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RESEARCH ARTICLE

Morphometric investigations on the vertebral column of the rock partridges (*Alectoris graeca*) and pheasants (*Phasianus colchicus*)

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Özet

Yüksel MF, Tıpırdamaz S. Kaya kekliği (*Alectoris graeca*) ve sülünlerin (*Phasianus colchicus*) columna vertebralisinin morfometrik incelenmesi. **Eurasian J Vet Sci, 2012, 28, 1, 05-09**

Amaç: Bu çalışmanın amacı kaya kekliği (*Alectoris graeca*) ve sülünlerin (*Phasianus colchicus*) columna vertebralisini oluşturan cervical, thoracal, lumbal ve sacral omurların sayılarını ve makroanatomisini belirlemektir.

Gereç ve Yöntem: 10 adet Kaya kekliği ve 10 adet sülün materyal olarak kullanıldı. Columna vertebralis üzerindeki deri ve kaslar diseke edilerek ayrıldı. Açığa çıkarılan kemikler %8'lik amonyak çözeltisinde 1.5 saat süre ile kaynatıldı. Daha sonra kemik üzerindeki kas, tendo ve benzeri gibi tüm oluşumlar temizlendi. Omurlarla ilgili ölçümler digital kumpas ile yapıldı.

Bulgular: Kaya kekliğinin vertebra cervicalis'ini oluşturan kemiklerin morfometrik ölçüleri değerlendirildiğinde; C7 ve C8'in en uzun, C13'ün en yüksek, C2 ve C3'ün en geniş, C8, C9, C10, C11, C12'nin kanal yüksekliği en fazla, C13'ün kanal genişliği en fazla olan omurlar olduğu, proc. articularis cranialis ve proc. articularis caudalis genişliği en fazla olan omurların ise sırasıyla C13 ve C3, C7 olduğu gözlendi. Sülünde vertebra cervicalis'i oluşturan kemiklerinin morfometrik ölçüleri değerlendirildiğinde; C8'in en uzun, C13'ün en yüksek, C3'ün en geniş, C8, C10 ve C12'nin kanal yüksekliği en fazla, C13'ün kanal genişliği en fazla olan omurlar olduğu, proc. articularis cranialis ve proc. articularis caudalis genişliği en fazla olan omurların ise sırasıyla C13 ve C8 olduğu gözlendi.

Öneri: Kaya kekliği ve sülüne ait vertebra'ların morfometrik değerlendirilmesi sonucunda diğer kanatlılara benzediği ifade edilebilir.

Abstract

Yuksel MF, Tipirdamaz S. Morphometric investigations on the vertebral column of the rock partridges (*Alectoris graeca*) and pheasants (*Phasianus colchicus*). **Eurasian J Vet Sci, 2012, 28, 1, 05-09**

Aim: The aim of this study was to determine macroanatomy and the number of cervical, thoracal and lumbar parts of the vertebral column in rock partridges (*Alectoris graeca*) and pheasants (*Phasianus colchicus*).

Materials and Methods: 10 rock partridges and 10 pheasants were used as materials. The vertebral column was dissected out and morphometric features of vertebral bones were revealed. The boiled vertebral bones during 1.5 hours in 8% ammonia solution were cleaned from muscles, tendons etc. The morphometric measurements were performed by a digital calliper.

Results: According to morphometric measurements of vertebral bones of partridges, the longest bones of cervical vertebrae were C7 and C8, the highest one was C13, the widest bones were C2 and C3; the bones with the highest canal were C8, C9, C10, C11, C12, the bone with the widest canal was C13, the bones with the largest cranial and the bones with the largest caudal width were C13, C3 and C7. When considering the morphometric measurements of vertebral bones of pheasants, the longest bone of cervical vertebrae was C8, the highest bone was C13, the widest bone was C3, the bones with the highest canal were C8, C10, C12, the bone with the widest canal was C13, the bone with the largest cranial width and the bone with the largest caudal width were C13 and C8, respectively.

Conclusion: It may be stated that morphometric values of vertebrae of partridges and pheasants are similar to those of other poultry.

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Anahtar kelimeler: Kaya kekliği, sülün, columna vertebralis

Keywords:Pheasants, rock partridges, vertebral columm

► Introduction

The most rapid increase in animal husbandry occurs in poultry. Consumption of poultry is composed of three classes as broiler, turkey and other poultry. Significant developments occurred in alternative poultry breeding in recent years. This breeding is mainly done intensively and semi-intensively for generating materials for hunting tourism, for hobby and for providing meat production. Partridges and pheasants are the main poultry bred for hunting tourism (Roenigk 1999, Çetin and Kırıkçı 2000, Yılmaz 2004).

Partridges were first mentioned in the text between 384 and 322 b.c. by Aristotales (Woodard et al 1983). The most proper partridge species for intensive breeding has been reported to be rock partridges (Çetin and Kırıkçı 2000), 14 subspecies of rock partridges have been reported. While the most commonly bred partridge species are Alectoris rufa (partridge) in Europe, it is Alectoris graeca (rock partridges) in Turkey (Çetin and Kırıkçı 2000, Yılmaz 2004).

Motherland of almost all pheasants is Asia continent. World Pheasant Organization (WPO) has reported 49 species and many subspecies of pheasants. Pheasants that have spreaded in Caucasia and eastern Black Sea region of Turkey (Phasianus colchicus) are known as upland pheasants (Howman 1993, Çetin and Kırıkçı 2000).

Bones of poultry are very hard and their tissue is rich of calciferous substances. There are no other cartilages than joint cartilages in the skeletal of poultry that has completed its development. The skeleton of poultry is composed of columna vertebralis, costae and sternum. Pelvis that shows bony union with many vertebrae may be regarded as one of them functionally (Wise and Jennings 1973, Getty 1975, Bahadır 2002, Demirkan 2002).

Columna vertebrae are analyzed as vertebrae cervicales speciales, vertebrae thoracicae, vertebrae lumbicales and vertebrae sacrales, vertebrae synsacrales, vertebrae caudales. Vertebrae located in pars cervicalis constitute a mobile joint. Vertebrae thoracicae and vertebrae caudales have joint to each other (Doğuer and Erençin 1964, Nickel et al 1977, Dyce et al 1987, Baumel et al 1993, Demirkan 2002).

Although some anatomical studies have been conducted about partridges and pheasants, sufficient studies are not available in terms of osteology. The aim of this study is to determine macroanatomy of vertebrae constitute vertebral column of partridges and pheasants and to compare obtained data with other species.

► Materials and Methods

A total of 10 rock partridges (493±12.7 g, *Alectoris graeca*) and 10 pheasants (873±25.9, *Phasianus colchicus*) aged 10 weeks and obtained from Research and Training Farm of Faculty of Veterinary Medicine were used. Ethics committee approval was obtained. Animals received anesthesia with 10 mg/kg of xylazine + 35 mg/kg of ketamin. A. carotis communis of the sedatized animals were dissected and animals were sacrificed. Skin and muscles surrounding vertebral column were dissected and columna vertebralis was separated from the body. Exposed bones were boiled in 8% amonnia solution for 1.5 hours and all material coating the bone were cleaned afterwards. Bones were stored in 20% sodium hypochloride for 3 days and bleached.

Obtained vertebrae were preserved until measurements. Measurements were performed using a digital calliper. Length, width and height of cervical, thoracal, lumbar and sacral vertebrae of both species studied were measured (Figures 1 and 2). Height (dorso-ventral), width (mediolateral) and distance between two processus articularis cranialis and caudalis were also measured. Terminology of Baumell et al (NAA-1993) developed for poultry was used.

ANOVA and Tukey tests were used for statistical analysis (SPSS 12.0). A p value of <0.05 was accepted statistically significant.

► Results

Morphometric measurements of rock partridges and pheasants are given in Tables 1-4. Number of cervical vertebrae was detected to be 13 in partridges and pheasants. The first cervical vertebra, atlas was not included in measurements as it is narrow and ring shaped. Measurements of remaining 12 vertebrae were done.

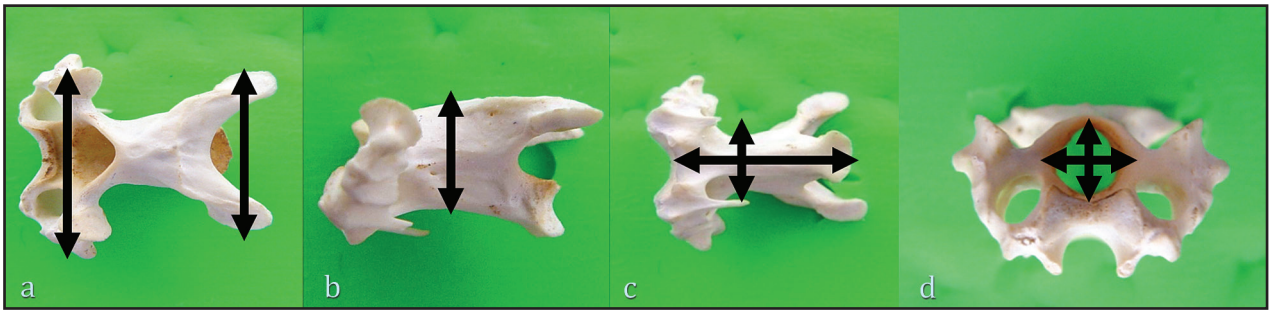

Figure 1. Tricuspid valve opened showing three cusps like anterior (ac), septal (sc) and posterior (pc), chordi tendinae (ct) and papillary muscles (pm).

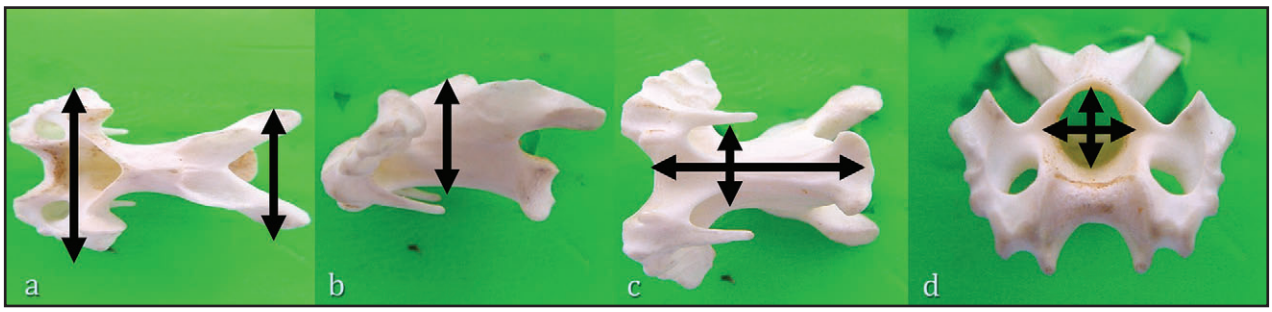

Figure 2. Measurement points of pheasants. a; cranial and caudal width, b; height of the bone, c; height and width of the bone, d; height and width of the vertebral canal.

Table 1. Morphometric measurements of cervical vertebra of rock partridge (mean±SE).

	Length of the vertebra	Height of the vertebra	Width of the vertebra	Height of the vertebral canal	Width of the vertebral canal	Width of Proc. articularis cranialis	Width of Proc. articularis caudalis
C_2	7.0±0.16^{d}	6.1±0.22^{bc}	6.2±0.26^{a}	2.3±0.04^{d}	2.9±0.02^{d}	7.8±0.09^{f}	8.0±0.22^{b}
C_3	7.9±0.18^{c}	5.8±0.35^{c}	6.5±0.35^{a}	2.3±0.07^{d}	2.8±0.07^{d}	8.6±0.21^{e}	8.6±0.16^{a}
C_4	9.0±0.17^{ab}	5.5±0.50^{c}	3.8±0.09^{def}	2.5±0.08^{c}	2.8±0.03^{d}	10.1±0.36^{bcd}	7.8±0.21^{b}
C_5	9.1±0.13^{ab}	5.1±0.51^{c}	3.6±0.08^{f}	2.6±0.05^{c}	2.8±0.02^{d}	10.5±0.22^{abc}	7.6±0.10^{b}
C_6	9.2±0.15^{ab}	5.3±0.51^{c}	3.6±0.07^{ef}	2.8±0.03^{b}	2.8±0.02^{d}	10.6±0.25^{abc}	7.8±0.10^{b}
C_7	9.3±0.18^{a}	5.2±0.52^{c}	3.6±0.09^{ef}	2.9±0.03^{ab}	2.8±0.06^{d}	10.7±0.27^{ab}	7.9±0.17^{b}
C_8	9.4±0.12^{a}	5.5±0.49^{c}	3.7±0.05^{ef}	2.9±0.03^{a}	2.9±0.04^{d}	10.7±0.20^{abc}	8.5±0.12^{a}
C_9	9.0±0.16^{ab}	6.1±0.51^{bc}	4.0±0.13^{cdef}	3.0±0.03^{a}	3.0±0.05^{cd}	10.0±0.15^{cd}	7.9±0.12^{b}
C_{10}	8.8±0.20^{ab}	6.3±0.44^{bc}	4.2±0.10^{bcd}	3.0±0.03^{a}	3.1±0.06^{c}	9.7±0.17^{d}	7.6±0.07^{b}
C_{11}	8.9±0.15^{ab}	6.6±0.42^{bc}	4.5±0.16^{b}	3.0±0.05^{a}	3.3±0.13^{ab}	9.7±0.30^{d}	6.8±0.16^{c}
C_{12}	8.7±0.25^{b}	7.4±0.34^{b}	4.1±0.16^{bcde}	2.9±0.03^{a}	3.2±0.12^{bc}	10.8±0.22^{ab}	7.6±0.29^{b}
C_{13}	5.2±0.18^{e}	8.7±0.38^{a}	4.3±0.16^{bc}	2.9±0.06^{ab}	3.4±0.12^{a}	11.1±0.28^{a}	6.1±0.31^{d}

$^{a-f}$:.Different letters in the same column are statistically significant (Tukey test, p<0.05).

Table 2. Morphometric measurements of thoracal and lumbosacral vertebrae of rock partridges (mean±SE).

	T_1	T_{2345}	T_6	Synsacrum
Length of the vertebra	5.4±0.11	31.8±0.99	6.2±0.14	44.1±1.61
Height of the vertebra	10.3±0.24	11.2±0.21	11.6±0.22	11.1±0.18
Width of the vertebra	4.7±0.10	4.8±0.17	5.2±0.08	6.6±0.23
Height of the vertebral canal	2.6±0.06	3.0±0.07	2.8±0.05	2.9±0.03
Width of the vertebral canal	3.2±0.07	3.4±0.10	3.1±0.07	3.4±0.08
Width of Proc. articularis cranialis	10.6±0.49	--	8.4±0.36	--
Width of Proc. articularis caudalis	5.1±0.21	--	6.5±0.17	--

► Discussion

Cervical vertebra is S-shaped in the poultry and cervical column is composed of 12 vertebrae in pigeons, 14 in chickens, 14 in ducks, 17-18 in geese and 23-25 in swans. Animals stick out their cervical vertebrae when they try to catch something with their beaks. They keep cervical vertebra S-shaped in order to prevent the brain from jounces when walking, jumping (Doğuer and Erençin 1964, King and McLelland 1975, Bahadır et al 1993, Taşbaş 2001). In this study, number of cervical vertebrae was seen to be 13 in pheasants and rock partridges (Table 1-4). The smallest cervical vertebra, atlas, has been stated to be a ring shaped bone composed of upper and lower parts (Zweers et al 1987, Bahadır 2002). Morphometric measurements could not be done for atlas also in pheasants and rock partridges as it composed of ventral and dorsal parts.

Thoracic vertebrae have been reported to compose of 7 vertebrae in chickens and pigeons, 9-10 vertebrae in ducks and geese (Doğuer and Erençin 1964, Nickel et al 1977, Bahadır et al 1993, Bahadır 2002) and this part of spinal column has been reported to be short and immobile (Nickel et al 1977, Taşbaş 2001). Vertebrae thoracicae were detected to be 6 in pheasants and rock partridges in this study. Although 1. and 6. vertebrae are separate bones in both species, 2. - 5. thoracic vertebrae were detected to union and present as a single bone.

Table 3. Morphometric measurements of cervical vertebrae of the pheasants (mean±SE).

	Length of the vertebra	Height of the vertebra	Width of the vertebra	Height of the vertebral canal	Width of the vertebral canal	Width of Proc. articularis cranialis	Width of Proc. articularis caudalis
C_2	9.3±0.18^{f}	7.4±0.16^{cd}	7.6±0.15^{b}	2.7±0.05^{f}	3.2±0.06^{d}	8.9±0.06^{d}	9.6±0.14^{ab}
C_3	10.3±0.15^{e}	7.0±0.09^{e}	8.0±0.13^{a}	2.7±0.06^{f}	3.1±0.04^{de}	9.4±0.12^{d}	9.1±0.16^{bcd}
C_4	11.8±0.26^{c}	6.2±0.16^{gh}	4.1±0.10^{fg}	3.0±0.08^{ce}	3.1±0.05^{de}	11.3±0.32^{c}	8.7±0.31^{d}
C_5	12.3±0.09^{b}	6.1±0.11^{gh}	4.0±0.06^{g}	2.9±0.04^{e}	3.0±0.04^{de}	11.5±0.20^{c}	9.0±0.25^{bcd}
C_6	12.6±0.15^{ab}	6.2±0.10^{h}	3.9±0.06^{g}	3.0±0.04^{e}	3.0±0.06^{e}	11.4±0.21^{c}	9.0±0.13^{cd}
C_7	12.7±0.21^{ab}	6.2±0.11^{gh}	4.1±0.08^{fg}	3.1±0.06^{bce}	3.1±0.04^{de}	12.3±0.35^{b}	9.2±0.27^{abcd}
C_8	13.0±0.13^{a}	6.5±0.12^{fg}	4.0±0.06^{g}	3.4±0.10^{a}	3.1±0.03^{de}	12.7±0.24^{b}	9.8±0.22^{a}
C_9	12.5±0.16^{ab}	6.6±0.13^{f}	4.3±0.15^{f}	3.2±0.06^{abc}	3.1±0.06^{de}	12.6±0.22^{b}	9.6±0.21^{abc}
C_{10}	12.4±0.18^{b}	7.1±0.09^{de}	4.8±0.10^{e}	3.3±0.04^{a}	3.2±0.06^{de}	12.4±0.29^{b}	9.5±0.18^{abc}
C_{11}	11.4±0.19^{c}	7.6±0.13^{c}	5.1±0.09^{d}	3.3±0.05^{ab}	3.4±0.05^{c}	11.4±0.21^{c}	8.7±0.19^{d}
C_{12}	10.8±0.13^{d}	8.3±0.09^{b}	5.7±0.06^{c}	3.3±0.06^{a}	3.9±0.13^{b}	12.2±0.18^{b}	8.6±0.17^{d}
C_{13}	7.2±0.18^{g}	10.4±0.12^{a}	5.9±0.13^{c}	3.4±0.08^{a}	4.6±0.08^{a}	14.2±0.14^{a}	7.3±0.18^{e}

$^{a-h}$: Different letters in the same column are statistically significant (Tukey test, $p<0.05$).

Table 4. Morphometric measurements of thoracal and lumbosacral vertebrae of the pheasants (mean±SE).

	T_1	T_{2345}	T_6	Synsacrum
Length of the vertebra	6.6±0.11	34.6±0.67	8.3±0.19	62.6±1.73
Height of the vertebra	11.0±0.17	15.0±0.45	14.7±0.32	7.1±0.19
Width of the vertebra	6.3±0.25	5.9±0.16	6.3±0.14	7.9±0.11
Height of the vertebral canal	3.1±0.08	2.9±0.06	2.9±0.03	3.1±0.07
Width of the vertebral canal	4.2±0.13	3.4±0.07	3.2±0.07	3.5±0.06
Width of Proc. articularis cranialis	13.60.19	--	8.4±0.12	--
Width of Proc. articularis caudalis	6.2±0.15	--	7.4±0.26	--

Synsacrum was detected to compose as the result of union of 14 lumbar and sacral vertebrae in rock partridges and pheasants and length was found to be 44.1-6.61mm in rock partridges and 62.6-1.73 mm in pheasants. Aforementioned vertebrae support the literature reporting that union of these vertebrae form synsacrum also in other poultry.

► Conclusions

When morphometric measurements of cervical vertebrae of pheasants and rock partridges were statistically evaluated together, the longest bone was detected to be C8, the highest C13, the widest C3, bones that have maximum canal height C8, C9, C10 and C12 and the bone that has the widest canal C13. C13 was the bone that has the widest proc. articularis cranialis in both species. Vertebrae that have the widest proc. articularis caudalis were observed to be C3 and C7 in greek partridges and C3 and C13 in pheasants.

► Acknowledgement

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