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Comparative skeletal osteology of three species of Scincid lizards (Genus: *Ablepharus*) from Turkey

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Abstract

Despite the abundance and diversity of lizards in the family Scincidae, descriptions of their cranial and postcranial osteologies are almost nonexistent. Here, we provide detailed descriptions of adult skeletal morphologies in three scincid species: *Ablepharus kitaibelii, A. chernovi* and *A. budaki*. The skeletal elements of these lizards are described on cleared and double-stained specimens. The general pattern of the cranial and postcranial skeletons in the three scincid species is characterized by the absence of the palatal teeth, presence of thirteen scleral ossicles in each eye, pattern of fore- hindlimb, and shape of the clavicle and interclavicle. Additionally, there are some remarkable variations regarding the number, size and position of the bones. These include the size and shape of the nasal, the degree of fusion or separation of the postfrontal and postorbital and the number of presacral vertebrae and marginal teeth.

Key words

Scincidae, *Ablepharus*, *Ablepharus kitaibelii, Ablepharus chernovi*, *Ablepharus budaki*, osteology, Turkey.

Introduction

Squamata is one of the largest orders of vertebrates with approximately 9000 recognized species. Scincidae is one of the most abundant and diverse families with more than 1200 described species that are found in Africa, Asia, Australia, Europe and North and South America. The genus *Ablepharus* is part of the Scincidae and is commonly known as snake-eyed skink. This name is based on the fact that they have eyelids like snakes. The Snake-eyed Skink *Ablepharus kitaibelii* (Bibron & Bory, 1833), the Chernov's Snake-eyed Skink *A. chernovi* (Darevsky, 1953) and the Budak's Snake-eyed Skink *A. budaki* (Göçmen, Kumlutaş & Tosunoğlu, 1996) are three out of the ten described species of the genus *Ablepharus*. The scincid lizards are mostly terrestrial and miniaturized species with elongated bodies and short limbs (Baran & Atatür, 1998).

There are few descriptions that detail the skeletal morphology of lizard species, despite their abundance and diversity (Baur, 1889; Cope, 1892; Arribas, 1998, 2013; Zalusky *et al.,* 1980; Shubin & Alberch, 1986; Rieppel, 1992; Maisano, 2001; Nance, 2007; Bell et *al.,* 2009; Roscito & Rodrigues, 2010, 2012; El-Bakry *et al.,* 2013). However, osteological characters have provided important data for phylogenetic and functional studies (Arnold, 1983; Arnold *et al.,* 2007; Evans, 2008; Arribas *et al.,* 2013). Despite their systematic importance, the osteology of scincid lizards is less known than its phylogenetic relationships. Although cranial osteology of scincid species was covered by Caputo (2004), Saddlier *et al.* (2006) and Young *et al.* (2009), a detailed study is lacking. Herein, we compare the adult osteology of the three scincid species (*A. kitaibelii, A. budaki* and *A. chernovi*) and provide detailed comparative osteological descriptions for other scincids.

Material and Methods

Twenty-eight specimens of three scincid *Ablepharus* specimens were used for this study (Table 2). All specimens used here were museum materials (Zoology Department Dokuz Eylül University (ZDEU) collection of Dokuz Eylül University). Snout-vent lengths (SVL), skull lengths and ages were measured to analyze the relationship between age and length (Table 3). All specimens were cleared and double stained following the methodology of Wassersug (1976). The osteological terminology follows Bell *et al.* (2003), Torres-carvajal (2003), Tarazona *et al.* (2008) and Guerra & Montero (2009). The cranial and postcranial characters selected for our study follow Arribas (1998). All descriptions and illustrations were made using Olympus SZ61 Stereoscope equipped with an Olympus digital camera. Illustrations were digitized and arranged in CORELDRAW (Ver. X3).

Skeletochronology

Twenty-eight specimens were used for skeletochronology of the long bones (femur or phalanges) of the limbs. Clipped limb bones were fixed in 70% alcohol, washed in running water for 12h, decalcified in 5% nitric acid for 2–3h, and rinsed overnight in distilled water. They were dehydrated using increasing ethanol series and then cleared in xylene. This was followed by the immersion of the femurs in paraffin for 24 h at 58°C, followed by the embedding in paraffin. Specimens were sectioned at 12 µ cross sections from the mid-diaphysis and stained in hematoxylin for 20 min. Sections were observed under a light microscope and the number of lines of arrested growth (LAGs) was counted.

Results

Premaxilla. The premaxilla forms the anterior margin of the upper jaw (Fig. 1B). Bones have an alveolar and a nasal process. The nasal process of the premaxilla is slender and posterodorsally oriented between the nasals. The alveolar process of the premaxilla is thinner and bears teeth along its ventral edge. The alveolar and nasal processes of the premaxilla are similar in the three scincid species. The premaxilla articulates with the maxillae posterolaterally, the vomer posteroventrally, and nasals posteriorly. The maxillary process of the premaxilla articulates with the premaxillary process of the maxilla.

Maxillae. The maxillae form the lateral margin of the upper jaw (Fig. 1B). The maxillae have three processes, a premaxillary process, an orbital process and a facial process. The maxillary process of the premaxilla is simple in the three scincid lizards. The facial process of the maxilla is oriented towards the nasals dorsomedially and contacts with the prefrontals posteriorly. The orbital process forms the posterior part of the maxilla. The bones articulate with the premaxilla, nasals, prefrontals, lacrimals and jugals. Ventrally, the alveolar portion of the maxilla bears teeth.

Nasals. The nasals articulate with the premaxillae anteriorly, the frontal posteriorly, the maxillae anterolateally and the prefrontals posterolaterally (Fig. 1A). The nasal process of the premaxilla separates the nasals anteromedially. The shape of the nasal is different in *A. budaki* compared to the other two species (*A. kitaibelii* and *A. chernovi*). In *A. kitaibelii* and *A. chernovi,* the posterior ends of the nasals are blunt and oriented to the prefrontals (Fig. 2B and C). In *A. budaki* the posterior ends of the bones are rounded and overlap the frontal (Fig. 2A).

Frontal. The frontal is a single bone in the roof of the skull (Fig. 1A). The bone articulates with the nasals anteriorly, the prefrontals anterolaterally, the postfrontals posterolaterally and the parietal posteriorly. The anterolateral process of the frontal extends between the posterior edge of the nasals and prefontals. The posterolateral process in *A. chernovi* is sharp, whereas this process in *A. kitaibelii* and *A. budaki* is rounded. In *A. budaki* only the nasals cover the anteromedial margin of the frontal.

Prefrontals. The prefrontals are approximately triangular shaped in three scincid lizards (Fig. 1A). The bones are anterior to the orbital cavity. The anterior process is broad and extends to the angle formed by the facial process of the maxilla, nasal and anterolateral process of the frontal. The posterodorsal process is slender and elongated and extends to the lateral margin of the frontal in the three species.

Parietal. The parietal is a single bone at the end of the skull (Fig. 1A). The bone has two processes: a short anterolateral and a long supratemporal process. The anterolateral process of the parietal articulates with the postfrontals whereas the supratemporal process is in contact with the supratemporals. The bone articulates with the postfrontals anterolaterally, the postorbitals lateromedially, the squamosals posterolaterally and the frontal anteriorly. The posttemporal fenestra is present in all species.

Postfrontals. The postfrontals are triradiate bones and form the posterodorsal portion of the orbit (Fig. 1A). The shape of the bones is similar in *A. budaki* and *A. chernovi* (Fig. 3A and B). In dorsal view, the bones lie between the frontal and postorbitals.

Postorbitals. These elongated bones are posterior to the orbit and lie between the postfrontals and squamosals (Fig. 1A). The bone in *A. budaki* and *A. chernovi* becomes slender and its end is a sharp-shaped. In *A. kita-*

Table 1. Cranial and postcranial characters in *A. kitaibelii*, *A. budaki* and *A. chernovi*.

Cranial characters	*A. budaki*	*A. chernovi*	*A. kitaibelii*
Shape of the nasal process of the premaxilla	Distal part is wider than proximal one	Distal part is wider than proximal one	Distal part is wider than proximal one
Shape of the posterior margin of the nasal	Rounded	Blunt	Blunt
Fusion or separation of the postfrontal and postorbital	Seperation	Seperation	Fusion
Overlap of the postorbital and the squamosal	More than half of the length of the postorbital	More than half of the length of the postorbital	More than half of the length of the postorbital
Postcranial characters			
Small bony ribs on the third presacral vertebra	Present	Present	Present
Ribs of the sixth presacral vertebra	Small rib	Small rib	Small rib
Sternal-xiphisternal costal formula	(3 + 2)	(3 + 2)	(3 + 2)
Number of the presacral vertebrae	31 ± 1	36 ± 1	36 ± 1
Number of short-ribbed posterior presacral vertebrae	4	4	4
Shape of the sternal fontanelle	Heart-shaped	Heart-shaped	Oval-shaped or Heart-shaped
Shape of the clavicle	Closed-shaped	Closed-shaped	Closed-shaped

Table 2. Information on the specimens used in the present study.

Species	Locality
A. kitaibelii	Kalkan, Antalya
	Köyceğiz, Muğla
	Bergama, İzmir
	Kaş, Antalya
	Bala, Ankara
A. budaki	Kaş, Antalya
	Fethiye, Muğla
A. chernovi	Between Bozkır and Hadim, Konya
	Between Zeyne and Gülnar, Mersin
	Between Mut and Karaman
	Meke, Karapınar Konya
	Pozantı, Adana

Table 3. Mean SVL (mm), SL (skull length; mm), age and marginal teeth; PT: Premaxillary teeth, MT: Maxillary teeth, DT: Dentary in 28 specimens used in the present study.

Species	Skull length	SVL	Age	PT	MT	DT
A. budaki (n = 11)	6.69	34.24	4.83	8.7	14.0	17.0
A. chernovi (n = 7)	7.01	41.23	5.85	8.4	13.0	15.0
A. kitaibelii (n = 10)	6.88	40.68	5.72	8.5	13.0	15.0

belii, the postorbitals combine with the postfrontal as a single bone whereas the postorbitals and postfrontals seem to be two distinct bones in *A. budaki* and *A. chernovi* (Fig. 3).

Jugals. The jugals are approximately L-shaped bones that enclose the orbit (Fig. 1B). The bones bear two processes: the anterior and posterior process. There is a small protuberance on the connection between anterior and posterior processes of the jugal. The anterior process articulates with the maxilla anterolaterally and ectopterygoid posteriorly. The posterior process is directed towards to the postorbital.

Squamosals. The squamosals are elongated and slender bones that lie lateral to the supratemporal fossa (Fig. 1A). In the dorsal view, the squamosals lie between the supratemporals and quadrates. The bones articulate with the quadrate ventrally and supratemporal laterally.

Vomer. The vomer lies between the premaxilla and palatines (Fig. 1B). The vomer is in loose contact with the premaxillary process of the maxilla and forms the fenestra vomeronasalis externa and exochoanalis.

Supratemporal. The supratemporal is a small and paired bone that lies between the squamosal and the supratemporal process of the parietal. Ventrally, the bone is in contact with the quadrate (Fig. 1A).

Palatines. The palatines are separated by the pyriform space. Anteriorly, the bones articulate with the vomer and maxilla via the vomerine and maxillary process, respectively (Fig. 1B). Posteriorly, the pterygoid process articulates with the pterygoids.

Ectopterygoids. The ectopterygoid is a small and slender bone in the three scincid lizards. The ectopterygoids have anterolateral, posterolateral and medial processes, which articulate with the maxillae, jugals and pterygoids, respectively (Fig. 1B).

Pterygoids. The pterygoids are not edentated bones that occupy the posterior part of the palate (Fig. 1B). The bones are separated by the pyriform space. The posterior part of this space is formed by both the pterygoids and parabasisphenoid. The bones bear three processes: the palatine, transverse, and quadrate. The palatine and transverse processes are present anteriorly, whereas the quadrate process lies posteriorly. The palatine process articulates with the pterygoid process of the palatine. The transverse process articulates with the medial process of the ectopterygoid. Posteriorly, the quadrate process articulates with the quadrate.

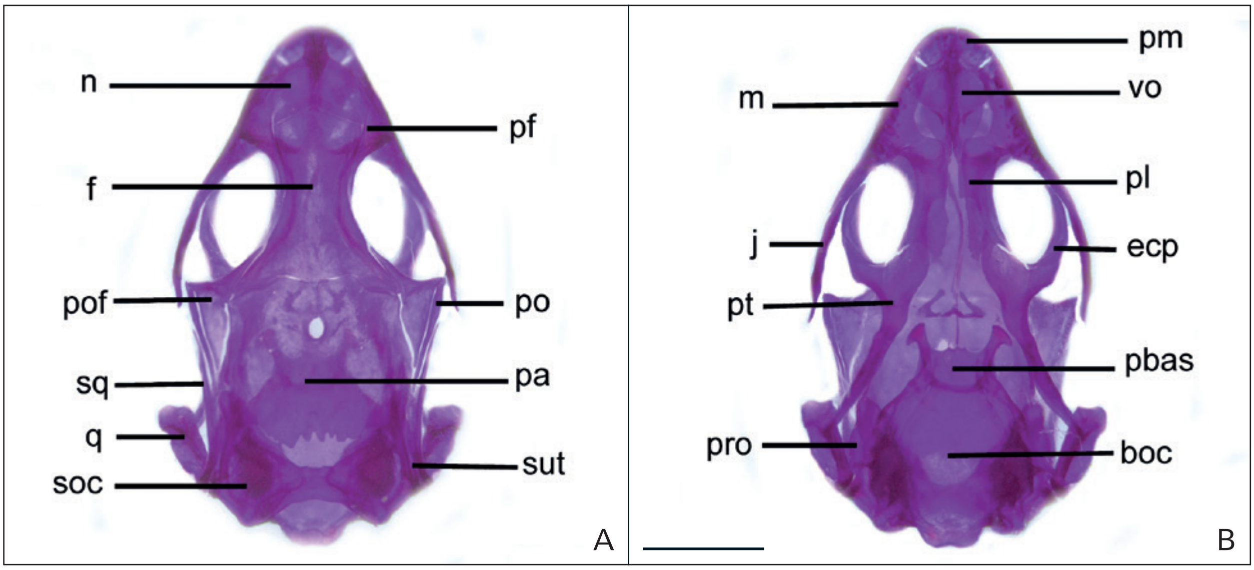

Fig. 1. Skull of *A. chernovi*. **A.** Dorsal view and **B.** Ventral view. boc – basioccipital; ecp – ectopterygoid; f – frontal; j – jugal; m – maxilla; n – nasal; pa – parietal; pbas – parabasisphenoid; pf – prefrontal; pl – palatine; pm – premaxilla; po – postorbital; pof – postfrontal; pro – prootic; pt – pterygoid; q – quadrate; soc – supraoccipital; sq – squamosal; sut – supratemporal; vo – vomer. Scale bar = 2 mm.

Scleral ossicles. The scleral ossicles are thin plates that overlap one another. There are thirteen scleral ossicles in each eye of the three scincid species.

Basioccipital. The basioccipital is the posterior floor of the braincase, whereas the supraoccipital forms the posterior roof of it. It lies anterior to the occipital condyl and posterior to the parabasisphenoid (Fig. 1B).

Parabasisphenoid. The parasphenoid and basisphenoid form a single parabasisphenoid. The bone forms the anterior floor of the braincase, whereas the basioccipital constitutes the posterior part. In the ventral aspect, the bone lies between the pterygoid anteriorly and basioccipital posteriorly (Fig. 1B). The bone bears a long cultriform process that is located at the anteromedial part of the parabasisphenoid. The posterolateral process overlaps the basioccipital and the basipterygoid process articulates with the quadrate process of the pterygoid. The anteromedial process overlaps the cultriform process.

Supraoccipital. In the dorsal view, the supraoccipital is located between the parietal and occipital condly (Fig. 1A). Anteriorly, the bone is separated from the posterior margin of the parietal but it is only processus ascendes that provide connection between the parietal and supraoccipital.

Prootic. The prootic forms the anterolateral part of the braincase. Each bone possesses three processes: an alar process, an anteroventral process and a posterodorsal process. The alar process articulates with the supraoccipital. The anteroventral process contacts the parabasisphenoid anteriorly and the basioccipital ventrally (Fig. 1B).

Quadrates. The quadrates, which articulate with the lower jaw, occupy the posterolateral corner of the skull (Fig. 1A).

Mandible

The mandible comprises six paired elements: the dentary, splenial, coronoid, angular, surangular and articular (Fig. 4). The bones articulate with the posterolateral margin of the skull via the connection between the quadrate and articular.

Dentary. The dentary is a long bone that forms the lower jaw with other mandibular bones (Fig. 4B). The dentary is the largest element of the jaw and it is only portion of the lower jaw that bears teeth. The posterior margin of the bone is in contact with the angular and splenial ventrally and coronoid dorsally. Posteriorly, the bone articulates with the surangular.

Splenial. The splenial is present on the ventromedial part of the mandible (Fig. 4B). Anteriorly, the bone overlaps the dentary. Dorsally the splenial articulates with the anteromedial process of the coronoid.

Coronoid. The coronoid is triangular bone that lies between the mandibular tooth row and the surangular bone (Fig. 4A). The coronoid has a large dorsal process that extends to the dorsal margin of the mandible. The height of the coronoid process is nearly equal to the height of the dentary in lateral view.

Angular. The angular is a small bone that lies at the ventral portion of the mandible (Fig. 4A) and is located posterior to the splenial.

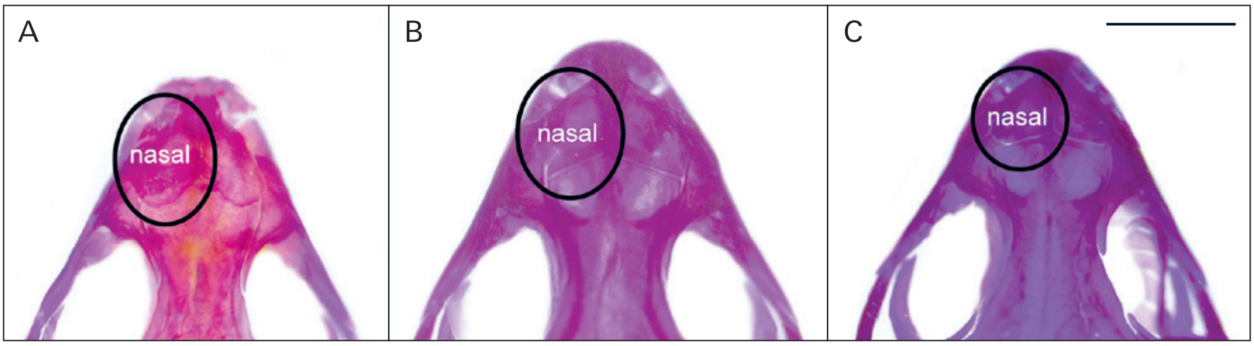

Fig. 2. Shape of the nasal. **A.** *A. budaki*, **B.** *A. chernovi* and **C.** *A. kitaibelii*. Scale bar = 2 mm.

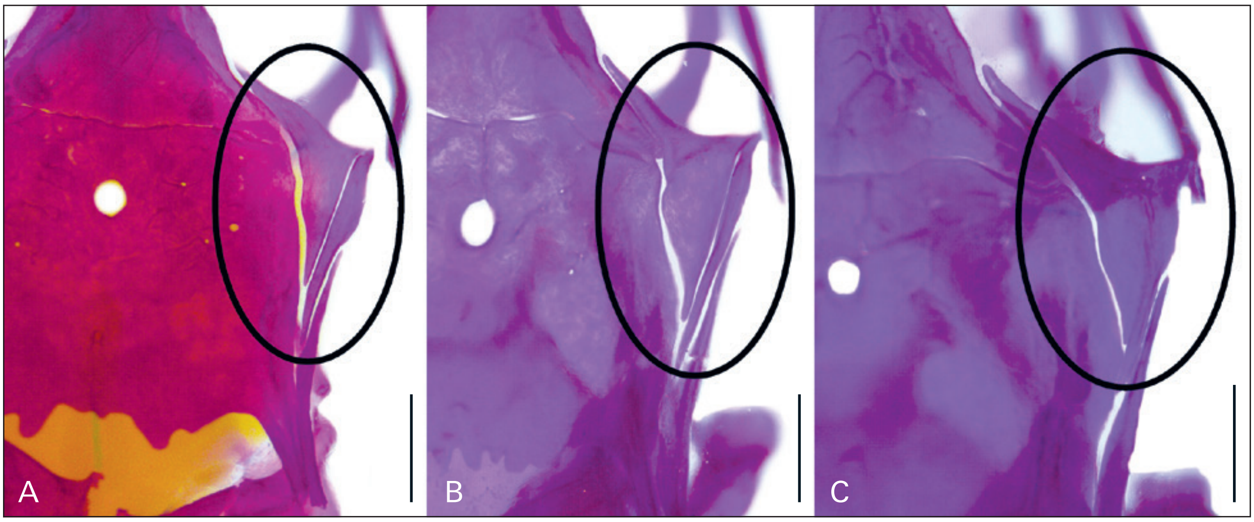

Fig. 3. Position of the postfrontal and the postorbital. **A.** *A. budaki*, **B.** *A. chernovi* and **C.** *A. kitaibelii*. Scale bar = 1mm.

Surangular. The surangular is located between the coronoid anterodorsally and angular ventrally (Fig. 3A). The bone is one of the largest bones of the mandible and lies posterior to the dentary. In a dorsal-to-ventral sequence, the bone articulates with the coronoid, dentary and angular.

Articular. The articular forms the posterior end of the mandible (Fig. 3B). In lingual aspect, the bone is enclosed by the angular, splenial and surangular bones. In labial view, the bone is surrounded by the angular and surangular.

Hyoid apparatus. The hyoid apparatus is located under the lower jaw and consists of the basihyal and three visceral arches (Fig. 5). The glossohyal is anterior to the basihyal that is the main body of the hyoid apparatus. The hypohyal, which is lies at the anterolateral margin of the basihyal, is a short visceral arch and continues with the posterolaterally oriented ceratohyal. The second visceral arch connects the posterolateral margin of the basihyal and forms the first long ceratobranchial. The third visceral arch comprises the second ceratobranchial that is located posterior to the basihyal. The first ceratobranchial is continuous with the first epibranchial.

Teeth

Marginal teeth. The premaxilla, maxillae and dentaries are dentate bones of these three scincids species. The number of marginal teeth in the three scincid species is given in Table 3.

Palatal teeth. There is edentate.

Axial and Appendicular skeleton

Vertebrae. There is a sexual dimorphism in terms of the number of presacral vertebrae. In the vertebral column, the atlas, the second and third vertebrae do not bear any ribs. The following three and last four vertebrae have short ribs in three scincids species. There is interspecific variation as observed by the variation in the number of the remaining vertebrae, which have long ribs. There are 22 (female) and 20 (male) presacral vertebrae in *A. budaki*, whereas there are 27 (female) and 25 (male) in *A. chernovi* and 28 (female) and 24 (male) in *A. kitaibelii*,

Pectoral Girdle and Forelimb. The pectoral girdle consists of a single interclavicle, paired clavicles, scapulae, coracoids, epicoracioids and suprascapulae (Fig. 6A).

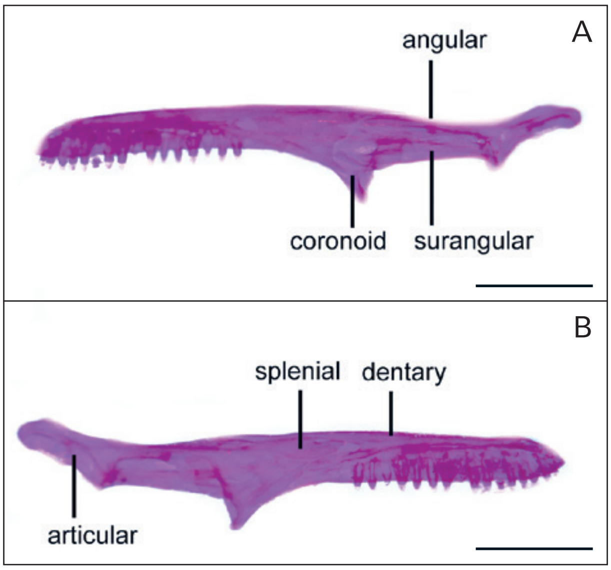

Fig. 4. *A. kitaibelii*. **A.** Labial view and **B.** Lingual view. Scale bar = 2 mm.

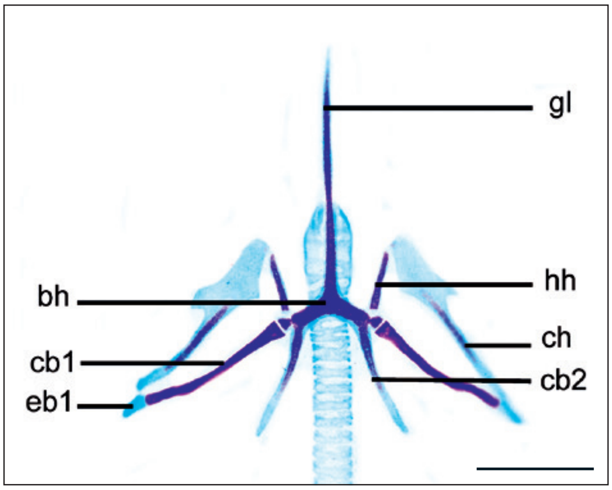

Fig. 5. Hyoid apparatus of *A. budaki*. bh – basihyal; cb1 – first ceratobranchial; cb2 – second ceratobranchial; ch – ceratohyal; eb1 – first epibranchial; gh – glossohyal; hh – hypohyal; Scale bar = 2 mm.

In all scincids species examined here, the interclavicle, the clavicles, the scapulas, and the coracoids are bony elements whereas the epicoracoids and suprascapulae in *A. chernovi* are partly ossified elements. The clavicle is closed and simple rounded shaped while the interclavicle is cruciform in three scincids species. The lengths of the anterior interclavicular process are shorter than the posterior interclavicular process in *A. budaki* and *A. chernovi* (Table 1).

The sternal-xiphisternal costal formula is (3+2), which indicates that the three pairs of ribs attach to the sternum and two pairs of ribs to the xiphisternum. A sternal fontanella is also present in all scincids species. However, the shape of the sternal fontanella in *A. kitaibelii* is mostly oval-shaped (except 4 specimens), whereas it is heart-shaped in *A. budaki* and *A. chernovi* (Table 1).

The forelimb is composed of the humeus, radius, ulna, metacarpals and digits (Fig. 6B). The ulna in the forelimb is larger than the radius. The carpus is composed of the radiale, ulnare, centrale and five distal carpals. The phalangeal formulae for the forelimbs is as follows; 2, 3, 4, 4, 3.

Pelvic Girdle and Hindlimb. The pelvic girdle consists of the epipubis, pubis, ilium, hypoischium and ischium (Fig. 7A). The single and large ischio-pubic fenestra is surrounded by the pubis and ischium. The epipubis is the terminal element, which occupies anterior to the pubis. The hypoischium is not present in the three scincid species.

The hindlimb consists of the femur, tibia, fibula, metatarsals and digits (Fig. 7B). The tarsus comprises the fibulare, tibiale and two distal tarsals. The fibulare is the biggest element of the tarsus. The phalangeal formulae for the hindlimbs from medial to lateral is as follows; 2, 4, 4, 3, 2.

Discussion

Despite the numbers of the scincids' lizards, only few osteological studies of these species have been published (Caputo, 2004; Sadlier & bauer, 2000). The skull is the most important and complicated element of lizard skeleton because of the size, shape and position of the bones. Osteological characters have provided important data for phylogenetic and functional studies (Arnold, 1983; Arnold *et al.,* 2007; Arribas *et al.,* 2013). The taxonomic position of Ablepharus species has been discussed by many authors. *A. kitaibelii* was defined by Bibron & Bory (1833) for the first time. Then, Mertens & Muller (1940) and Martens & Wermuth (1960) were defined that *A. k. kitaibelii, A. k. fabichi* and *A. k. fitzingeri* were three subspecies of *A. kitabelii*. In the following years, Fuhn (1969, 1970) was described *A. kitaibelii* into five subspecies (*A. k. kitaibelii, A. k. chernovi, A. k. fitzingeri, A. k. stepaneki* and *A. k. fabichi*). Finally, Schmitler (1997) accepted that there are three species (*A. kitaibelii, A. chernovi* and *A. budaki*) in Turkey. Taxonomic position of three species of skinks is still discussed. It is worth to be studied to show the existence of three species as a confirmation to earlier external morphological study of Schmidtler (1997).

Osteologically, we indicated that these three scincid species differ from one another in some aspects of their skeletal elements. Three remarkable differences were found among three scincid species and these are as follows: 1) the shape of the nasal, 2) the fusion/separation of the postfrontal and postorbital, 3) the numbers of the marginal teeth and 4) the number of the presacral vertebrae. Also, the subfamily Scincinae shows some osteological characters (Greer, 1970). These are the fused vomer, C-shaped palatine, separated nasal, frontal and

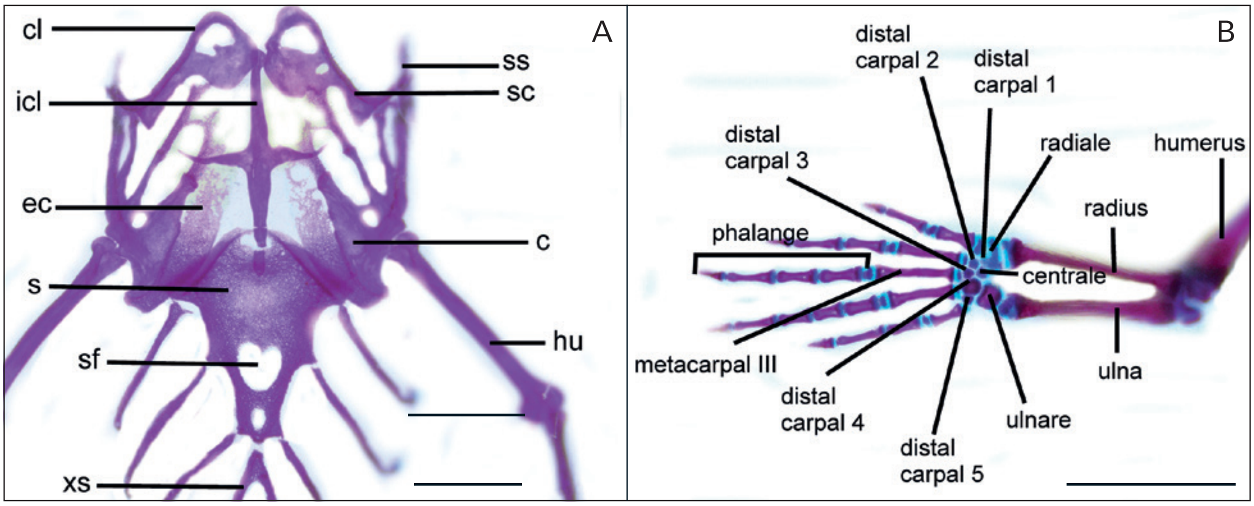

Fig. 6. A. Pectoral girdle of *A. chernovi* and **B.** Forelimb of *A. budaki*. c – corocoid; cla – clavicle; ec – epicorocoid; hu – humerus; icl – interclavicle; s – sternum; sc – scapula; ss – suprascapula; sf – sternal fontanella; xs – xiphisternum; Scale bar = 2 mm.

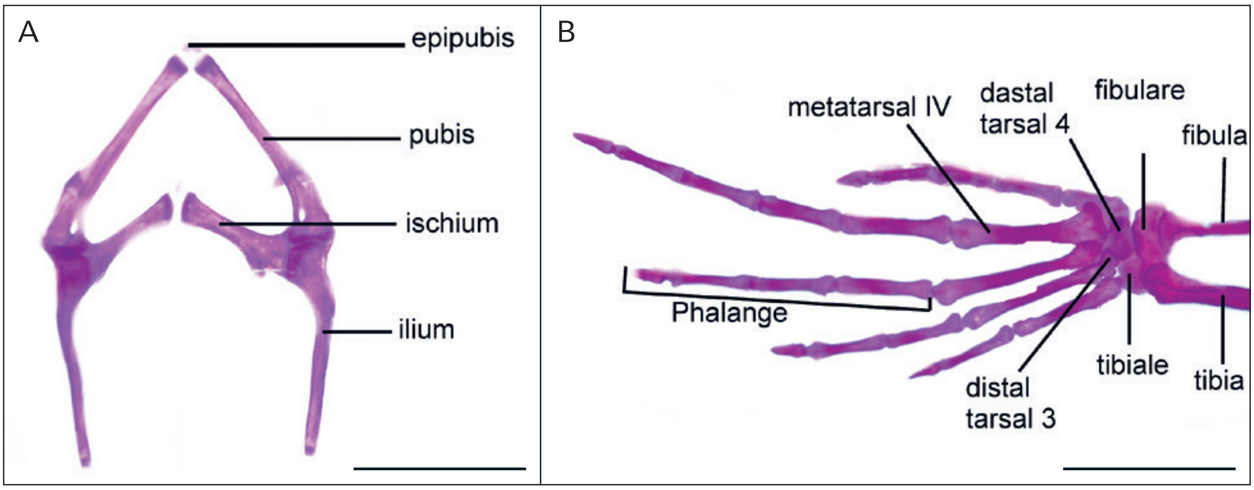

Fig. 7. A. Pelvic girdle of *A.chernovi* and **B.** Hindlimb of *A. budaki*. Scale bar = 2 mm.

premaxillae. Unlike the subfamily Scincinae, the frontal in these three scincids is a single element of the skull. Also, the palatine is approximately L-shaped in these scincids. Morover, the nasals are separated by the nasal process of the premaxilla anteriorly, whereas posterior parts of them contact each other.

Studies of skeletal morphology of lizards are limited and the family scincidae is the least studied group in this regard. There are some osteological studies that are related to different lizard families such as Agamidae, Tropiduridae, Lacertidae, Gymnophthalmidae (Abdala *et al.,* 1997; Bell *et al.,* 2009; Rostico & Rodrigues, 2010; Khosravani *et al.,* 2011). But, detailed studies of scincid osteology are limited (Caputo, 2004). *Ablepharus* species share several features with each other including the absence of the palatal teeth, presence of thirteen scleral ossicles in each eye, pattern of fore- hindlimb, and shape of the clavicle and interclavicle. These similarities may be related to similar life habits (Kardong, 2005).

The posttemporal fenestra is present in three scincids, which shows that these species have a kinetic skull because the supraoccipital is not overlapped by the parietal bone. It was formerly reported that it is present in miniaturized species (Hanken & Wake, 1993). Specimens of *Ablepharus* are one of the smallest lizards and some of the heterochronic features are associated with the small size. Miniaturazation give rise to reduced body size, bones and energy expenditure. In addition to the suptemporal fenestra, the connections between the premaxillary process of the maxilla and the maxillary process of the premaxilla is simple in these three species.

Fusion or separation of the postfrontal and postorbital is remarkable osteological character for the three scincids. In *A. kitaibelii,* the postfrontal and the postorbital bones are present as a single cranial element. It shows that there is a fusion in this part of the skull of *A. kitabelii.* But, both bones are distinct from one another in *A. budaki* and *A. chernovi.*

The number of vertebrae is also an important anatomical feature. It has interspecific and intraspecific variation within Squamata (Hoffstetter & Gasc, 1969). In our study, the numbers of the presacral vertebrae of the three scincids differ from one another. Also, there is a sexual variation among these species. In females, the higher number of presacral vertebrae is associated with the increased body length and also the shortest limb (Kaliontzopulou *et al.*, 2007). The measures of the skulls length, SVL and age are given in Table 3. *A. chernovi* specimens are longer and get older than others (*A. kitaibelii* and *A. budaki*). Also, ages in *A. chernovi* are correlated with their body length.

In the present study, we used skeletochronology to determine whether any developmental changes occur with the age or not. In our previous research, we found that skeletal elements like the clavicle have some changes with the age. The clavicle of the youngest specimens of *Eumesces schneideri pavimentatus* has two fenestrae. However, these fenestrae convert into a single one in the oldest individuals (Yildirim *et al.,* 2015). We analyzed that there are not any differences between the shape of the skeletal elements and age.

Finally, the present study emphasizes the necessity of this kind of osteological studies in lizards. Such studies contribute the systematic and phylogenetic positions of these lizards.

Conclusions

A. budaki, A. chernovi and *A. kitaibelii* show morphological differences comparable to each other such as the shape of the nasals or the fusion/separation of the postfrontals and postorbitals. These differences among three scincid lizards provide important data for future comparative morphological studies. Besides molecular studies, in the previous morphological studies have changed the taxonomic position of some lizard species (Arnold, 1983; Fu, 1998; Arribas *et al.,* 2013). So, this kind of studies shed more light on the systematic situation of these lizards.

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