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Macro-anatomical investigations on skeletons of otter (*Lutra lutra*). III. Skeleton axiale

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ABSTRACT

The aim of this study was to investigate the axial skeleton of otters (*Lutra lutra*). The important features of the skull as observed in this study were as follows: Tympanic bulla was well developed. Zygomatic process of the frontal bone and the supraorbital foramen was absent. Infraorbital foramen was very well developed. Dental formula was 2(I3/3, C1/1, P3/3, M2/2)=36. Mental foramens and the angular process of mandible were present. Vertebral formula was found as C7, Th14, L6, S3, Ca18. The eleventh vertebra of the thoracic vertebra was found as anticlinal vertebra. The accessory processes were caudally located on all lumbal vertebrae. The auricular surface of sacral bone was faced laterally and spinous processes were not fused. Haemal arches were present on ventral surfaces of the caudal ends of the bodies of the third to seventh caudal vertebrae. There were fourteen pairs of ribs. The first nine ribs were sternal, and four ribs were asternal. The last rib was floating. The dorsal half of ribs (*os costale*) was almost round in shape and the ventral half of ribs was flat in shape. The sternum was cylindrical.

Key words: otter, *Lutra lutra*, axial skeleton, anatomy

Introduction

The otter, which is the subject of this study, belongs to the Mustelidae family, order Carnivora. The most important features of otters are their dependence upon water for life and their webbed feet (DEMIRSOY, 1992; KAROL, 1963; KURU, 1987).

Despite anatomical studies on the osteology of wild carnivores such as the wolf and fox (GIRGIN et al., 1988), the fox and jackal (GÜLTEKIN and UCAR, 1980), the mink (DURSUN and TIPIRDAMAZ, 1989), the hyena

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(TECIRLIOGLU, 1983), wild ruminants like sheep and wild goat (TASBAS, 1978, 1983), and the porcupine (YILMAZ, 1998; YILMAZ et al., 1998, 1999) from Rodentia, the osteology of otters has not been studied in detail.

The aim of this study was to investigate the axial skeleton of otters, thereby making a contribution to filling the gap of knowledge in this field.

Materials and methods

In this study, three adult male otters, hunted in a dam near Elazig City, Turkey, were used for examination purposes. Maceration of bones was carried out according to established protocols (TASBAS and TECIRLIOGLU, 1966).

For terminology, Nomina anatomica veterinaria (ANONYMOUS, 1994) was used.

Results

Ossa cranii

A prominent external occipital crest (crista occipitalis externa) and nuchal crest (crista nuchae) was observed on the occipital bone. Two foramens (its name was not found in Nomina anatomica veterinaria) were found laterally on each side of the external occipital protuberance (protuberantia occipitalis externa). The hypoglossal foramen (foramen nervi hypoglossi), the condylar foramen (foramen condylare) and the jugular foramen (foramen jugulare) were considerably pronounced. The interparietal bone was triangular in shape and there was external sagittal crest (crista sagittalis externa). The parietal bones were dorso-laterally convex. The tympanic bulla (bulla tympanica) on the temporal bone was well developed. The articular tubercle (tuberculum articulare) was concave while the frontal bones were slightly concave and narrow. The zygomatic process of the frontal bone and supraorbital foramen (foramen supraorbitale) were absent (Fig. 1).

Ossa faciei

The nasal bones were slightly convex, but there were two prominent points on the septal processes (processus septalis). The maxilla was convex, while the infraorbital foramen (foramen infraorbitale) was rather wide. The zygomatic bone was narrow. However, the zygomatic arch (arcus zygomaticus) was well developed. The horizontal lamina of the

palatine bone was wide, while the perpendicular lamina of the palatine bone was narrow. The dental formula of upper jaw was I3, C1, P3, M2. The body of the mandible (corpus mandibulae) was narrow and long. Five mental foramina (foramina mentalia lateralia) were detected. The massateric fossa (fossa masseterica) was deep, the coronoid process (processus coronoideus) was wide, and the condylar process (processus condylaris) was convex. Angular process (processus angularis) was observed. The dental formula of the lower jaw was I3, C1, P3, M2.

Fig. 1. General view of otter's skull

Vertebrae cervicales

Atlas - Atlas was butterfly-shaped. The dorsal tubercle (tuberculum dorsale) was uncertain, as opposed to the ventral tubercle, which was positive. Alar notch (incisura alaris) and transverse foramen (foramen transversarium) were noted (Fig. 2).

Axis - The spinous process (processus spinosus) was bladelike cranially and expanded caudally. Facies articularis cranialis ended beneath the dens and was shaped as a dens cone.

The transverse process (processus transversus) was projected caudally.

Third, fourth and fifth cervical vertebrae - The height of the spinous processes and the width of the transverse foramen gradually increased

from the third to the fifth cervical vertebrae and the ventral crest (crista ventralis) was present in all three.

Sixth cervical vertebra - The costal process (processus costarius) was wide and horizontally shaped. The transverse foramen was larger than the previous cervical vertebrae.

Seventh cervical vertebra - The transverse process extended towards lateral, and the costal process was not developed. The ventral crest was noticeable and the caudal costal fovea (fovea costalis caudalis) was observed.

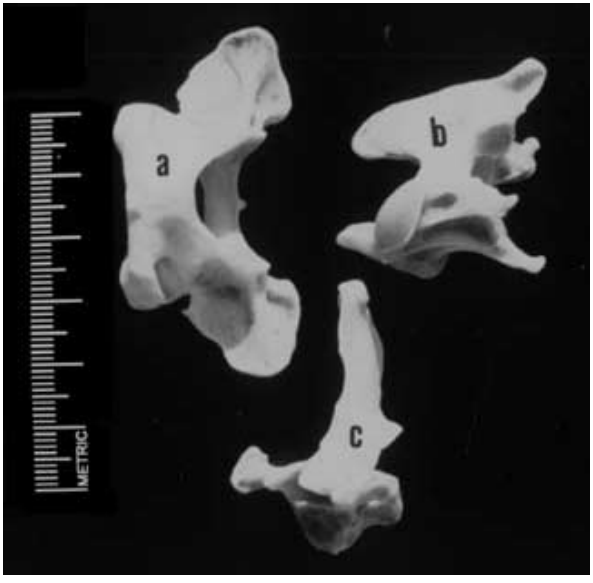

Fig. 2. a) Atlas, b) Axis, c) Vertebra thoracica of otter

Vertebrae thoracicae

There were 14 thoracic vertebrae. Height of the spinous processes decreased from the third vertebra. The first ten spinous processes were caudally sloped, the eleventh is the anticlinal vertebra and the last three were inclined cranially. The caudal costal fovea (fovea costalis caudalis) was larger than the cranial costal fovea (fovea costalis cranialis). However, the transversal costal fovea (fovea costalis processus transversi) was faced laterally. Incisura vertebralis caudalis was also observed.

Vertebrae lumbales

There was a total of six lumbal vertebrae. The height of the spinous processes and the length of transverse processes gradually increased from the first to the last lumbal vertebra. Transverse processes were cranio-ventrally directed. The accessory processes (processus accessorius) were caudally located on all vertebrae, their sizes gradually decreasing from the first to the last vertebra.

Vertebrae sacrales

The bodies of the three sacral vertebrae were fused to form a sacrum. Spinous processes were not fused.

A lateral sacral crest (crista sacralis lateralis) was observed and the auricular surface (facies auricularis) faced laterally.

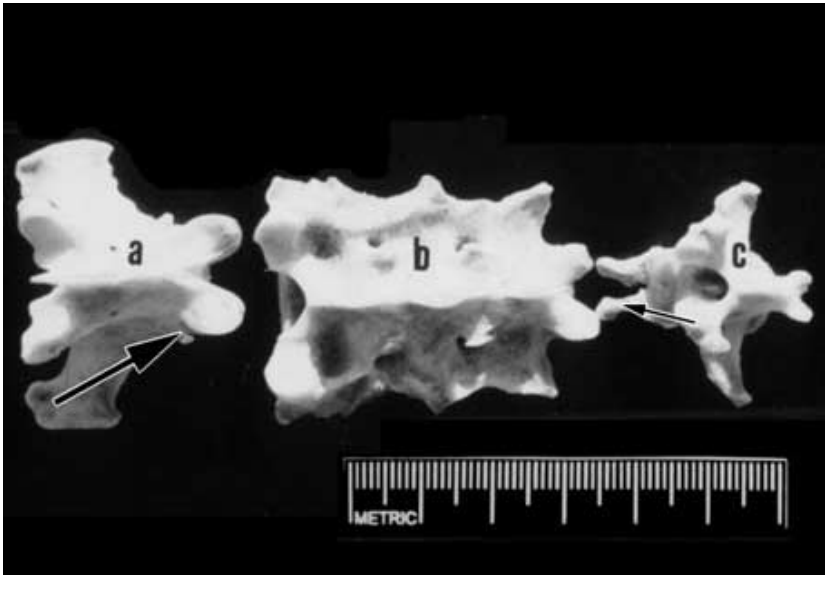

Fig. 3. a) Vertebra lumbalis, b) Sacrum, c) Vertebra caudalis, arrow, (proc. accessorius), small arrow, (proc. hemalis) of otter

Vertebrae caudales

There was an average of eighteen caudal vertebrae. Haemal arches (arcus haemalis) were found on the ventral surfaces of the caudal ends of the bodies of the third to seventh caudal vertebrae (Fig. 3).

Costae

There were fourteen pairs of ribs in the otter. The first nine pairs were sternal, and four pairs were asternal. The last pair of ribs was floating. The dorsal half of the os costale was almost round in shape and the ventral half of the os costale was flat.

Sternum

The body of the sternum was composed of nine sternebrae and were almost cylindrical in shape.

Discussion

DEMIRSOY (1992) and KURU (1987) identified the dental formula as I3, C1, P2-4, M1 / I2-3, C1, P2-4, M1-2 in the Mustelidae family. However, in this study it was found to be I3, C1, P3, M2 / I3, C1, P3, M2.

Vertebral formula was reported in the following carnivores as C7, T13-16, L4-6, S2-4, Ca15-25 in Mustelidae (GRASSÉ, 1967); C7, T13, L7, S3, Ca- in the wolf and the fox (GIRGIN et al., 1988); C7, T13, L7, S3, Ca- in the fox and jackal (GÜLTEKIN and UÇAR, 1980); C7, T14, L6, S3, Ca- in the hyena (TECIRLIOGLU, 1983), and as C7, T14, L7, S3, Ca15-18 in the mink (DURSUN and TIPIRDAMAZ, 1989). According to the results of the present study on otters, it was found to be C7, T14, L6, S3, Ca18.

Alar notch and transverse foramen are observed on the atlas in the wolf and the fox (GIRGIN et al., 1988); in the hyena (TECIRLIOGLU, 1983); in the mink (DURSUN and TIPIRDAMAZ, 1989), and in the jackal (GÜLTEKIN and UÇAR, 1980). Similar findings were observed in this study.

In carnivora, ribs comprise nine sternal and four asternal ribs in the fox and jackal (GÜLTEKIN and UÇAR, 1980); six sternal and seven asternal and one floating in the mink (DURSUN and TIPIRDAMAZ, 1989), and nine sternal and four asternal and one floating in the dog (EVANS and CHRISTENSEN, 1979). The latter corresponds to our results.

The body of the sternum comprised five sternebrae in the mink (DURSUN and TIPIRDAMAZ, 1989); eight in the wolf and fox (GIRGIN et al., 1988), and eight or nine in the dog (EVANS and CHRISTENSEN, 1979). In our study, the body of sternum comprised nine sternebrae.

Haemal arches have been reported to be present in the domestic dog (DURSUN, 1994; EVANS and CHRISTENSEN, 1979; GETTY, 1975); in carnivora and some rodentia (ÖKTAY, 1988); in the mink (DURSUN and TIPIRDAMAZ, 1989), and in wild squirrel, lemur and kangaroo (GRASSÉ,

1967). In this study, haemal arches were present on ventral surfaces of the caudal ends of the bodies of the third to seventh caudal vertebrae.

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SAŽETAK

Cilj ovog istraživanja je bio da se istraži osovinski kostur vidre (*Lutra lutra*). Važna obilježja koja su opažena na lubanji su bila: bubnjišni mjehur je bio dobro razvijen, jagodični izdanci i nadočni otvor čeone kosti nisu postojali, dok je podočni otvor bio dobro razvijen. Zubna formula je bila 2 (I 3/3, C 1/1, P 3/3, M 2/2) = 36. Bradeni otvori i kutni izdanak donje čeljusti su razvijeni. Kralježnica je imala ovaj broj kralježaka: C7, Th14, L6, S3 i Ca18. Jedanaesti kralježak grudne kralježnice je antiklinalni. Dodatni izdanci su na svim slabinskim kralješcima bili smješteni kaudalno. Uškasta zglobna površina križne kosti je bila usmjerena lateralno, a njeni trnasti izdanci nisu bili spojeni. Krvožilni lukovi su bili razvijeni na ventralnim površinama trupova trećeg do sedmog repnog kralješka. Bilo je 14 pari rebara. Prvih 9 rebara su bila prava rebra, a 4 su bila lažna rebra. Zadnje rebro je bilo slobodno rebro. Dorzalna polovica koštanih rebara je u presjeku bila gotovo okrugla, a njihova ventralna polovica plosnata. Grudna kost je bila valjkastog presijeka.

Ključne riječi: vidra, *Lutra lutra*, osovinski kostur, anatomija