

Comparative osteometric difference in ulna and radius of commercial layer and desi chicken

Waseem Ali Vistro¹, Illahi Bux Kalhoro², Muhammad Ghiasudin Shah²,
Muhammad Farooq Laghari², Imran Tarique¹, Nisar Ahmed³, Yifei Liu¹

¹Nanjing Agricultural University, Nanjing Jiangsu China.

²department of anatomy and histology, faculty of animal husbandry and veterinary sciences, Sindh agriculture university tandojam, Pakistan.

³Faculty of Veterinary and Animal Sciences, LUAWMS, Uthal, 90150, Pakistan

Corresponding Author: Waseem Ali Vistro

Abstract: Anatomically the ulna and radius of both birds are long type bones, consists of shaft and two extremities (proximal and distal). The proximal extremity of ulna and radius of commercial layer is more thicker than desi birds. The shaft of both bones of commercial layer is more thicker but less smooth than desi birds. The distal extremity of both bones of commercial layer is thick and wider than desi birds. The biometrical studies of ulna and radius of layer and desi birds includes, the length and width of proximal extremity of ulna were shown significant difference ($p < 0.05$). On the other hand the circumference of proximal extremity of ulna of birds were highly significant ($p < 0.01$). The length and width of distal extremity of ulna and were shown significant difference ($p < 0.05$). Similarly the circumference of distal extremity of ulna was highly significant ($p < 0.01$). However the significant difference was observed in the width of shaft of ulna. The length and circumference of shaft of ulna were highly significant ($p < 0.01$). The width of proximal extremity of radius was shown no difference. The length of proximal extremity of radius was significantly different ($p < 0.05$). Circumference of radius were highly significant ($p < 0.01$). The circumference of distal extremity of radius was shown no difference. The length and width of distal extremity of radius were shown highly significant difference ($p < 0.01$). However non-significant differences was observed in width and circumference of shaft of radius but extremely significant difference in length.

Key words: Morphological, Osteometric difference, Ulna and Radius, Commercial layer, Desi chicken.

Date of Submission: 22-08-2018

Date of acceptance: 04-09-2018

I. Introduction.

In Pakistan, poultry production is one of the most dynamic and well organized sectors contributing 26.8%, 5.76% and 1.26% respectively to total meat production, agricultural sector and overall GDP. In the last few years, the poultry sector has shown excellent growth and has emerged as a source of employment for more than 1.5 million people¹.

Forelimbs of the avian species have been adapted to function as wings. This long time evolution had dramatic morphological changes on the bones of the forelimbs in avian species as compared to those of other tetrapoda. Characteristics of the bones of the forelimbs in domestic avian species have long been observed by the researchers and documented in literature reports and textbooks^{2, 3, 4, 5}.

The two bones of the forearm are the ulna -the thicker and longer, and the radius that lies laterally to the ulna. The ulna and radius contain between them a large space called the interosseous space⁶. The ulna of Pariah kite was considerable larger than radius but approximately of same length. The proximal extremity of the ulna articulated with radius and distal extremity of humerus. Proximal extremity was larger than distal of ulna. Proximal extremity of ulna had a concave surface for articulation with large condyle of humerus, and an extension called olecranon⁷. As stated by Getty⁸, the ulna had a nutrient foramen in lower part of upper one third of the shaft. The outer surface of the shaft had a series of small bony projections which represented points of attachment for secondary feathers of wing. Distally ulna had two articular areas or facets for articulation with radial and ulnar carpal.

The radius of Pariah kite was smaller and thinner than the ulna. Both the bones were separated by wide interosseous space proximally and narrow space distally. The outer surface of the shaft had a series of small bony projections which represented points of attachment for secondary feathers of wing. The radius was smaller and thinner than the ulna. The proximal extremity of radius articulated with ulna and distal extremity of humerus. The proximal end of radius has an articular facet which articulated with smaller of the humeral

condyle. Both the extremity was of same size. The distal extremity articulated with radial carpal and distal extremity of ulna with a facet. The shaft was flattened in its upper one fourth part and cylindrical below. Both the bones were separated by wide interosseous space proximally and narrow space distally. The length and circumference of radius was 13.20 cm and circumference: 1.10 cm⁷.

II. Materials and Methods:

Immediately after slaughter the wing bones of birds were separated with knife, removed muscles, tendons, ligaments and other soft tissues with the help of scalpel. Physical examine the wings at the point where it was removed from the body of bird. Cut was made until reach the shoulder to elbow joints. Then rinsed the wing bone (Ulna and Radius) in running water, Then they were soaked in hot 10% potassium hydroxide for 5 days. Samples of the commercial layer and desi chicken with no gross anatomical lesions were obtained for further studies. Total 80 bones samples from both groups of birds were measured for following comparative gross anatomical structures and biometrical observations. The measurements were taken in (mm)

III. Data Analysis

The length, width and circumference expressed as mean \pm SD (Standard Deviation) were analyzed statistically using Statistical Package for Social Sciences (SPSS) version 17.0. For the paired samples t-test 95 and 99% confidence interval we used to determine the level of significant difference between two species of chicken.

IV. Results and Discussion

A comparative anatomical study on the Ulna and Radius of commercial layer chicken and desi chicken were conducted.

1. Ulna

The ulna of both birds is long type bone, consists of shaft and two extremities (proximal and distal). The proximal extremity of ulna of commercial layer is more thicker than desi birds (Plate -1). The shaft of ulna of commercial layer is more thicker but less smooth than desi birds (Plate -2). The distal extremity of ulna of commercial layer is thick and wider than desi birds (Plate -3).

2. Radius

The radius is long type of the bone and also consists of shaft and two extremities (proximal and distal). The proximal extremity of radius of commercial layer is broad but narrow in desi bird (Plate-4). The shaft of radius commercial layer is thick but thin in desi bird (Plate-5). The distal extremity of radius of commercial layer is broad but narrow in desi bird (Plate-6).



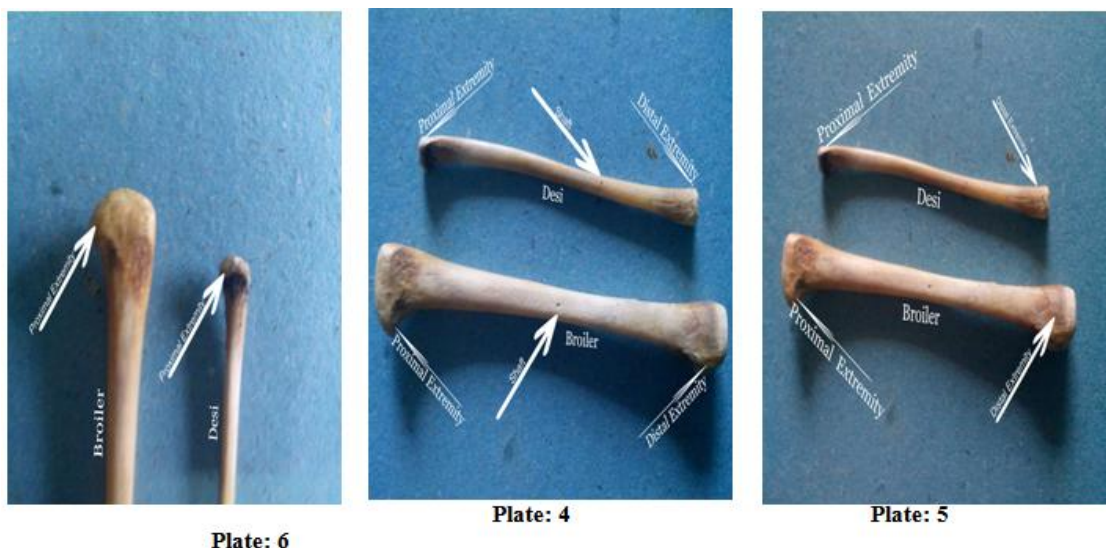
Plate: 1



Plate: 2



Plate: 3



1) Proximal extremity of the ulna

The values for mean ± SD for length, width and circumference of proximal extremity of ulna of commercial layer and desi bird are presented in Table No.1 The data for comparison proximal extremity of right ulna was further statistically analysed which shows significant differences in length and width but extremely significant difference was observed in circumference between two variables.

Table No. 1 Mean ±SD values of proximal extremity ulna of layer and desi birds

Parameter	Layer		Desi Bird	
	Min-Max	Mean±SD	Min-Max	Mean±SD
Length	7.0-15.0	12.7±2.79	7.0-12.0	9.7±1.49*
Width	6.0-11.0	8.0±1.63	4.0-6.0	5.5±0.85*
Circumference	21.0-40.0	31.4±6.54	21.0-24.0	22.6±0.97***

2) Distal extremity of the ulna

Table No. 2. The data for comparison distal extremity of right ulna was further statistically analyzed which shows significant differences in length and width but extremely significant difference was observed in circumference between two variables.

Table No. 2 Mean ±SD values of distal extremity of ulna of layer and desi birds

Parameter	Layer		Desi Bird	
	Min-Max	Mean±SD	Min-Max	Mean±SD
Length	10.0-16.0	13.5±1.90	9.0-12.0	10.5±0.97*
Width	7.0-11.0	9.5±1.58	3.0-8.0	6.5±0.70*
Circumference	23.0-39.0	32.2±5.43	24.0-26.0	24.9±0.57***

3) Shaft of the ulna

Table No. 3. The data for comparison shaft of right ulna was further statistically analyzed which shows significant differences in width, very significant in length and circumference between two variables.

Table No. 3 Mean ±SD values of shaft of ulna of layer and desi birds

Parameter	Layer		Desi Bird	
	Min-Max	Mean±SD	Min-Max	Mean±SD
Length	50.0-69.0	69.0±5.76	54.0-61.0	56.8±2.15**
Width	5.0-8.0	7.3±1.06	4.0-6.0	5.1±0.57*
Circumference	15.0-26.0	20.7±2.90	15.0-18.0	15.8±1.03***

4) Proximal extremity of the radius

Table No. 4. The data for comparison proximal extremity of radius was further statistically analysed which shows non quite significant difference in width, significant in length and extremely significant difference in the circumference between two variables.

Table No. 4 Mean \pm SD values of proximal extremity of radius of layer and desi birds

Parameter	Layer		Desi Bird	
	Min-Max	Mean \pm SD	Min-Max	Mean \pm SD
Length	6.0-13.0	9.2 \pm 2.30	5.0-8.0	6.1 \pm 0.99*
Width	3.0-6.0	4.7 \pm 1.33	2.0-4.0	2.5 \pm 0.85 ^{NS}
Circumference	15.0-25.0	20.5 \pm 3.71	14.0-18.0	15.3 \pm 1.16***

5) Distal extremity of the radius

Table No. 5. The data for comparison distal extremity of radius was further statistically analysed which shows non quite significant difference in circumference, and very significant difference in length and width between two variables.

Table No. 5 Mean \pm SD values of distal extremity of radius of layer and desi birds.

Parameter	Layer		Desi Bird	
	Min-Max	Mean \pm SD	Min-Max	Mean \pm SD
Length	6.0-11.0	8.4 \pm 1.50	4.0-6.0	5.2 \pm 0.63**
Width	4.0-8.0	5.7 \pm 1.25	3.0-5.0	4.0 \pm 0.47**
Circumference	15.0-25.0	22.0 \pm 4.42	10.0-17.0	14.6 \pm 0.50 ^{NS}

6) Shaft of the radius

Table No. 6. The data for comparison shaft of radius was further statistically analysed which shows non-significant differences in width and circumference but extremely significant difference in length between two variables.

Table No. 6 Mean \pm SD values of shaft of radius of layer and desi birds

Parameter	Layer		Desi Bird	
	Min-Max	Mean \pm SD	Min-Max	Mean \pm SD
Length	50-68	59.5 \pm 6.31	52.0-58.0	54 \pm 1.70***
Width	3.0-6.0	4.5 \pm 1.08	2.0-5.0	2.7 \pm 0.95 ^{NS}
Circumference	12.0-18.0	14.6 \pm 1.71	10.0-15.0	11.3 \pm 1.77 ^{NS}

V. Discussion.

In the present study the shaft of ulna of commercial layer is thick but thin in desi bird. Previous research reported that the outer surface of the shaft of ulna had a series of small bony projections which represented points of attachment for secondary feathers of wing⁸.

In the present study the nutrient foramen is present on medial surface of the shaft of ulna of commercial layer and desi bird. Previously reported that the ulna has a nutrient foramen in lower part of upper one third of shaft⁷.

In the present study the distal extremity of ulna of commercial layer is broad but narrow in desi bird. Previous research reported that the distally ulna has two articular areas or facets for articulation with radial and ulnar carpal bones⁷.

In the present the radius is long type of the bone and also consists of shaft and two extremities (proximal and distal) of commercial layer and desi birds. Previous research reported that the radius is smaller (length: 13.20 cm) and thinner (circumference: 1.10 cm) than the ulna⁹. Shaft is flattened in its upper one fourth part and cylindrical below⁷.

In the present study the proximal extremity of radius of commercial layer is broad but narrow in desi bird. Previous report said that the proximal extremity of radius articulated with ulna and distal extremity of humerus. The proximal end of radius has an articular facet which articulated with smaller of the humeral condyle. In the present study the shaft of radius commercial layer is thick but thin in desi bird. In the present study the distal extremity of radius of commercial layer is broad but narrow in desi bird. Tiwari et al. 2011; reported that both the extremities were of same size. The distal extremity articulated with radial carpal bone and distal extremity of ulna with a facet. Both the bones were separated by wide interosseous space proximally and narrow space distally⁷.

Previously studied gross morphometry of the fore limb or pectoral limb of Pariah kite (*Milvus migrans*). The pectoral limb of Pariah kite was comprised of following bones; radius and ulna, carpals, carpometacarpus and digits. The radius was smaller and thinner than the ulna. Both the bones were separated by wide interosseous space proximally and narrow space distally. The outer surface of the shaft had a series of small bony projections which represented points of attachment for secondary feathers of wing⁷.

In the present study the mean for length, width and circumference of proximal extremity of right ulna of commercial layer and desi bird was 12.7 \pm 2.79, 8.0 \pm 1.63 and 31.4 \pm 6.54; and 9.7 \pm 1.49, 5.5 \pm 0.85 and 22.6 \pm 0.97 respectively.

In the present study the data for mean length, width and circumference of proximal extremity of ulna of commercial layer and desi bird was significant differences in length and width but extremely significant difference was observed in circumference. In previous report mean width of proximal extremity of ulna of adult male and female duck was 15.0 ± 0.9 and 14.0 ± 0.5 mm respectively¹⁰.

In the present study the data for mean length, width and circumference of distal extremity of ulna of commercial layer and desi bird was significant differences in length and width but extremely significant difference was observed in circumference. In previous report mean width of distal extremity of radius of adult male and female duck was 11.3 ± 1.0 and 11.0 ± 1.2 mm respectively¹⁰.

In the present study the data for mean length, width and circumference of distal extremity of ulna of commercial layer and desi bird was significant differences in width, very significant in length and extremely significant difference was observed in circumference. In previous report in the domestic ducks these are the bones in the shape of a bow insignificantly longer and much thicker than radius. The maximum length of the mentioned bone in the adult males and females was respectively 102,4 and 100,1 mm and the difference was not significant ($p>0,05$). The maximum width of the shaft (7.3 mm) as well width of the caudal end of ulna (11.3 mm) was also insignificantly greater for group of the males duck. On the other hand the maximum width of the cranial end of ulna was significantly greater in the adult males than in females (tab.2). There was statistically significant difference in the length of ulna between immature and adult males which was estimated as 14.1 mm. The length of mentioned bone in immature males was also shorter than in females of that age group (90.7 mm). The minimum width of the shaft (6.1 mm) as well as width of the caudal end of ulna (10,1 mm) was insignificantly greater in immature males while the width of the cranial end of mentioned bone was greater in immature females (tab. 2). In the immature ducks olecranon as well as placed in the caudal end of ulna anconeal process and their structures were hardly visible¹⁰.

In the present study the mean for length, width and circumference of shaft of ulna of commercial layer and desi bird was 69.0 ± 5.76 , 7.3 ± 1.06 and 20.7 ± 2.90 ; and 56.8 ± 2.15 , 5.1 ± 0.57 and 15.8 ± 1.03 respectively. In previous research determined lengths of ulna of layer 6 week was 73.9 mm¹¹.

In the present study the data for mean length, width and circumference of shaft of ulna of commercial layer and desi bird was significant differences in width, very significant in length and circumference. In previous report mean length of shaft of ulna of adult male and female duck was 102.4 ± 2.1 and 100.1 ± 3.0 mm respectively¹⁰.

In the present study the mean for length, width and circumference of proximal extremity of radius of commercial layer and desi bird was 9.2 ± 2.30 , 4.7 ± 1.33 and 20.5 ± 3.71 ; and 6.1 ± 0.99 , 2.5 ± 0.85 and 15.3 ± 1.16 respectively. In previous report the length: 13.20 cm and circumference of 1.10 cm of radius⁹.

In the present study the data for mean length, width and circumference of proximal extremity of radius of commercial layer and desi bird was not quite significant difference in width, significant in length and extremely significant difference in the circumference. Shows not quite significant difference in width, significant in length and extremely significant difference in the circumference. In previous report the maximum length of the radius in the adult male ducks (94,9 mm) was greater almost 4 mm than in adult females ($p>0,05$). The minimum width of the shaft of radius (4 mm) was also similar for both sex groups of the ducks. The width of the cranial and caudal end of radius was respectively significantly greater in the adult males than in females, mean width of proximal extremity of radius of adult male and female duck was 6.9 ± 0.5 and 6.0 ± 0.4 mm respectively¹⁰.

In the present study the data for mean length, width and circumference of distal extremity of radius of commercial layer and desi bird was not quite significant difference in circumference, and very significant difference in length and width. In previous report mean width of distal extremity of radius of adult male and female duck was 9.4 ± 0.6 and 9.0 ± 0.3 mm respectively¹⁰.

In the present study the data for mean length, width and circumference of shaft of radius of commercial layer and desi bird was not significant differences in width and circumference but extremely significant difference in length. In previous report mean length of shaft of radius of adult male and female duck was 94.9 ± 2.1 and 91.0 ± 13.59 mm respectively¹⁰.

In the present study the data for mean length, width and circumference of shaft of radius of commercial layer and desi bird was a not significant difference in circumference, not quite significant difference in width and extremely significant difference in length. Parallel values of that bone in the research was slightly lower and the mean value in immature and adult ducks was respectively 80.0 and 91.5 mm. The mean values of maximum length of ulna shaft in both analyzed age group of domestic ducks was in like manner. There were estimated, for mature and immature birds, respective quality of ulna length, 101.2 and 89.5 mm. On the other hand the respective values in the mentioned elaboration was 86.2 mm for immature ducks and 100.4 mm for adult birds¹².

VI. Conclusion

In view of above findings it is concluded that anatomically proximal and distal wing bones (ulna and radius) of layer and desi birds showed major difference in structure of bones. Biometrically, commercial layer possesses longer bones as compared with desi birds.

References

- [1]. GOP (Government of Pakistan) Economic Survey of Pakistan, Ministry of finance, Government of Pakistan. 2014
- [2]. Nickel R, Schummer A, Seiferle E. The Skin Anatomy of the Domestic Birds. Berlin: Verlag Paul Parey, 1977: 14- 15.
- [3]. King AS, McLelland J. Birds, Their Structure and Function, 2nd ed. London: Bailliere Tindall, 1984: 58-60.
- [4]. Hifny A, Abdalla KEH, Alam El-Din MA. Relation of the length of the main bones of the wing and pelvic limb to the mode of locomotion in certain birds. Accepted and discussed. Proc. of XVII Kongress. European Association of Veterinary anatomists, 1988; 28: 8-19.
- [5]. Abdel-Moneim ME. Role of the bones of the wing and pelvic limb of quails in its mode of locomotion. Assuit Vet Med J1992; 27:1-11.
- [6]. Wilson, L.W, (1980). "Birds" Freeman, Ed. San Francisco.
- [7]. Tiwari, Y., A. Pandey, A. B. Shrivastav, M. P. S. Tomar and R. Vaish, (2011). Gross Morphometrical Studies on Pectoral Limb of Pariah Kite (*Milvus migrans*). Annual Review & Research in Biology. 1(4): 111-116.
- [8]. Getty, R, (1975). Sisson and Grossman's the Anatomy of the Domestic Animals-II.5th edn. Publ., the Macmillan Co. of India Ltd., pp. 1790-1801.
- [9]. Mayr, G., C. Mourer-Chauvire and I. Weidig. (2004). Osteology and Systematic Position of the Eocene Primobucconidae (Aves, Coraciiformes *Sensu Stricto*), with first records from Europe. Jr of Sys Palaentol., 2(1):1-12.
- [10]. Charuta, A., B.J. Bartyze, M. Karbowicz and H. Kobryń, (2005). Morphology and morphometry of the antebrachial skeleton and bones of hand of the domestic Pekin Duck. Veterinarija IR Zootechnika. T. 29(51):26-30.
- [11]. Biesiada-Drzazga, B., T. Bombik, A. Rojek, M. Kubiak2, M. Penda and U. Brodzik, (2012). Growth of selected bones and muscles groups in layer chickens during rearing period. Acta Sci. Pol., Zootechnica 11 (1): 25-34.
- [12]. Timman O and U.H Vergleichende, (1919). Und wldenten: Zool Ib. 36. P. 621-652. Jena.. 30

Waseem Ali Vistro. " Comparative osteometric difference in ulna and radius of commercial layer and desi chicken." IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS) 11.9 (2018): 28-33