis of skeletal diseases and surgical interference of the limbs of this important zoo-animal. Four (two male and two females) free-living porcupines (***Atherurus africanus***) from the El-Jabal Alakhdar region of Libya were selected for this study. Lateral, craniocaudal and caudocranial radiographs from the thoracic and pelvic limbs were obtained. The important anatomic structures of the appendicular skeleton were revealed, seen clearly and labeled in two corresponding photographs of radiograph and bones of porcupine limbs. The various boney structures of the limbs were recorded. The radiograph pictures from these porcupines were compared with the normal canine and feline skeletal radiographic anatomy.

INTRODUCTION

African Brush-tailed Porcupine (***Atherurus africanus***) is a hystricomorph rodent, which lives in the forests of west and central Africa, it is a favorite source of meat for rural population, and its price is often high in comparison with that of other domestic animals[1]. Radiographic examination is a method that can play an important role in the diagnosis of a wide variety of skeletal diseases.

The macroanatomical study of domestic animals skeletons[2], porcupine[3] and hedgehog[4] had been reported. Radiographic anatomy

of the appendicular skeleton is performed increasingly in many animals[5, 6] such as dogs, cats[7,8] and hedgehog[9], but to our knowledge there is no any earlier study has been reported on the normal radiographic anatomy of the appendicular skeleton of African Brush-tailed Porcupine (*Atherurus africanus*).

The aim of this study was to provide an atlas of the normal radiographic anatomy of the bones of the porcupine limbs which might be necessary to describe any abnormalities that may be present.

MATERIAL AND METHODS

The present study was carried on four healthy adult free-living porcupines (Atherurus africanus, Fig.1) (two males, two females) from the El-jabal Alakhdar region of Libya. The porcupines were anesthetized by injecting (35 mg/kg ketamine + 5 mg/kg xylazine IM). Lateral, craniocaudal and caudocranial x-ray radiographs from the thoracic and pelvic limbs were obtained. The radiographic films were stored digitally. After radiographic images were obtained, the porcupines were slaughtered and subjected to boiling method of skeleton preparation techniques to correspond with the radiographic images. The radiographic images were labeled by comparison with the boney skeleton. The nomenclature was adopted according to the Nomina Anatomica Veterinaria[11]. Some structures present in the bones could not see on the corresponding radiographic images. Some Radiographic images artifacts were noted.

Fig.1: A photograph of African Brush-tailed Porcupine (Atherurus africanus).

RESULTS

The results of the present study consisted of eleven radiographic images and eleven boney images. The important anatomic structures of the appendiclar skeleton were revealed, seen clearly and labeled in two corresponding photographs of radiograph and bones of porcupine limbs. The various boney structures of the limbs were recorded.

The thoracic limb radiographs revealed that, the scapula had a long acromion process reaching the level of the glenoid cavity (Fig. 2,3 A&B). The spine of the scapula divided the lateral surface into supraspinous and infraspinous fossae by ratio 2:1 (Fig. 2, 3. 4, 5 A&B).

The clavicle was observed as a complete bone connected to the scapula and manubrium of the sternum (Fig. 4 A&B).

The radial and olecranon fossae of the humerus communicated with each other through an oval supratrochlear foramen (Fig. 6 A&B).

The ulna was longer and larger than the radius and separated from it by interossous space (Fig. 6 A&B).

There were seven carpal bones, three in the proximal row and four in the distal rows, the radial and intermediate bones fused in on bone. There were five metacarpal bones and five digits in the thoracic limb. Each digit had three phalanges except the first one which had two phalanges only (Fig.7 A&B).

The pelvic limb radiographs revealed that, the wing of the ilium was long and its gluteal surface was less concave. In the lateral view, the pubis and ischium are relatively small (Fig. 8, 9 A&B).

The highest point of the greater trochanter of the femur lied at the same level of the head (Fig. 10 A&B).

The fibula was separated from the tibia by long interossous space (Fig. 11 A&B).

There were seven tarsal bones arranged in three rows, Calcaneus and Talus in the proximal row, Central tarsal bone in the middle row and First tarsal bone, Second, Third and Fourth tarsal bones in the distal row. There were five metacarpal bones and five digits in the pelvic limb each digit had three phalanges except the first digit which had two phalanges only (Fig. 12 A&B).

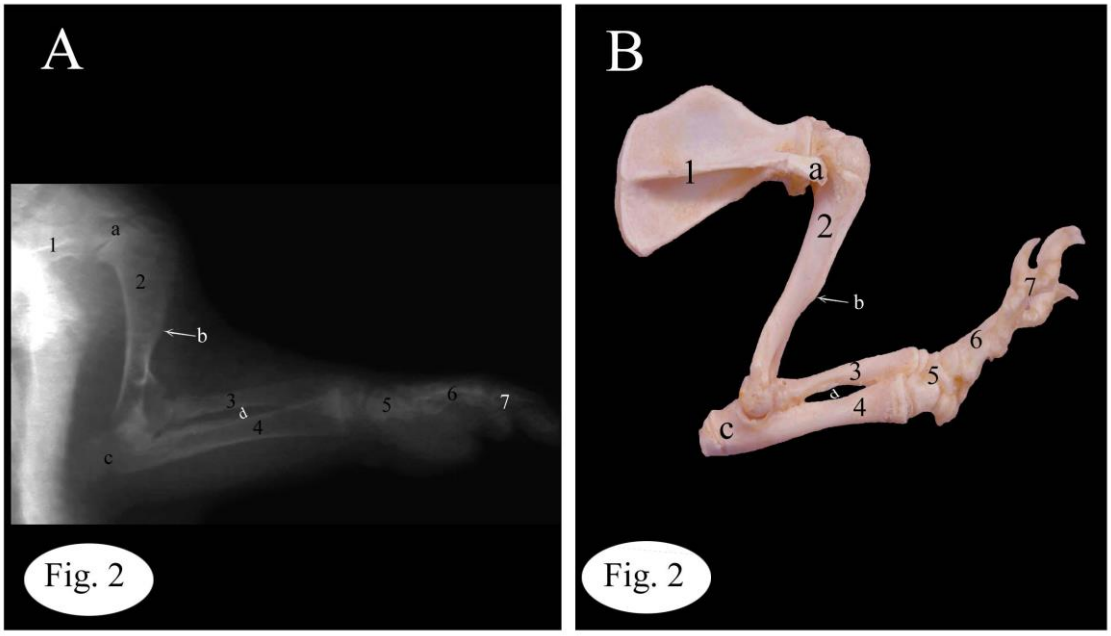

Fig.2: Lateromedial radiographic image (A) and boney representation (B) of the right forelimb.
1. Scapula. 2. Humerus. 3. Radius. 4. Ulna. 5. Carpal bones. 6. Metacarpal bones. 7. Digits. a. Acromion process. b. Deltoid tuberosity of the humerus. c. Olecranon tuberosity. d. Interosseus spaces.

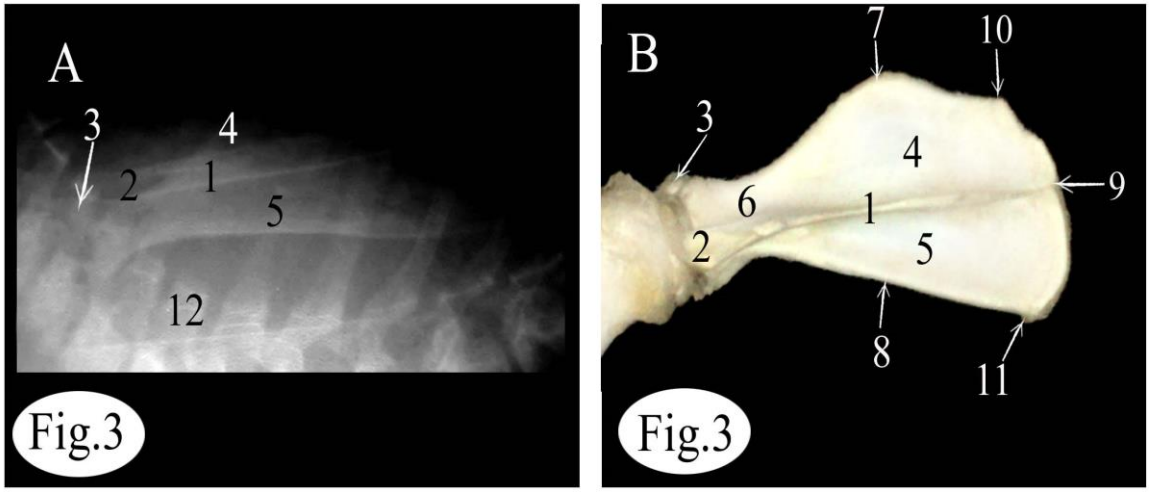

Fig.3: Dorsolateral radiographic image (A) and boney representation (B) of the left scapula.
1. Spine of scapula. 2. Acromion process. 3. Supraglenoid tuberosity. 4. Supraspinous fossa. 5. Infraspinous fossa. 6. Neck. 7. Cranial border. 8. Caudal border. 9. Dorsal border. 10. Cranial angle. 11. Caudal angle. 12. 4th thoracic vertebra.

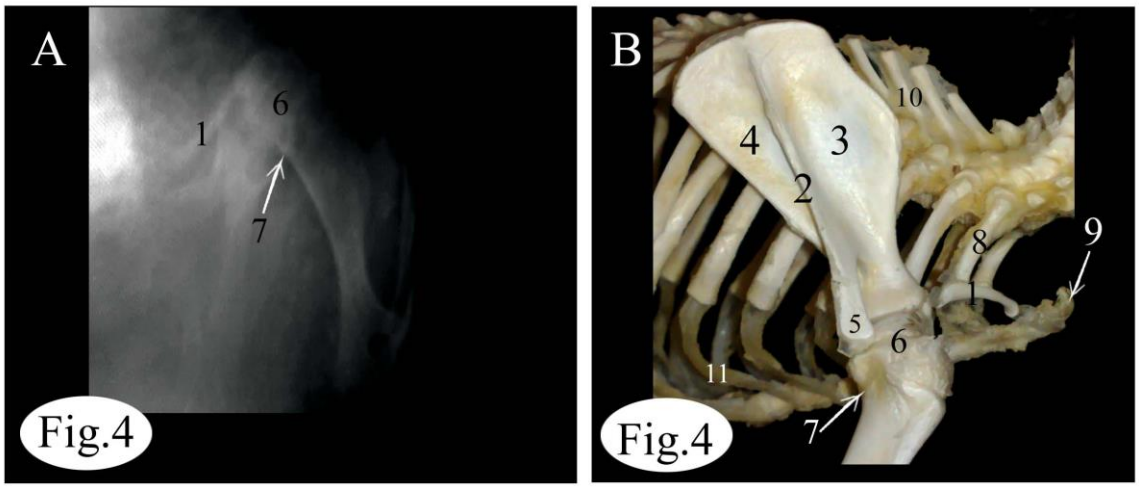

Fig.4: Dorsolateral radiographic image (A) and boney representation (B) of the right shoulder joint.

1. Clavicale. 2. Spine of scapula. 3. Supraspinous fossa. 4. Infraspinous fossa. 5. Acromion process. 6. Head of the humerus. 7. Neck of the humerus. 8. Frist rib. 9. Manubrium of the sternum. 10. 4th thoracic vertebra. 11. Costal cartilage of 5th rib.

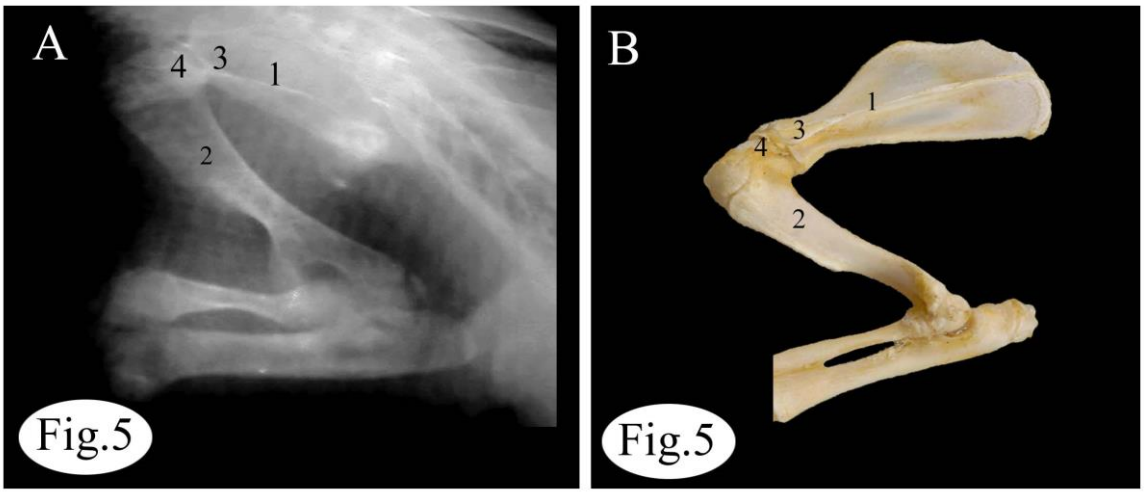

Fig.5: Caudolateral radiographic image (A) and boney representation (B) of the left shoulder joint (complete flexion).

1. Scapula. 2. Humerus. 3. Neck of the scapula. 4. Head of the humerus.

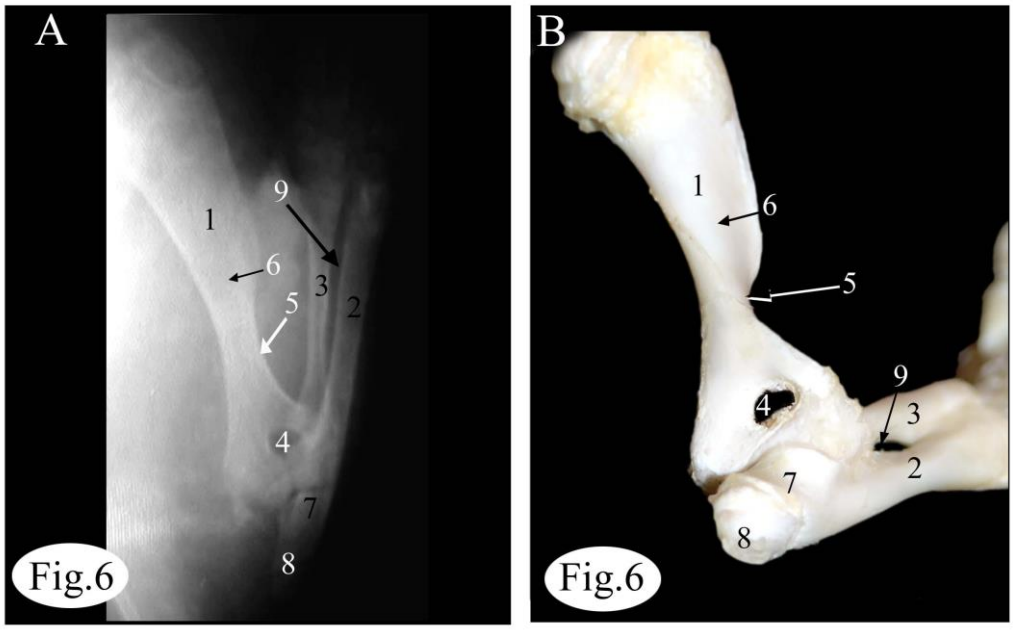

Fig6: Lateromedial radiographic image (A) and boney representation (B) of the right elbow joint.

1. Humerus. 2. Ulna. 3. Radius. 4. Supratrochlear foramen 5. Crest of the humerus. 6. Sulcus m.brachialis. 7. Olecranon. 8. Olecranon tuberosity. 9. Interosseus space.

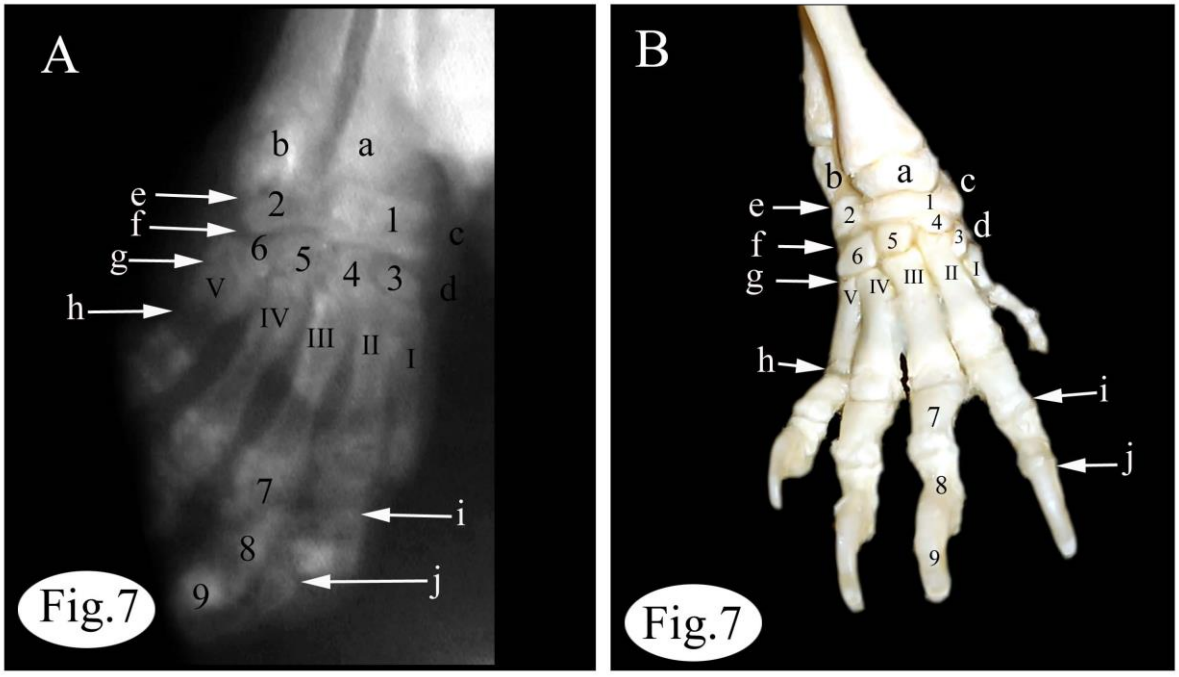

Fig.7: Dorsopalmar radiographic image (A) and boney representation (B) of the right manus.

a. Distal epiphysis of radius. b. Distal epiphysis of ulna. c. Proximal row of carpal bones. d. Distal row of carpal bones. e. Radiocarpal joint. f. intercarpal joint. g. Carpometacarpal joint. h. Metacarpophalangeal joint (Fetlock joint). i. Proximal interphalangeal joint (Pastern joint). j. Distal interphalangeal joint (Coffin joint) 1. Intermedioradial carpal bone. 2. Ulnar carpal bone. 3. First carpal bone. 4. Second carpal bone. 5. Third carpal bone. 6. Fourth carpal bone. I-V Metacarpal bones. 7. Proximal phalanx of digit III. 8. Middle phalanx of digit III. 9. Distal phalanx of digit III.

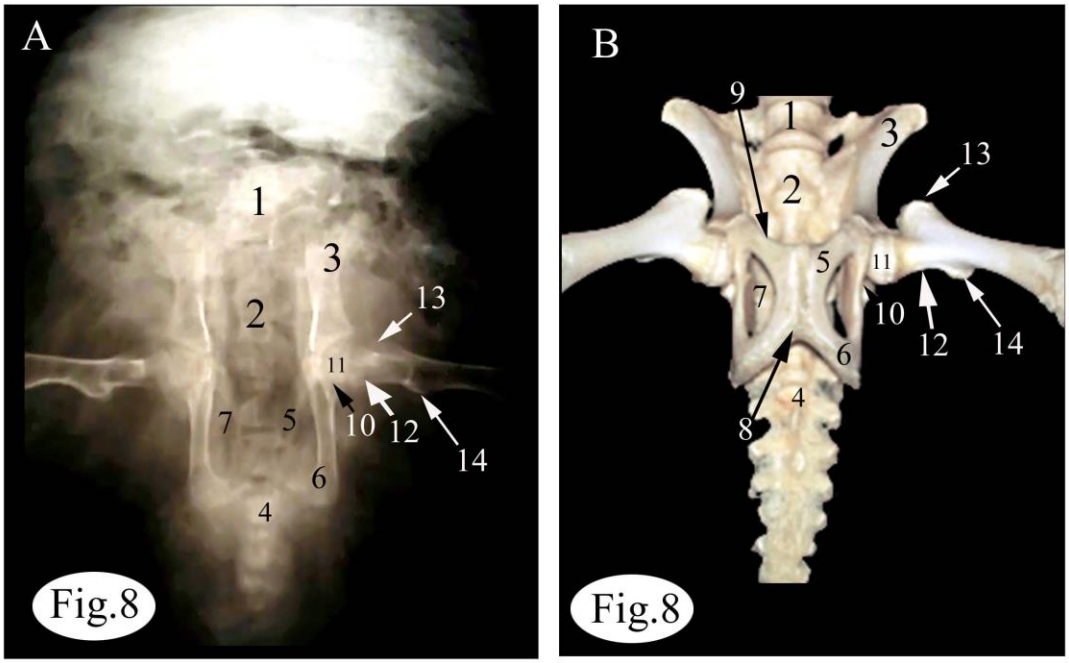

Fig.8: Ventrodorsal radiographic image (A) and boney representation (B) of the pelvis.

1. Last (6^{th}) lumbar vertebra. 2. Sacrum. 3. Ilium. 4. First caudal vertebra. 5. Pubis. 6. Ischium. 7. Obturator foramen. 8. Ischial arch. 9. Pectin of pubis. 10. Acetabulum. 11. Head of femur. 12. Neck of femur. 13. Greater trochanter of femur.

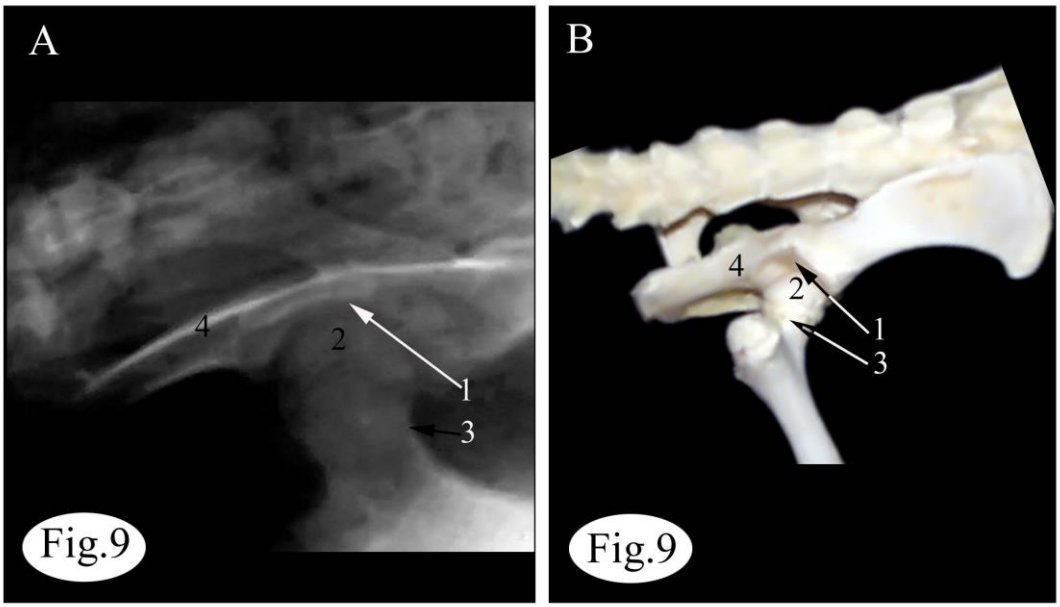

Fig.9: Lateromedial radiographic image (A) and boney representation (B) of the right hip joint.

1. Acetebulum. 2. Head of the femur. 3. Neck of the femur. 4. Ischium.

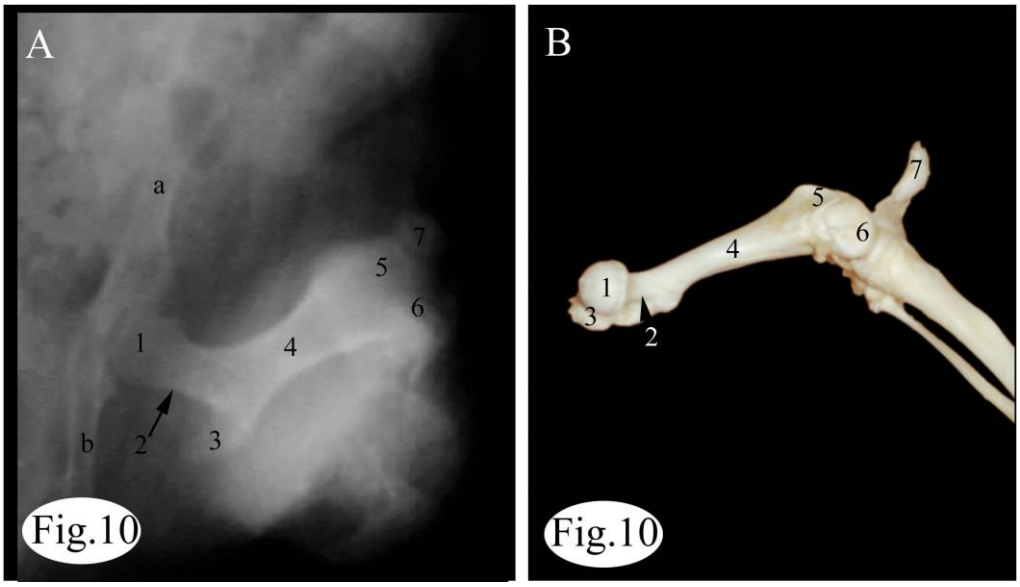

Fig.10: Mediolateral radiographic image (A) and boney representation (B) of the left femur.

1. Head of the femur. 2. Neck of the femur. 3. Greater trochanter of femur. 4. Body of the femur. 5. Trochlea of femur. 6. Medial condyle of femur. 7. Patella. a. Ilium. b. Ischium.

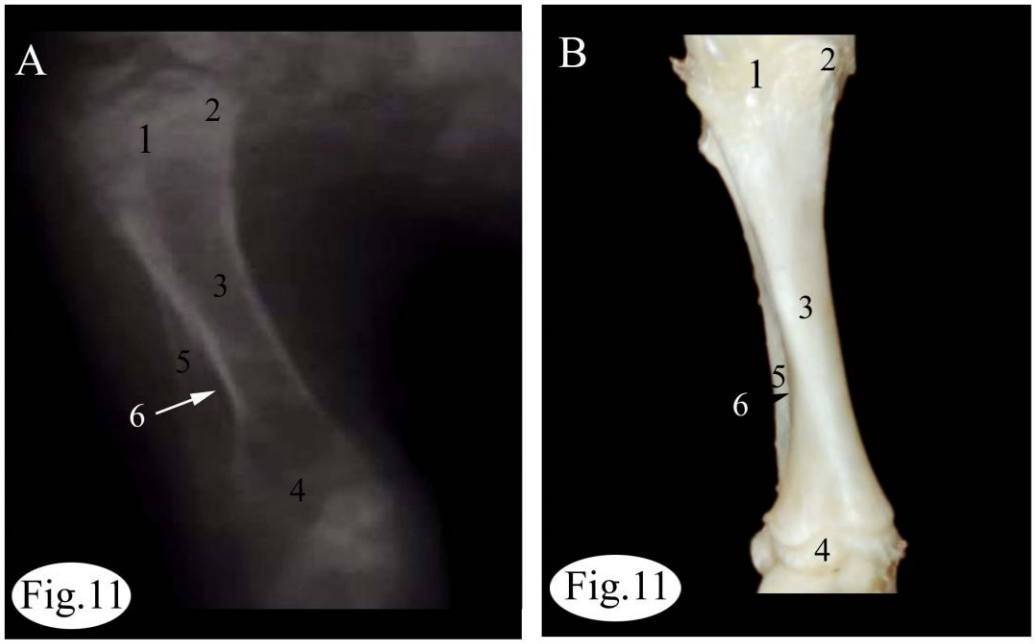

Fig.11: Mediolateral radiographic image (A) and boney representation (B) of the left tibia.

1. Proximal epiphysis of tibia. 2. Medial condyle of the tibia. 3. Body of the tabia. 4. Distal epiphysis of tibia. 5. Fibula. 6. Spatium between tibia and fibula.

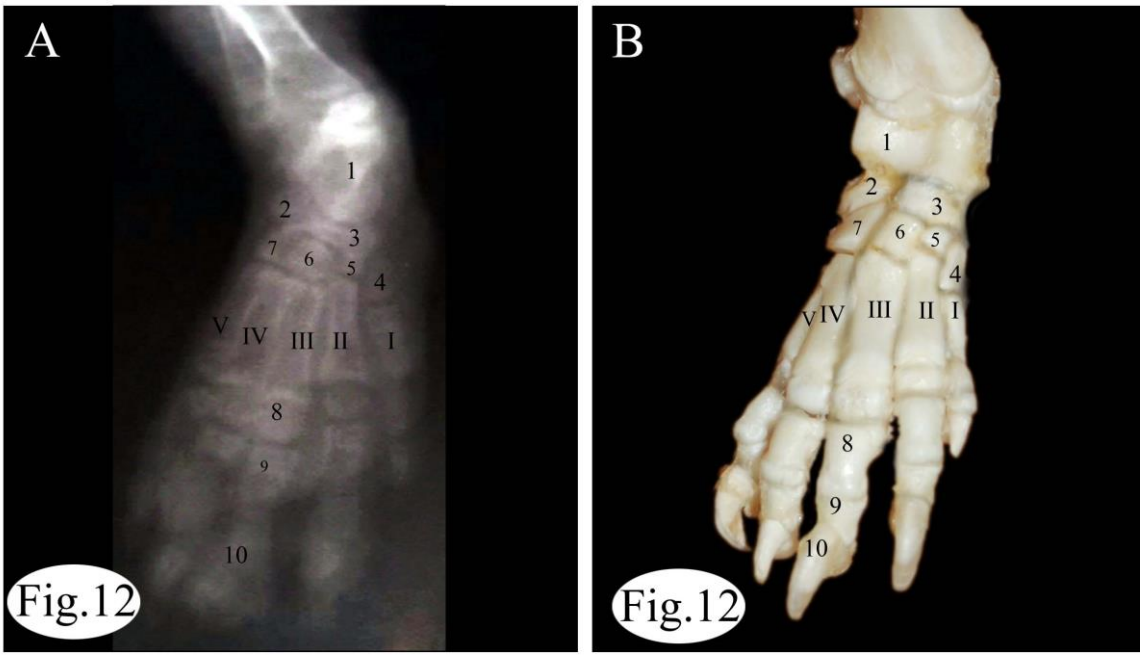

Fig.12: Plantarodorsal radiographic image (A) and boney representation (B) of the left pes.

1. Calcaneus. 2. Talus. 3. Central tarsal bone. 4. First tarsal bone. 5. Second tarsal bone. 6. Third tarsal bone. 7. Fourth tarsal bone. I-V. Metatarsal bones. 8. Proximal phalanx of digit III. 9. Middle phalanx of digit III. 10. Distal phalanx of digit III.

DISCUSSION

This article presents the first series of labeled radiographical images of African Bruch-tailed porcupine and allow for visualization of the normal structure of the porcupine apendicular skeleton from macroscopic and radiological images.

The present investigation had revealed both similarities and differences between the African Bruch-tailed porcupine apendicular skeleton and dog and cat [7, 8] and hedgehog [9].

Radiological images of the African Bruch-tailed porcupine provide complete details of the anatomical structure of the appendicular skeleton and correlates well with corresponding boney specimens.

The radiological images could be useful in studies of the abnormalities and lesions of the appendicular skeleton of the African Bruch-tailed porcupine[5].

The tarsal bones, carpal bones and digits are similar in the number to that of the dog [11].

In conclusions as demonstrated in the this study, labeled radiological images of the normal African Bruch-tailed porcupine appendicular skeleton provides excellent visualization of many anatomic structures of the appendicular skeleton and establish an anatomical basis for diagnosis of skeletal diseases and surgical interference of the limbs of the African Bruch-tailed porcupine which is an important zoo-animal and valuable favorite source of meat for rural population.

REFERENCES

1. Jori, F., Lopez-Bejar, M. and Houben, P. 1998. The biology and use of the African bruch-taild porcupine (Atherurus africanus, Gray, 1842) as a food animal. A review. Biodiversity and conservation. 7, 1417-1426.

2. Nickel, R., A. Schummer, E. Seiferle, H. Wilkens, K. H. Wille, and J. Frewine. 1986. The locomotor system of the domestic mammals. *In:* Nickel, R., A. Schummer, and E. Seiferle (Eds.). The Anatomy of the Domestic Animals. Verlag Paul Parey, Berlin-Hamburg, Germany. Pp. 62–65.

3. Yilmaz, S., G. Dync, and A. Aydin. 1999. Macro-anatomical investigations on the skeletons of porcupine (*Hystrixcristata*). II. Ossa membri pelvini. Turk. J. Vet. Anim. Sci 23:297–300.

4. Ozkan, Z. E. 2002. Macro-anatomical investigations on the skeletons of hedgehog (*Erinaceus europaeus L.*). II. Ossa membri pelvini. Veterinarski Arhiv 72:213–220.

5. Thrall, D. E. 2002. Textbook of Veterinary Diagnostic Radiology, 4th ed. W. B. Saunders Co., Philadelphia, Pennsylvania.

6. Saunders, J. T. and S. M. Manton. 1969. A Manual of Practical Vertebrate Morphology, 4th ed. Oxford Univ. Press, London, England.

7. Ruberte, J. and J. Sautet. 1996. Atlas de Anatomia del Perro y del Gato, Volum 2, Torax y Miembro Toracico. Universitat Autonoma de Barcelona. Impreso en Espana.

8. Ruberte, J. and J. Sautet. 1998. Atlas de Anatomia del Perro y del Gato, Volum 3, Abdomen, Pelvis y Miembro Pelviano. Universitat Autonoma de Barcelona. Impreso en Espana.

9. Hashemi M., Javadi S., Hadian M., Pourreza B., and Behfar M. 2009. Radiological Investigations of the Hedgehog (Erinaceus

concolor) Appendicular Skeleton Journal of Zoo and Wildlife Medicine 40(1):1-7.

10. Nomina Anatomica Veterinaria (NAV). Published by international committee on Veterinary Gross Anatomical Nomenclature of the World Association of Veterinary Anatomists. Zurich and Ithaca, New York. 2005.

11. Schaller, O. Illustrated Veterinary Anatomical Nomenclature. Stuttgart: Enke Verlag. 1992.

فحص شعاعي للهيكل الطرفي للشيهم الأفريقي

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الملخص العربي

تهدف هذه الدراسة إلي وصف التشريح بالأشعة السينية للهيكل الطرفي للشيهم الأفريقي لسد فجوة في مجال التشريح المقارن ولبناء أساس تشريحي لتشخيص أمراض الأطراف والتدخل الجراحي الأمثل فيها في هذا الحيوان الهام. استعملت لهذه الدراسة أربعة شياهم برية (ذكرين وأنثيين) طبيعية سريرياً , جمعت من منطقة الجبل الأخضر بليبيا .

تم الفحص بالأشعة وحشياً أنسياً وأمامياً خلفياً وخلفياً أمامياً لكل من الطرف الصدري والطرف الحوضي . تم توضيح التراكيب التشريحية الهامة وتم وضع البيانات عليها في صورتين متطابقتين لكل من صور الأشعة وصور العظام. تم مقارنة صور الأشعة التشريحية للشيهم مع مثيلاتها في الكلاب والقطط.