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Research Article

# Morphological Features of the Bones and the Arterial Supply of the Wing in the Hooded Crow (*Corvus cornix)* with Special Reference to the Muscles of Flight

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## ABSTRACT

The present study was performed on twelve adult, apparently healthy hooded crows (*Corvus cornix*) to investigate the anatomical features of bones of thoracic limb, the muscles responsible for flight and the arterial blood vessels of the wing with special emphasize about the origin, course and distribution of the axillary artery. The birds were slaughtered and subjected for latex injection technique through inserting catheter through the brachiocephalic trunk. Other birds injected with Urograffin for x-ray purposes. These radiographs provided true picture of the topographic relations of the arteries with bony skeletons. The bony structures of the wing were formed by the humerus, ulna, radius, (ulnar and radial carpals), carpometacarpaus and three digits. The main two muscles of wing that responsible for flight; the pectoralis M. and supracoracoideus M. The wing received its arterial supply through the axillary artery.

**Key words:** Bones of wing, Muscles, Arterial supply, Wing, Hooded crow

## INTRODUCTION

The progress in the avian surgery increased the demand for more knowledge about the anatomy of the birds. On reviewing the available literature, there wasn't any adequate information about the skeleton of wing, muscles responsible for flight and its arterial supply in the hooded crow.

There were numerous studies on the functional morphology of the avian wing, most based on gross anatomical dissection. Few data exists on the muscles responsible for powering and controlling the wing in pigeon (Dial, 1992). The function of wing beating frequency, wing movement and wing shape varies among the avian species (Ali *et al.*, 2016; Bishop, 2005; Tobalske *et al.*, 2003; Askew *et al.* 2001; Rayner, 1985 and Nishida (1960).

The pectoralis and supracoracoideus muscles (breast muscles) were specialized to accommodate a variety of flight styles, from high frequency flapping to prolonged gliding and soaring (Rosser *et al.*, 1994). These muscles that move the wing were mainly vascularized by the pectoral trunk, which was the strongest branch of the subclavian artery (Nickel *et al*., 1977).

The skin vascularization in the head, neck, wing and feet acts as heat exchangers in birds. It helps as support for the presumed thermoregulatory role of some of these structures. Although the arterial catheterization of birds is initially a difficult technical procedure, that is considered as an ideal method used in all critically ill or anesthetized avian patients (Schnellbacher *et al.*, 2014).

The objectives of the present study was aimed to investigate the arterial blood vessels of the wing in the hooded crow to determine the blood vessels suitable for arterial puncture and also to study the skeleton of the wing with muscles that were responsible for flight.

## MATERIALS AND METHODS

The present work was conducted on twelve healthy Hooded Crow (*Corvus cornix)*. Before exsanguinations, the hooded crow was injected with heparin (Cal Heparin, 5000 I.U.) through the muscle of the thigh region. Birds were slaughtered then the wings were skinned and fleshed in two birds and immersed into boiling water for 5 min for cleaning the bones and scratched till complete cleaned. The specimen was soaked in cold water with ammonia solution for 24 hours to remove blood and making the bones white (Hildebrand; 1968). Seven birds were slaughtered and inserted catheter though the brachio-cephalic trunk for injection of latex neoprene colored red with Rottring® ink (Tompsett and Wakelly, 1965). The specimens were kept in 10% formalin 4% phenol and 1% glycerin for three days before dissection. Muscles were

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dissected from both fresh and preserved specimens for anatomical studies. Macroscopic course and distribution about arterial blood supply of the wings were studied. The other three birds injected with urograffin® for x-ray purposes. The exposure factors were 100 cm. FFD, with 15 mAs and 55 KV. The obtained results were photographed and recorded. The nomenclature used in this study was as per the Nomina Anatomica Avium (Baumel et. al., 1993).

## RESULTS

### The bones of the wing

The skeleton of the wing consisted of humerus, ulna and radius, wrist or carpus, carpometacarpus and digits (Fig. 1, 15). The humerus was the strongest and largest of the wing bones. It was flat, expanded at both ends and tubular along its shaft (Fig. 1, 2A/8). The proximal extremity carried a large ovoid head *(Caput humeri)* (Fig. 2A/1) which articulated with the glenoid articular cavity, formed by the scapula to form the shoulder joint. Also it carried a dorsal tubercle (Fig. 2A/2) situated dorsolaterally and continued as the prominent lateral tubercular crest (deltoid crest) (Fig. 2A/3) and the ventral tubercle (Fig. 2A/4) was slightly larger, aroused ventromedially and continued caudally as the bicipital crest (Fig. 2A/5). The shallow pneumatic fossa (Fig. 2A/6) was located at the caudal aspect of the humerus distal to the head and contained large pneumatic foramina (Foramen pneumaticum) (Fig. 2A/7). The distal extremity was directed caudolaterally. It comprised the ulnar and radial condyles (Fig. 2A/9, 10) for articulating with the ulna and radius to form the elbow joint. Also it carried a relatively larger ulnar epicondyle (Fig. 2A/11) and a smaller radial epicondyle (Fig. 2A/12). A short distance cranial to each epicondyle, the dorsal supracondylar tubercle (Fig. 2A/13) and the smaller ventral supracondylar tubercle (Fig. 2A/14) were situated.

Ulna and Radius constituted the bones of the forearm. The ulna was thicker and longer than the radius. The cylindrical shaft of ulna (Fig. 1, 2B/15) was distinctly curved leaving a wide interosseous space between them. Its posterior margin had small raised projections (Fig. 2B/ 15a) for the attachment of the origin of the secondary follicles of the wing feathers. The proximal thickened end of ulna carried the olecranon process (Fig. 2B/16) and had two concave articular surfaces for the condyles of the humerus and a radial articular facet (Fig. 2B/17, 18). The distal end of ulna consisted of a small cranial condyle (Fig. 2B/19) which articulated with the ulnar carpal bone and relatively large caudal condyle (Fig. 2B/20) which articulated with both ulnar and radial carpal bones.

The Radius (Fig. 1, 2B/21) was a small, rod- like bone. Its proximal extremity represented the head of the bone (*caput radii*) (Fig. 2B/22) for articulation with the radial condyle of humerus. The distal end of the radius had radiocarpal articular surface (Fig. 2B/23) for articulation with radial carpal bone.

The manus consisted of carpal bone, carpometacarpal bone and phalanges, Two carpal bones were remained unfused (two separated bone); the ulnare, (ulnar carpal bone) (Fig. 1, 3/24) was a slender bone located at the caudal aspect of the wrist region that articulated proximally with ulna while distally with the carpometacarpal bone, and the radiale (radial carpal bone) (Fig. 1, 3/25) was situated on the cranial aspect of the wrist which articulated proximally with the distal end of the radius and the ulna and distally with the carpometacarpus. The distal surface of the carpal bones became fused with the proximal end of the metacarpus formed Carpometacarpal bone. There were three digits in the wing articulating proximally with the corresponding carpometacarpal bones.

There were three carpometacarpal bones (second, third and fourth). The third carpometacarpal bone (major carpometacarpus) (Fig. 1, 3/26) was the largest and strongest of them. The second carpometacarpal bone (Fig. 1, 3/27) and the fourth carpometacarpus, (Fig. 1, 3/28) was a thin arched bone, fused together to form a single unit, Ossa digitorum manus. Between the third and fourth carpomatacarpus had a fenestra (interosseous space) (Fig. 3/29) 2 cm long by 2 mm wide.

There were three digits (Fig. 1, 3/II, III and IV) in the wing articulating proximally with the corresponding carpometacarpal bones. The second digit (II) was also called thumb or pollex consisted of one long proximal phalanx. It articulated proximally with the second carpometacarpus, the third digit (III) was the longest and strongest digit; it articulated with the distal end of the third carpometacarpus and consisted of two phalanges. The first phalanx was the larger and had thick cranial border and a sharp curved edge. The distal phalanx was in the form of a pointed cone. The fourth digit (IV), the minor digit had only one phalanx that articulated with the distal end of the fourth carpometacarpus.

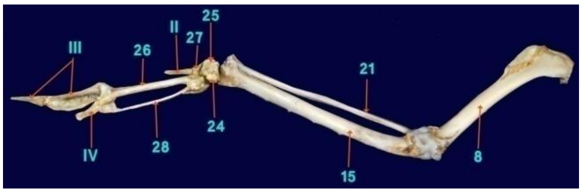


**Fig. 1:** A photograph showing the bones of left wing in hooded crow.

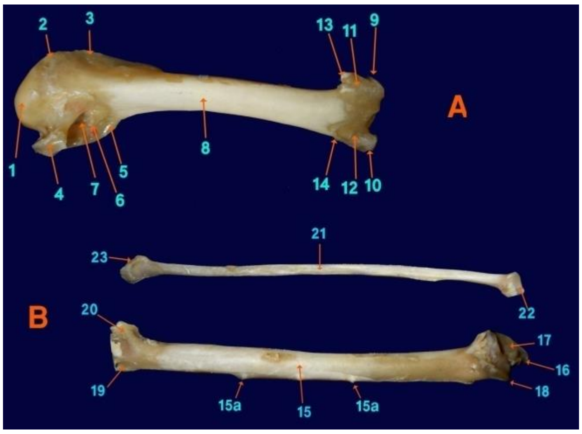


**Fig. 2:** A photograph showing bones of hooded crow. (A) The caudal surface of left humerus. (B) The ulna and radius.

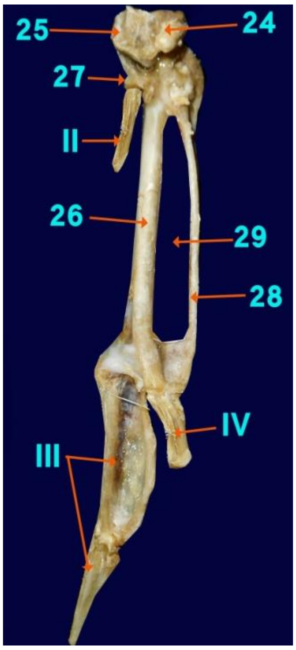


**Fig. 3:** A photograph showing the dorsal surface of left carpometacarpaus and digits of hooded crow.

**Legand from (Figures 1-3):** 1, head of humerus *(Caput humeri*) 2, dorsal tubercle 3, deltoid crest 4, ventral tubercle 5,bicipital crest 6, pneumatic fossa 7, pneumatic foramina (Foramen pneumaticum) 8,shaft of humerus 9,ulnar condyle 10, radial condyle 11, ulnar epicondyle 12, radial epicondyle 13, dorsal supracondylar tubercle 14, ventral supracondylar tubercle, 15 shaft of ulna, 15a, small projection for the origin of the secondary follicles 16, olecranon process, 17, humeral articular facet 18, radial articular facet 19, cranial condyle 20, caudal condyle 21, the radius 22, head of radius(*caput radii*) 23, radiocarpal articular surface 24, ulnar carpal bone(ulnare) 25, radial carpal bone(radiale) 26, The third carpometacarpal bone 27, The second carpometacarpal bone 28, The fourth.

**Flight musculature of the wing:**

There were two muscles based on their function in flight. Mm. pectoralis and supracoracoideus were the main downstroke and upstroke muscles for wing.

**M. pectoralis pars thoracicus (PT):** The pectoralis muscle (Fig. 4,5/PT), was the largest flight muscle in birds which considered as the main depressor of the wing. It was a broad muscle that covered ventral surface of the chest region. PT aroused from the distal edge of the sternal keel, from the lateral and caudal surfaces of the sternal body, from the lateral surface of the furcula. PT mainly inserted into the ventral surface of the deltoid crest of the humerus, but also had a connective tissue connection to the bicipital crest of the humerus.

**M. supracoracoideus (SC):** The supracoracoideus muscle (Fig. 5/SC) was a fusiform-shaped muscle, laid deeper to pectoralis on the ventral surface of the body. SC originated from the body of sternum and keel bone. The insertion of SC into the dorsal tubercle of the humerus and its tendon that inserted into the dorsal surface of the humerus was responsible for the main elevation of the wing.

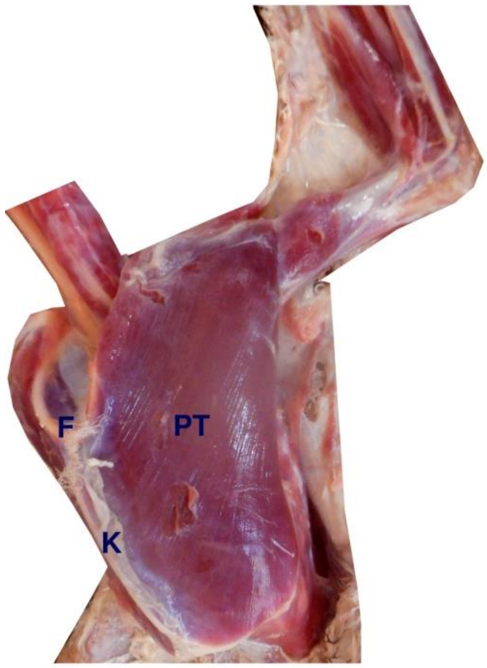


**Fig. 4:** A photograph showing the left pectoral muscle in hooded crow.

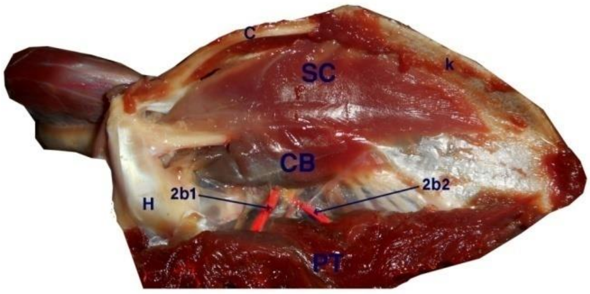


**Fig. 5:** A photograph showing the right supracracoideus muscle in hooded crow.

**Legend from (Figures 4-5):** PT, pectoralis pars thoracicus, SC ,supracoracoideus M. CB, coracobrachialis M. 2b1, cranial pectoral artery 2b2, caudal pectoral artery. C, clavicle K, the sternal keel F, frucula H,humerus.

**The arterial blood supply of the thoracic limb**

The arterial blood supply of the wing of hooded crow was mainly achieved by the axillary artery which considered as the continuation of the subclavian artery in the thoracic limb. carpometacarpal bone 29, interosseous space. II, the second digit III, the third digit IV, the fourth digit.

**A. Subclavia:** The subclavian artery (Fig. 6, 7/2) derived from the brachiocephalic trunk (Fig. 6, 7/1), as one of its terminal branches. It gave off the sternoclavicular artery, the pectoral trunk and the internal thoracic artery (Fig. 6/2a, 2b, 2c respectively) and continued along the thoracic limb as the axillary artery (Fig. 6, 7/3).

**A. Sternoclavicularis:** The sternoclavicular artery (Fig. 6/2a) originated from the subclavian artery that distributed in the supracoracoidus and the sternum.

**Truncus pectoralis:** The pectoral trunk (Fig. 6/2b) detached from the subclavian artery and accompanied with the pectoral vein and nerve. It supplied mainly to the pectoral muscles. It branched into the cranial pectoral (Fig. 5/2b1) and caudal pectoral (Fig. 5/2b2) arteries, which distributed to the pectoralis and supracoracoideus.

**A. Axillaris:** The axillary artery (Fig. 6, 7, 8/3) was considered as the direct continuation of the subclavian artery in the thoracic limb. It passed craniodorsally with the axillary vein and crossed the brachial plexus, then gave off three branches; the supracoracoid artery (Fig. 7/4) to the supracoracoideus. The subscapular artery (Fig. 7/5) detached 2-4 branches to the medial head of the subscapularis. The axillary artery passed laterally, leaving the thoracoabdominal cavity to enter the axilla. The axillary artery gave third branch; the deep brachial artery (Fig. 7/6) then terminated as the brachial artery (Fig. 7/7).

**A. Profunda brachii:** The deep brachial artery (Fig. 7, 8, 9 /6) was aroused from the axillary artery at the proximal end of the arm region and descended in company with the radial nerve. It gave off the dorsal circumflex humeral artery (Fig. 8/6a) then bifurcated into collateral ulnar (Fig. 8, 11/6b) and collateral radial branches (Fig. 8/6c).

**A. Circumflexa dorsalis humeri:** The dorsal circumflex humeral artery (Fig. 8/6a.); gave off three branches to supply the proximal muscles of the arm (deltoideus major, deltoideus minor, scapulotriceps and humerotriceps) and shoulder joint.

**A. Collateralis ulnaris:** The collateral ulnar artery (Fig. 8, 11/6b); aroused from the deep brachial artery between the scapulotriceps and humerotriceps. It passes caudally and distally to appear at the ventral aspect of the arm region. It gave off about several branches to supply these muscles and the elbow region. The collateral ulnar artery communicated with the recurrent ulnar artery at the elbow joint.

**A. Collateralis radialis:** The collateral radial artery (Fig. 8/6c) was considered as the direct continuation of the deep brachial artery. It passed between the scapulotriceps and deltoideus major with the radial nerve then appeared on the dorsal aspect of the arm region. It supplied the **Ulnaris**: extensor carpi radialis, and also it gave off cutaneous branches to the skin of the forearm region and articular branches to the elbow joint.

**A. Brachialis:** The brachial artery (Fig. 7, 8, 9, 10, 12, 13/7) was the continuation of the axillary artery along the arm region. It passed distally over the medial aspect of the head of the humerus, between the biceps and triceps muscles. It gave off the bicipital artery (Fig. 7, 8, 9/8) to the biceps brachii and several cutaneous branches to the skin of the arm. The brachial artery was divided into two branches at the level proximal o the elbow joint; the larger ulnar and smaller radial arteries.

**A.** The ulnar artery (Fig. 8, 9, 10, 13/9); aroused from the brachial artery with the radial artery on the deep face of the biceps brachii. The ulnar artery located at the caudo-ventral aspect of the antebrachium and manus for supplying the surrounding muscles and skin to the level of the metacarpophalangeal joint of the minor digit. It gave off a recurrent ulnar artery (Fig. 10, 12/16) which supplied the flexor carpi ulnaris and united with a branch from the collateral ulnar artery. The ulnar artery continued distally till enter the carpal region between the ulnar and radial carpal bones, it gave off three branches; the artery of the pollex (Fig. 10, 12, 13/17), the articular branch (Fig. 10 /18) to carpal joint and the ventral metacarpal artery (Fig. 12 /19), the latter passed in the carpometacarpal space between the shafts of carpometacarpal bones III and IV and gave off the superficial branch (Fig. 12/19a) passed along the third carpometacarpal bone and at the level of digit III, which supplied the feather follicles attached to the digits.

**A. Radialis:** The radial artery (Fig. 8, 9, 10, 12, 13/10); detached from the brachial artery that passed on cranio-dorsal aspect of the antebrachium and manus, including the claw of the major digit to supply the muscle, skin and feathers. It gave off two branches; the superficial radial artery (Fig. 9, 10, 11, 12/11) along the ventromedial border of the extensor carpi radialis and it continued in the forearm as the deep radial artery. The deep radial artery (Fig. 9, 10, 11/12) lied just between the tendons of the extensor digitorum longus and the flexor digitorum profundus. It gave the recurrent radial artery (Fig. 10/13) at the level of the elbow joint that anatomized with the branch of the deep brachial artery. Also it gave off the dorsal interosseous artery (Fig. 10/14) to the space between radius and ulna. The deep radial artery passed dorsally through the radio-ulnar interosseous space and supplied the extensor muscle of antibrachium region. It gave the dorsal metacarpal artery (Fig. 11/15) at the carpal joint that sand smaller branches to the extensor muscles, skin of the forearm region and to the follicles of flight feathers attached to the ulna.

## DISCUSSION

The present investigation revealed that the humerus was the strongest and largest of the wing bones. It was flat at both ends and tubular along its shaft and it is the proximal extremity contained dorsal and ventral tubercles as well as the head which is medially directed. In addition, the cranial surface of humerus carries the deltoid crest at its most proximal part similar to (Ali *et al*., 2016, Tahon *et al*., 2013, Dyce *et al.*, 2010, Baumel *et al.*, 1993 and Nickel *et al*., 1977).

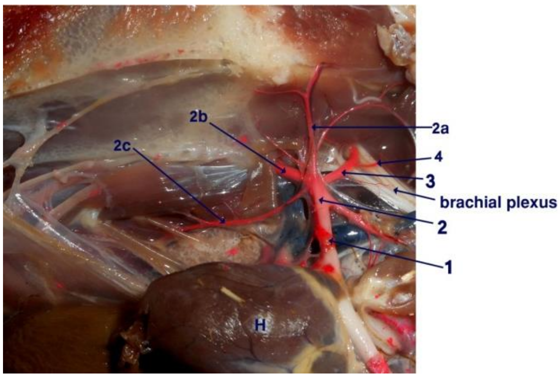


**Fig. 6:** A photograph showing the branches of the subclavian artery.

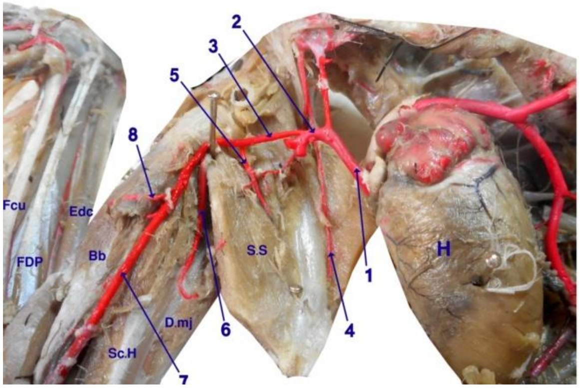


**Fig. 7:** A photograph showing the origin of the subclavian artery from the brachiocephalic trunk and branches of theaxillary artery in the right wing(ventral view)

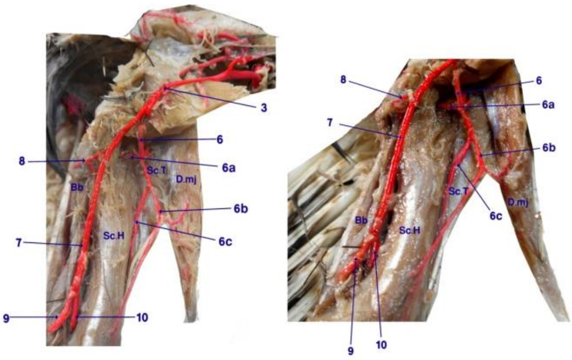


**Fig. 8:** A photograph showing the branches of deep brachial artery in the right wing (ventral view).

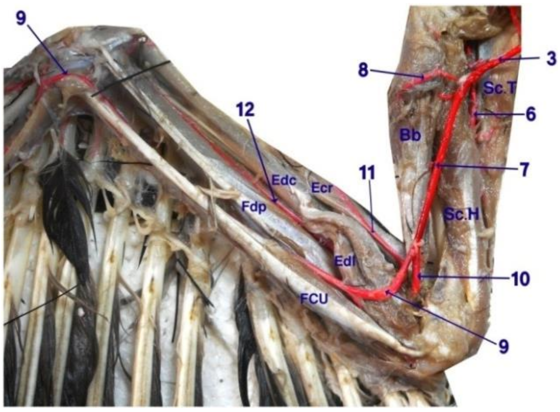


**Fig. 9:** A photograph showing the branches of brachial artery in the right wing (ventral view).

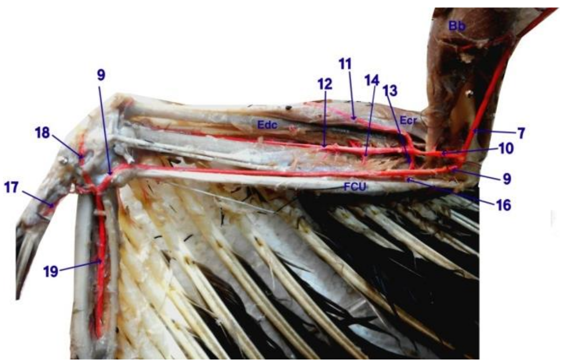


**Fig. 10:** A photograph showing the branches of the radial and ulnar arteries in the right wing(ventral view).

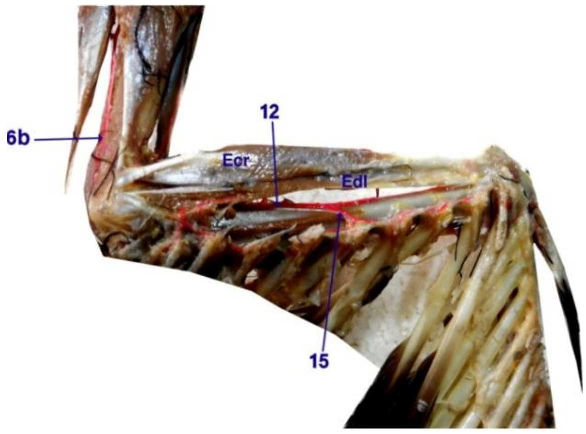


**Fig. 11:** A photograph showing the dorsal metacarpal artery in the right wing (dorsal view).

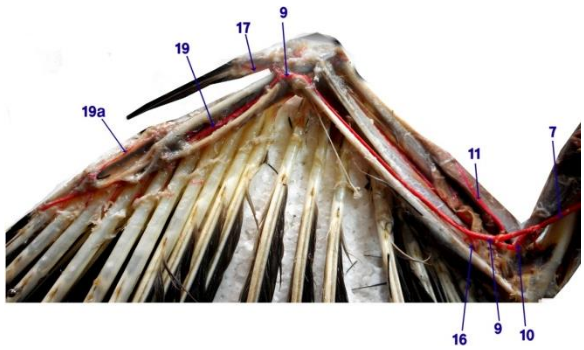


**Fig. 12:** A photograph showing the ulnar artery in the right wing (ventral view).

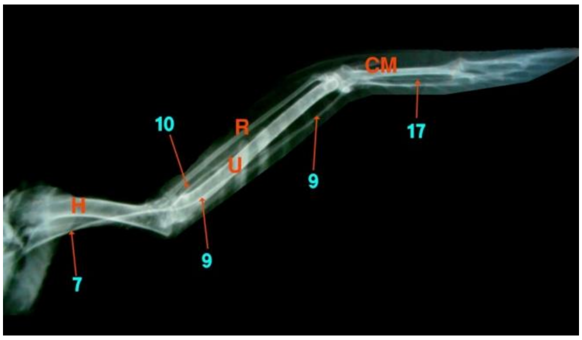


**Fig. 13:** A radiograph showing the arteries in the left wing of hooded crow.

**Legend from (Figures 8 to 13):** 1.Brachiocephalic a. 2. Subclavian a. (2a. sternoclavicular artery 2b. pectoral trunk 2c. internal thoracic artery) 3. Axillary a. 4. Supracrocoid a. 5. Subscapular a. 6. deep brachial a. 6a. dorsal circumflex humeral a. 6b. collateral ulnar a. 6c. collateral radial a. 7. Brachial a. 8. Bicepital a. 9. ulnar a. 10. Radial a. 11. superficial radial a. 12. deep radial a. 13. Recurrent radial a. 14. Dorsal interosseous a. 15. Dorsal metacarpal a. 16. recurrent ulnar a. 17. Artery of polex 18. Articular branch 19. Ventral metacarpal a. 19a. superficial branch.

**Muscle:** S.S- Subscapularis Sc. H-Scapulohumeral B. b-Biceps brachii Sc.T.-Scapulotriceps E.c.r-Extensor carpi radialis E.d.c-Extensor digitorium communis E.d,l-Extensor digitorium longus. F.d.p- Flexor digitorium profundus F.c.u- Flexor carpi ulnaris.

The present study was as well as those of (Ali *et al*., 2016, Tahon *et al*., 2013 and Baumel *et al.,* 1993) revealed that the shallow pneumatic fossa was located at the caudal aspect of the humerus distal to the head and contained large pneumatic foramina (Foramen pneumaticum). On the other hand, *Baumel et al.* (1993) mentioned that the pneumatic foramen is not found in the humeri of all birds.

In agreement with (Ali *et al*., 2016 and Tahon *et al*., 2013) the description of ulna was thicker and longer than radius. The cylindrical shaft of ulna was distinctly curved leaving a wide interosseous space between it and the radius. Its posterior margin had small raised projections for the attachment of the origin of the secondary follicles of the wing feathers.

In accordance with (Ali *et al*., 2016 and Tahon *et al*., 2013 and Hinchliffe, 1985) the carpal bones were the radiale (*os carpi radiale)* and the ulnare *(os carpi ulnare)*, while the remaining carpals are fused with the proximal ends of the metacarpals, forming the carpometacarpus.

Similar to the observations of (Ali *et al*., 2016 and Tahon *et al*., 2013, Akers and Denbow 2008) the Carpometacarpal bones are composed from three metacarpal bones fused with the distal carpal bones.

The present study as well as those of (Tahon *et al*., 2013, *Hinchliffe 1985* and *Muller and Alberch, 1990)* revealed that the carpometacarpal bones are three bones; Second (II), third (III) and fourth (IV) carpometacarpal bones. This result disagreed with *Nickel et al. (1977)* who mentioned that the carpometacarpal bones are the first (I), the second (II), the third (III) carpometacarpal bones.

Our observation revealed that the digits of wing are composed of; the second digit (II), the third digit (III), and the fourth digit (IV) that statement similar to (Tahon *et al*., 2013, Muller and Alberch 1990 and Hinchliffe *1985).* This result disagreed with (*Ostrom* 1979 and *Nickel et al.* 1977) as they mentioned that the three digits of the wing are the first digit (I), the second digit (II), and the third digit (III).

**Muscle of flight in wing**

There were two muscles based on their function in flight. Mm. pectoralis and supracoracoideus were the main downstroke and upstroke muscles respectively for wing that was selected due to their anatomical orientation. Muscles were described relative to the avian anatomical position (Askew, *et al*., 2001; Kovacs and Meyers, 2000, and Baumel *et al*., 1993).

Regarding to (Biewener, 2011, Kovacs and Meyers 2000, Dial *et al*., 1997 and Dial and Biewener, 1993), The pectoralis musclewas the largest flight muscle in birds which considered as the main depressor of the wing. It was a broad muscle that covered ventral surface of the chest region. PT aroused from the distal edge of the sternal keel, from the lateral and caudal surfaces of the sternal body, from the lateral surface of the furcula. PT mainly inserted into the ventral surface of the pectoral crest of the humerus.

The present study reported that the supracoracoideus muscle was a fusiform-shaped muscle, laid deep to the pectoralis on the ventral surface of the body. SC originated from the body of sternum and the keel bone. The insertion of SC into the dorsal tubercle of the humerus and its tendon that inserted into the dorsal surface of the humerus.it was responsible for the main elevation of the wing that statement agreement with (Kovacs and Meyers 2000 and Poore *et al*., 1997).

**The arterial vasculature of the wing**

Regarding the arterial vasculature of the wing, the present investigation as well as given by (Ali *et al*., 2016 in chickens, ducks and pigeons; El-Bably and Rezk, 2014 in domestic fowl; Petneházy *et al*., 2005 in the pigeon; Gadhoke *et al*., 1975 in domestic turkey and Nickel *et al*., 1977 in domestic birds) agreed that the blood supply and the distribution of blood vessel to the wing of hooded crow was mainly achieved by the axillary artery which considered as the continuation of the subclavian artery in the thoracic limb.

The present study revealed that, the subclavian artery derived from the brachiocephalic trunk, this finding was confirmed by Ali *et al*. (2016), El-Bably and Rezk, (2014), Dyce *et al*., (2010), Petneházy *et al.* (2005), Baumel *et al*. (1993), Mclelland (1990), Bezuidenhout and Coetzer, (1986) in ostrich and by Gobeil (1970) in herring gull.

The axillary artery was considered a direct continuation of the subclavian artery. It gave off three branches; the supracoracoid artery to the supracoracoideus, the subscapular artery which detached 2-4 branches to the medial head of the subscapularis and the subcoracoideus and the deep brachial artery then continued as the brachial artery. This result was in accordance with Ali *et al*. (2016), El-Bably and Rezk, (2014), Dyce *et al.* (2010), Petneházy *et al.* (2005), Baumel *et al.* (1993), Bezuidenhout and Coetzer, (1986) and Nickel *et al.* (1977).

In agreement with the description of (El-Bably and Rezk, 2014; Bezuidenhout and Coetzer, 1986 and Nickel *et al*., 1977), the deep brachial artery was aroused from the axillary artery at the proximal end of the brachium region. It gave off the dorsal circumflex humeral artery then bifurcated into collateral ulnar and collateral radial branches**.** But the last two arteries were not recorded in the results of Ghetei (1976) in birds.

The deep brachial artery or its branches, the radial and ulnar collateral arteries anastomosed at or just distally to the elbow with the brachial artery or its branches, the radial and ulnar arteries. Bezuidenhout and Coetzer, (1986). In the ostrich, observed that no anastomoses between branches of the deep brachial and brachial arteries could be demonstrated.

The present work recorded that the brachial artery was the continuation of the axillary artery along the arm region. It passed distally over the medial aspect of the head of the humerus, between the biceps and triceps muscles. It gave off bicipital arteryto the biceps brachii and several cutaneous branches to the skin of the arm. The brachial artery was divided into two branches at the level proximal o the elbow joint; the larger ulnar and smaller radial arteries. That similar to (Ali *et al.,* 2016; El-Bably and Rezk, 2014; Petneházy *et al*., 2005, Baumel *et al*., 1993 and Bezuidenhout and Coetzer, 1986).

Our observation in this study revealed that the ulnar artery aroused from the brachial artery with the radial artery on the deep face of the biceps brachii. The ulnar artery located at the caudo-medial aspect of the antebrachium and manus for supplying the surrounding muscles and skin to the level of the metacarpophalangeal joint of the minor digit. It gave off a recurrent ulnar artery which supplied the flexor carpi ulnaris and united with a branch from the collateral ulnar artery. The ulnar artery continued distally between flexor carpi ulnaris and ectepicondylo-ulnaris along the ventral aspect of the forearm region, to enter the carpal region between the ulnar and radial carpal bones, it gave off artery of the pollex and ventral metacarpal artery (fig), the latter passed between the proximal extremity of the III and IV carpometacarpal bones and gave off superficial branch and proceeded in the carpometacarpal space between the shafts of carpometacarpal bones III and IV. The superficial branch passed along the third carpometacarpal bone and at the level of digit III, which supplied the feather follicles attached to the digits. This was in the same line with the observation of (Ali *et al.,* 2016; El-Bably and Rezk, 2014; Petneházy et, al., 2005; Baumel *et al*., 1993 and Nickel *et al*., 1977).

The radial artery detached from the brachial artery that passed cranio-laterally aspect of the antebrachium and manus, including the claw of the major digit to supply the muscle, skin and feathers.It gave off two branches; the superficial radial artery and the deep radial artery. Our results were the same as reported by (El-Bably and Rezk, 2014; Petneházy et, al., 2005 and Baumel *et al*., 1993).

The deep radial artery lied just between the tendons of the extensor digitorum longus and the flexor digitorum profundus. It gave the recurrent radial artery at the level of the elbow joint that anatomized with the branch of the deep brachial artery. Also it gave off the dorsal interosseous artery to the space between radius and ulna. The deep radial artery passed dorsally through the radio-ulnar interosseous space and supplied the extensor muscle of antibrachium region. It gave the dorsal metacarpal artery at the carpal joint. The same result mentioned by (Ali *et al.,* 2016 and El-Bably and Rezk, 2014).

According to Baumel *et al.,* (1993), Cralley (1965), Gadhoke *et al.,* (1975), Gobeil (1970) and Nishida (1960), the main blood supply to the antebrachium and manus comes from the ulnar artery and its branches. (Schnellbacher, *et al.,* 2014; Tegtmeyer *et al.,* 2006; Mazzaferro, 2004 and Smith *et al.,* 1994) reported that the best site for arteriopuncture was the brachial artery, where it passed over the ventral aspect of the head of the humerus. In this position there were no structures that could be damaged. The superficial ulnar artery lied medially over the extensor metacarpi radialis, pronator superficialis, and pronator profundus muscles before dipping along the ulna and crossing the carpus to insert into the base of the distal phalanx of the major digit. Moreover, the deep radial artery lies just between the tendons of the extensor digitorum longus and the flexor digitorum profundus Catheter placement should occur where the artery is most superficial at the ulnar carpal bone or at the distal head of the ulna. At this location, the deep radial artery can be readily found and palpated on the medial side of the wing. This was in line with the present study.

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