A comparative study of the skull between *Trachylepis vittata* (Olivier, 1804) of the family Scincidae and *Lacerta media media* (Lantz & Cyrén, 1920) of the family Lacertidae

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In this study, the adult cranial osteology of *Trachylepis vittata* and *Lacerta media media* collected from Kermanshah Province, western Iran, are described and compared based on seven dry skull preparations. Herein, variation patterns are considered in morphology of the cranial, elements of position in the skull structure and elements of connection together between the skull of two species in order to use in phylogenetic analyses and systematic studies. The skull roof, the palate, the mandible, the teeth within each of these two species discussed and compared. The obvious differences are as follows: A complete loss of any one bone was not discerned in the study of the skull of both species, but a obvious decrease was watched in the postorbital bones in *T. vittata*. Articulations of the jugal, the squamosal and the palatine in the various regions. The variations in form, size and position in bones such as: The nasal processes of the premaxilla, the parietal, the supraoccipital, otoccipital, the paraoccipital process, prearticular, the dentary.

Key words: *osteology, postorbital, systematic, western Iran, phylogenetic analyses, cranial.*

INTRODUCTION

The vertebrate cranial system is a striking example of a complex, integrated system (Romer, 1956). The cranial system is composed of a multitude of highly integrated structural units (e.g., hyolingual system, jaws, brain, and sensory organs), each associated with, and shaped by, the different functional and structural demands exerted on the system as a whole (Romer, 1956). Although various components of the cranial system are of crucial importance in many ecologically and behaviorally relevant contexts, the use of the jaws and tongue for feeding (reviewed by (Schwenk, 2000), drinking [reviewed by Bels et al. (1994)] and fighting behaviors [Lailvaux et al. (2004); Huyghe et al. (2005); Lappin and Husak (2005); Lappin et al. (2006)] appears to be of prime importance for fitness (Herrel et al. 2007). Variations in skull proportions are common; there are, in the various lizard families, numerous departures from this generalized and primitive pattern, both in major features and in details. (Romer, 1956). Comparative anatomy of skull between different taxa of lizards for answering to the questions such as structure of the skull and differences and origin of these differences between organisms like lizards has always been a fascinating field (Herrel et al. 1999; Bell et al. 2003; McBrayer, 2004; Stayton, 2005; Faizi and Rastegar-Pouyani, 2007; Rastegar-Pouyani and Afroosheh, 2011). Most complicated of all reptilian skeletal structures and most important in problems of classification and phylogeny is the skull (Romer, 1956). The skull is a

multi-purpose tool involved in a great variety of functions. Its designs reflect and incorporate these multiple roles, like feeding systems (Kardong, 2002; Rastegar-Pouyani and Afroosheh, 2011). In addition, the skull and its associated musculature participate in sensory roles (Cooper et al. 2001) and sexual selection (Herrel et al. 1999; Rastegar-Pouyani and Afroosheh, 2011). Here we described cranial elements in the two taxa of *Trachylepis vittata* and *Lacerta media media* then the morphological differences were compared in cranial structure of two species. In this comparative study we will discuss the differences in the two different phylogenetic lines according to the osteology and comparison of the size, shape and connection of the skull bones between the two above mentioned taxa of skinks and lacertids.

MATERIAL AND METHODS

The species used in this study are four adult specimens of *Trachylepis vittata* (mean SVL= 78.79 mm) and three adult specimens *Lacerta media media* (mean SVL= 119/95 mm) were collected in Kermanshah province, during field work in 2010–2011. The specimens were prepared and stained according to the standard methods of skull preparation (Taylor, 1967; Zug & Crombie, 1970). Following preparation, specimens were labeled and scanned in lateral, dorsal and ventral views. Illustrations were produced by photographing the skulls through a Camera model Canon PowerShot SX120IS and a scanner Ginus (color page HR7X slim). Then by use of an Olympus loop (Model: SzX12) the detailed characters of each skull were examined. A full description of each cranial element of *Trachylepis vittata* and *Lacerta media media* is given and morphological characters are used for the description and comparative differences.

RESULTS

Description of the Skull Elements of *Trachylepis vittata*

The premaxillae (pm) are paired that form the anteromedial margin of the snout, Dorsally the premaxillae articulate with the nasals and with the maxilla anterolaterally and on the ventroanterior surface of the skull they articulate with the vomer posteromedially and the maxilla posterolaterally. The premaxilla have four pleurodont teeth per each side and one in the median (Figs. 1 A, B, C).

The maxillae (m) are the bones of skull with 20 pleurodont teeth per each side that they exist between the orbits and the snout. Replacement teeth are present. The teeth are cylindrical, homodont, rounded at the tips. Anterodorsally, the maxillae articulate with the premaxilla and septomaxilla, with the nasal posterodorsally, with the prefrontals, the lacrimals, and the jugals, posteriorly. Ventrally, articulation is with the premaxillae and the vomers anteriorly, the palatines medially, the jugals and the ectopterygoids posteriorly. The maxillae are not contact with the frontal. The lateral surfaces of the each maxillae include 4-6 labial foramina (lf) of varying sizes and shapes (Figs. 1 A, B, C).

The septomaxillae (sm) are small bones lying dorsal to Jacobson's organ and anteriorly within the nasal capsules. The septomaxillae articulate with the premaxilla and with the maxillae in the floor of the narial openings (Figs. 1 A, C).

The nasal (n) bones are thin plates and oval that they cover most of the anterior dorsal surface of the nasal capsules. Anteriorly, the nasal articulate with the premaxillae and the narial openings, the maxillae anterolaterally, the prefrontal posterolaterally, the frontal posteriorly. Three to five nasal foramina are present (Figs. 1 A, C).

The prefrontal (pref) bones are placed at the anterodorsal end of the orbit. They articulate with the maxillae dorsolaterally, the frontals dorsomedially, the nasals anterodorsally, the lacrimal laterally (Figs. 1 A, C).
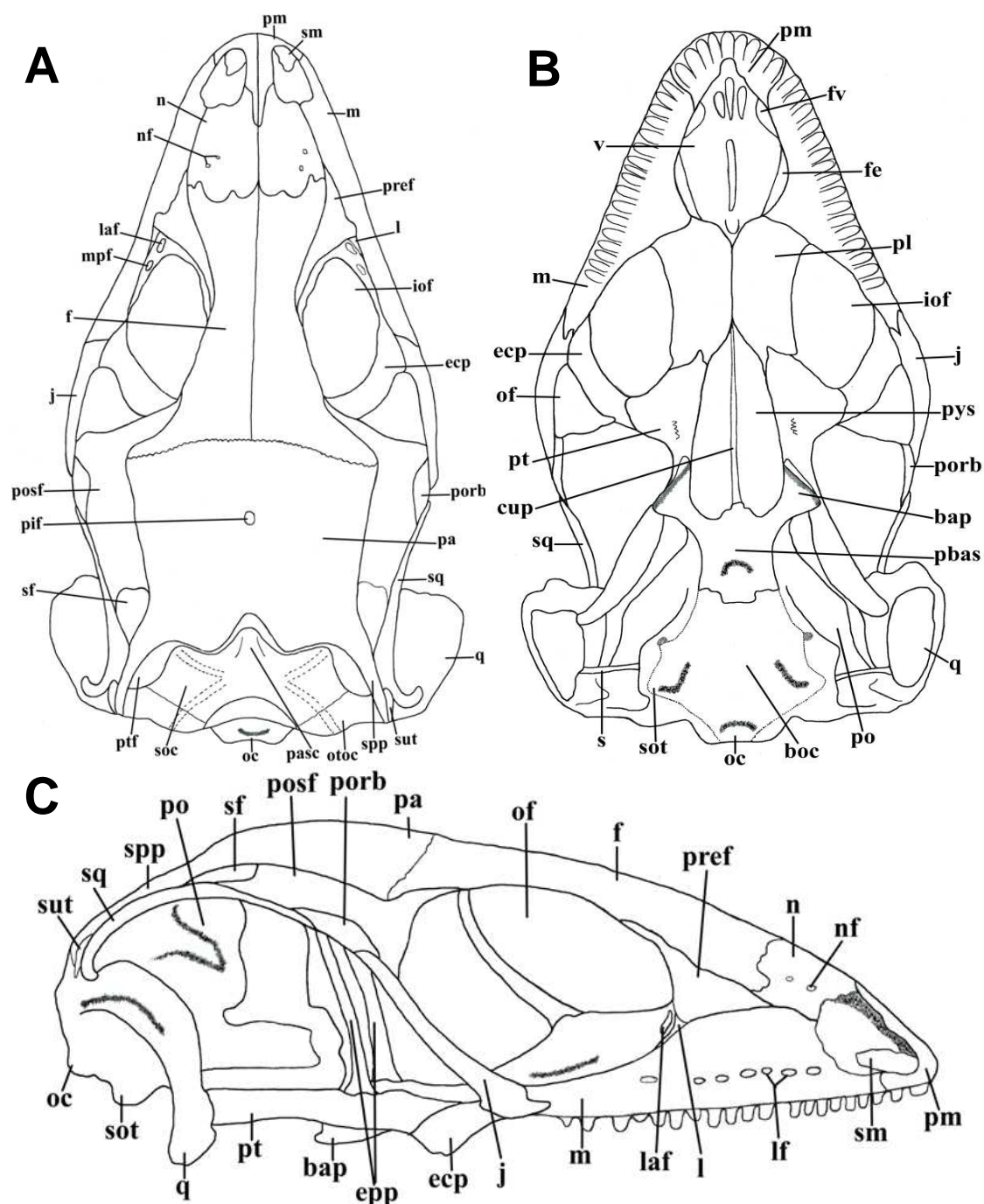
FIGURE 1. Dorsal (A), ventral (B) and Lateral (C) views of the skull in the adult *Trachylepis vittata*. Abbreviations; bap, basipterygoid process; boc, basioccipital; cup, cultriform process; ecp, ectopterygoid; epp, epipterygoid; f, frontal; fe, fenestra exochoanalis; fv, fenestra vomeronasalis externa; iof, inferior orbital fenestra; j, jugal; l, lacrimal; laf, lacrimal foramen; lf, labial foramina; m, maxilla; mpf, maxilloplatine foramen; n, nasal; nf, nasal foramen; oc, occipital condyle; of, orbital fossa; otoc, otoccipital; pa, parietal; pasc, processus ascendens; pbas, parabasisphenoid; pif, pineal foramen; pl, palatine; pm, premaxilla; po, prootic; porb, postorbital; posf, postfrontal; pref, prefrontal; pt, pterygoid; ptf, post temporal fossa; pys, pyriform space; q, quadrate; s, stape; sf, supratemporal fossa; sm, septomaxilla; soc, supraoccipital; sot, sphenoccipital tubercle; spp, supratemporal process of parietal; sq, squamosal; sut, supratemporal; v, vomer.

The lacrimals (l) are small bones at the ventroanterior margin of the orbit. On their posteroventral surface there is a foramen penetrating which forming from the orbital side into the nasal cavity. They are fused with the prefrontals and the maxillae (Figs. 1 A, C).

The jugals (j) are curved and narrow bones form the lateroventral margin of the orbits. Its posterior end contact with the postfrontal and postorbital. The ventral part becomes broad that it articulates with the ectopterygoid and the maxillae (Figs. 1 A, B, C).

The frontals (f) are two in number form the skull roof between the orbits and they placed under the frontal and frontoparietal scales of the dorsal surface of the head. Anteriorly they meet the nasals and prefrontals. Posteriorly, they articulate with the postfrontal and parietal (Figs. 1 A, C).

The parietal (pa) is a single posterior dorsal element placed under the parietal, interparietal and nuchal scales of the surface of the head. The parietal articulates with the postfrontals laterally and the frontal anteriorly. The supratemporal processes contact with the squamosals, the supratemporals, quadrate and otoccipital. Ventrally supratemporal processes form the lateral margin of the supratemporal fossa (sf), and articulation with the anterodorsal border of the epipterygoids. A parietal foramen lies on the posteroventral surface of the parietal (Figs. 1 A, C and 2).

The postfrontals (posf) are thin, narrow pieces that form the posterior margin of the orbits. The postfrontals contact with the frontal anterolaterally, the parietal dorsolaterally, the postorbitals and jugal anterolaterally (Figs. 1 A, C).

The postorbitals (porb), small bones lie beneath the postfrontals, do not form part of posterior orbits and reduced in size when compared to other near bones. These elements articulate with the jugal anteroventrally, the postfrontal dorsally and the squamosal posteroventrally (Figs. 1 A, C).

The squamosals (sq) are slender bones, posteriorly they curve and downward to contact with the quadrate. The squamosals are separated from the jugals by the postorbitals, and also form the posterolateral border of the supratemporal fossae. They contact in front with the postorbitals, the postfrontal dorsally, supratemporal process of parietal and supratemporal posterodorsally, the quadrate and paraoccipital posteriorly (Figs. 1 A, B, C and 2).

The supratemporals (sut) are small slender bones that lie between the squamosals and the supratemporal process of the parietal dorsally. Ventral articulation is with the quadrates and the paraoccipital processes (Figs. 1 A, C and 2).

The vomers (v) cover the anteroventral surface of the skull. They form the inner border of each fenestra vomeronasalis externa (fv) and each fenestra exochoanalis (fe). Anteriorly they become broad, and contact with the premaxillae and the maxillae. The right and left halves are united in a groove along their median line. Each half includes one pair of Jacobson's organs. At the extreme anterior end in medial longitudinal groove is a tubercle with a cartilaginous tip. Posterior articulation is with the palatines (Fig. 1 C).

The palatines (pl) are broad in the entire length, relatively large, with a small overlap and they are posteromedially separated by the anterior pyriform space (pys). Two plates make up this bone, one placed dorsally and other ventrally. Both plates are fused along the lateral borders. Posteriorly these two plates unite each other and contact with the pterygoids. Anteriorly the dorsal plates articulate with the vomers. The ventral plates contact with the maxillae by the posterior palatine processes (Fig. 1 C).

The pterygoids (pt) are large and Y-shaped bones. These elements have several pleurodont teeth. The pterygoids form the posterior margin of each inferior orbital fenestra, and also with the basipterygoid processes of the parabasisphenoids together produce two-thirds of posterior margin pyriform space. These elements articulate anteriorly with the palatines, laterally with the ectopterygoids, and the jugals, posteriorly with the quadrate, and about its middle with the basisphenoid (Figs. 1 B,C and 2).
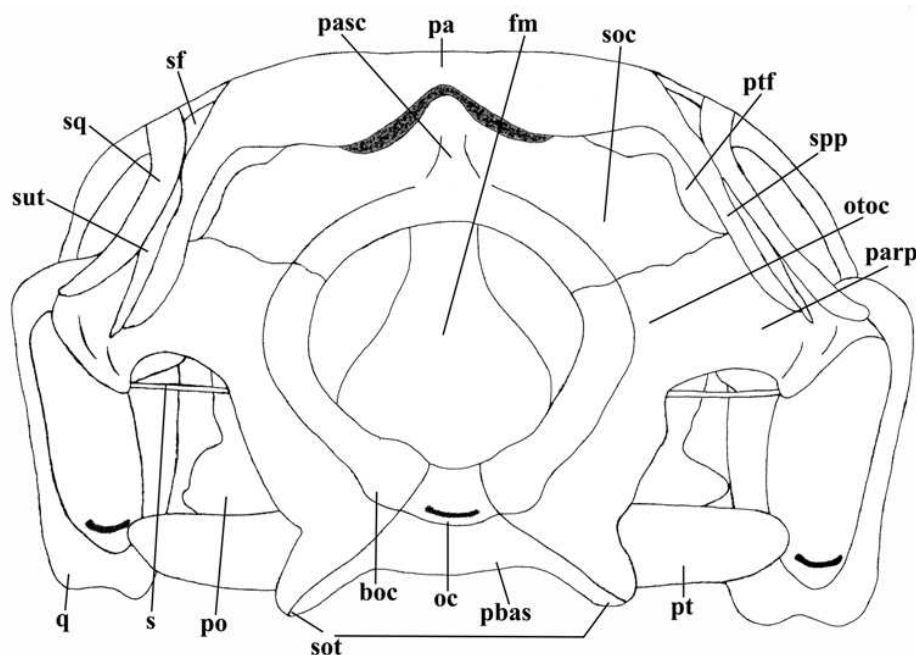
FIGURE 2. Posterior view of the skull in the adult *Trachylepis vittata*. Abbreviations; boc, basioccipital; fm, foramen magnum; oc, occipital condyle; otoc, otoccipital; pa, parietal; parp, paraoccipital process; pasc, processus ascendens; pbas, parabasisphenoid; po, prootic; pt, pterygoid; ptf, post temporal fossa; q, quadrate; sf, supratemporal fossa; soc, supraoccipital; sot, sphenoccipital tubercle; spp, supratemporal process of parietal; sq, squamosal; sut, supratemporal; s, stape.

The ectopterygoids (ecp) enlarge from the maxillary and jugal bones to the pterygoid (Figs. 1 A, B, C).

The epipterygoids (epp) are rod-shaped bones extending from dorsal surface of the pterygoids to the parietal and the prootics (Fig. 1 C).

The quadrates (q) are large and semicircular units articulate with the lower jaw and form the posterior and lateral surfaces of the skull. Posterior articulation is squamosal, supratemporal, and supratemporal process of the parietal and paraoccipital process of the otoccipital and with the pterygoids and stape anteriorly (Figs. 1 A, B, C and 2).

The stapes (s) are thin cylindrical bones that locate into the fenestrae ovali of the paraoccipital process. They are directed posterolaterally and expand into the quadrate region (Figs. 1 A, B and 2).

The basioccipital (boc) contributes to the cranium floor, it is located ventral to the foramen magnum (fm) and between the otic capsules. It fused with the parabasisphenoid anteriorly and the prootics laterally. Along the anterior and lateral margin of this diamond-shaped area the basioccipital contacts with the parabasisphenoid by an irregular suture and the basioccipital-prootic suture extends posteriorly and then dorsally. This element contact with the otoccipital ventrolaterally and supraoccipital dorsally. In ventral surface, on each side the basioccipital has a small ventrolateral process, spheno-occipital tubercle (sot) (Fig. 1 B).

The parabasisphenoid (pbas) contributes to the anterior portion of the braincase floor. This element has four processes: two anterolateral processes that enlarge distally into flangelike processes and articulate with the quadrate process of the pterygoid by a cartilaginous pad, basipterygoid processes (bap), its apex has a long process that extending to the pyriform space, cultiform process (cup), and the posteromedial process, a short process, contacts the anterior margin of the basioccipital (Fig. 1 B).

The otoccipitals (otoc) contribute to the posterolateral walls of the braincase and articulate the prootics anterolaterally, the supraoccipital dorsomedially, the parabasisphenoid ventromedially and the basioccipital mediolaterally. These elements form the lateral borders of the foramen magnum and lateral portions of the occipital condyle. The otoccipitals have anterolateral paraoccipital processes (parp) (Fig. 2).

The prootics (po) form the posterolateral walls of the braincase and the otic capsules. They articulate with the basioccipital ventroposteriorly, the parabasisphenoid ventrally, the supraoccipital posterodorsally, the otoccipital posteriorly, the parietal dorsally. Posteroventrally fusion is made with the paraoccipital processes. Its articulation with the otoccipital and basioccipital is fused. The anterior descending processes articulate with the posterodorsal border of the epipterygoids. In the adult specimens the sutures are not clearly distinguishable (Figs. 1 B,C and 2).

The supraoccipital (soc) is an unpaired median element, at the posterior roof of the braincase that forms the superior margin of the foramen magnum (fm) and fuses with the exoccipitals, paraoccipitals and some of the bones of the otic capsule. It contacts with the posterior region of the parietal anterodorsally, with the prootic anteroventrally, and with the otoccipital posterolaterally. A ascendens process of the anterodorsal margin of the supraoccipital extends posteriorly under the parietal and forms a metakinetic articulation by a gap of connective tissue with the medial posterior processes of the parietal, processes ascendens (pasc). The supratemporal process of the parietal, the otoccipital and supraoccipital forms margins of the post temporal fossa (ptf) (Figs. 1 A and 2).

Description of the Mandible's Elements of *Trachylepis vittata*

The dentary (d) is the tooth-bearing element of the mandibular bones. Each dentary bone has 23 to 26 pleurodont teeth. The anterior end of the Meckel's cartilage exits the dentary anterolingually through the anterior end of Meckel's canal. The dentary articulates the splenial at the posterior end of Meckel's cartilage and with the anterior process of the coronoid, the surangular, and the angular anteriorly. Laterally, the anterior half of the dentary contains 5 to 7 mental foramina (menf) of various sizes and shapes (Figs. 3 A, B).

The coronoid (cor) is an inverted "V" shaped element which located between the dentary and supra-angular. In lingual surface, this element has three processes: The posterior process contacts with the supra-angular and prearticular, the anterior process contacts with the dentary anteriorly, splenial ventrally, prearticular and supra-angular posteriorly, and the dorsal process that contacts with the dentary anteriorly. Anteriorly, the base of the dorsal process is separated from the tooth row by connective tissue. In lateral surface, mandible, the coronoid contacts with the dentary anteroventrally, and supra-angular posteroventrally (Figs. 3 A, B).

The angular (an) is placed on both surface of the mandibular ramus. On the lateral surface, it contacts with the dentary anteriorly, supra-angular dorsally and prearticular posteroventrally. On the lingual surface, the angular contacts with the splenial anteriorly, and with the prearticular dorsally and posteriorly. Anteroventrally, this element contains a small foramen, named as posterior mylohyoid foramen (pmyf) (Figs. 3 A, B).

The supraangular (sa) covers the dorsal portion of the ramus between coronoid and articular lingually, and coronoid and prearticular laterally. It forms the anterior portion of the articular process and in lateral view articulates with the coronoid anterodorsally, the dentary anteroventrally, the angular ventrally and prearticular posteriorly. On the lateral surface two foramina are placed that the larger is the anterolateral supra-angular foramen (alsf), close to the coronoid and the smaller, the posterolateral supra-angular foramen (plsf), is close to the posterior end. On the lingual surface it is overlapped by the coronoid anteriorly and fused with the prearticular ventrally. Posteriorly it contributes to the adductor fossa (afs) with the prearticular, which is described by these two bones.
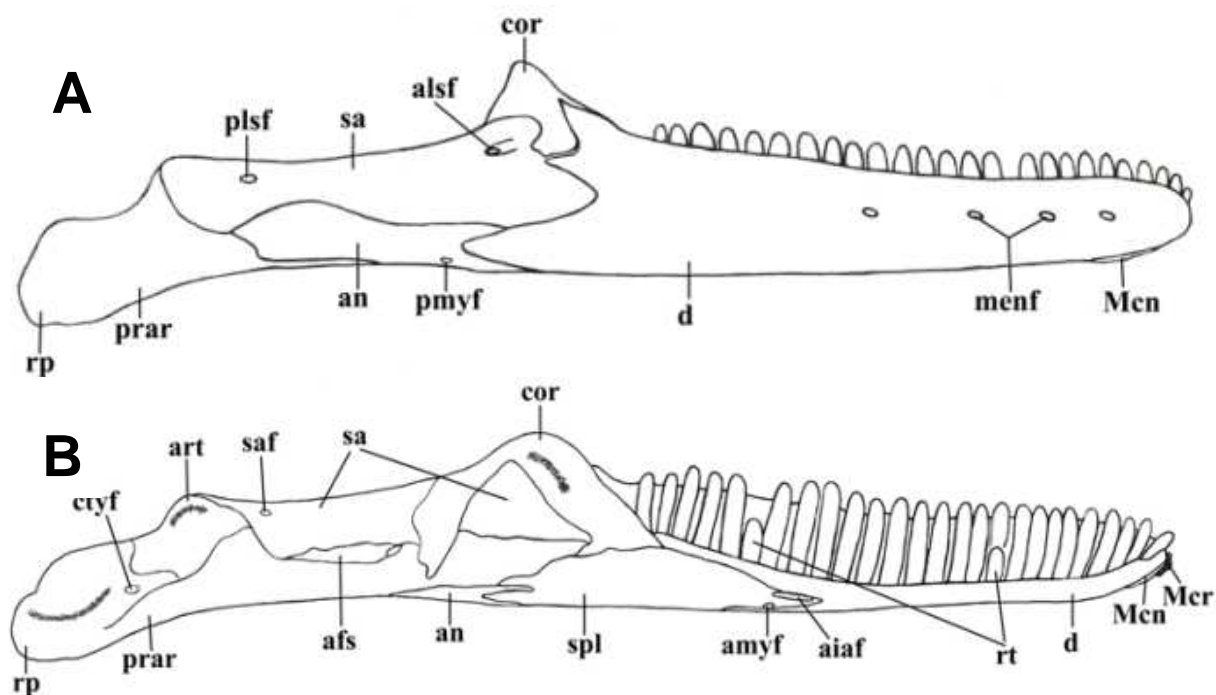
FIGURE 3. Ventral (A) and Lateral (B) views of the mandible of the skull in the adult *Trachylepis vittata*. Abbreviations; afs, adductor fossa; aiaf, anterior inferior alveolar foramen; alsf, anterolateral supra-angular foramen; amyf, anterior mylohyoid foramen; an, angular; art, articular; cor, coronoid; ctyf, chorda tympani foramen; d, dentary; Mcn, Meckel's canal; Mcr, Meckel's cartilage; menf, mental foramina; plsf, posterolateral supra-angular foramen; pmyf, posterior mylohyoid foramen; prar, prearticular; rp, retroarticular process; rt, replacement teeth; spl, splenial; sa, supra-angular; saf, supra-angular foramen.

In lingual surface, on the posteromedian portion of the articular, the supra-angular has a foramen, herein designated the supra-angular foramen (saf) (Figs. 3 A, B).

The prearticular (prar) is a major component of the lingual surface of the ramus and forms the posterior half of the ramus. In lingual surface, It is generally fused with the articular posteriorly, supra-angular dorsally, anterior lingual process of the coronoid and splenial anteriorly, posterior lingual process of coronoid anterolaterally, the angular anteroventrally. Posteriorly, this element forms the retroarticular process of the ramus. The chorda tympani foramen (ctyf) is located in lateral side of its proximal end, at the inner posteriorly. The adductor fossa is formed by the posteroventral margin of the supra-angular and the dorsal margin of the prearticular. In lateral surface, the prearticular articulates the angular and supra-angular anteriorly (Figs. 3 A, B).

The splenial (spl) locates on the medial anterior portion of the ramus. This element contacts with the dentary anterodorsally, anterior lingual process of the coronoid dorsally, prearticular posterodorsally, and angular posteriorly. This element contains the posteroventral rims of the anterior inferior alveolar foramen (aiaf) and also the anterior mylohyoid foramen (amyf) just posterior to the open portion of Meckel's cartilage (Figs. 3 B).

Description of the Skull Elements of *Lacerta media media*

The premaxillae (pm) unpaired element forms the anteromedial margin of the snout and penetrates between the fenestra exonaria. This element contacts with the maxilla anterolaterally, with the nasals dorsally. In ventroanterior surface, it articulates with the vomer posteromedially and the maxilla posterolaterally. The premaxilla bears nine pleurodont teeth with single cusps anteriorly (Figs. 4 A, B, C).

The maxillae (m) are the large bones that form most of the anterolateral surface of the skull. They form the posterior margin of the fenestra exonaria dorsally. These elements bear 20 pleurodont teeth. These elements articulate with the nasal and prefrontal posterodorsally, the lacrimals, and the jugals, posteriorly, the premaxilla and septomaxilla, anterodorsally. The maxillae are contact with the frontal dorsally. In ventral surface, they contact with the premaxillae and the vomers anteriorly, the palatines medially, the jugals and the ectopterygoids posteriorly. 5 – 6 labial foramina are present in the lateral surfaces of the each maxilla in varying sizes and shapes (Figs. 4 A, B, C).

The septomaxillae (sm) are small bones, usually convex above in the anterior border of the nasal capsule. It articulates with the premaxilla anteriorly and with the maxilla posteriorly in the floor of the narial openings (Figs. 4 A, C).

The nasals (n) are small bones that form roof of the nasal capsules. Articulation is with the premaxillae and the narial openings anteriorly, the maxillae anterolaterally, the prefrontal posterolaterally, and the frontal posteriorly (Figs. 4 A, C).

The prefrontals (pref) are rather triangular elements in shape and form anterodorsal border of the orbit. These elements contact with the maxillae dorsolaterally, the frontals dorsomedially, the lacrimal ventrolaterally (Figs. 4 A, C).

The lacrimals (l) are long and small bones at the ventroanterior border of the orbit. They articulate with the maxilla anterolaterally, with the jugal ventrolaterally and posterolaterally, with the prefrontal posteromedially and posterolaterally. They have a foramen in ventral surface, the lacrimal foramen (Figs. 4 A, C).

The jugals (j) are L-shaped and form the lateroventral rims of the orbits. They have two processes: The ventral process becomes broad that contact the maxilla anteriorly, the ectopterygoid posteromedially, and the lacrimal anterodorsally. The posterior process is narrow and contacts the postorbital (Figs. 4 A, B, C).

The frontals (f) are two elements on the roof of the skull and form most of the dorsal orbital margin. Anteriorly, the frontal is W-shaped because of the presence of one anteromedial and two anterolateral processes. They articulate with the nasal anteriorly, the maxilla and the prefrontal anterolaterally. Posteriorly, these elements contact the parietal, the postfrontal posterolaterally and the supraocular plates midlaterally (Figs. 4 A, C).

The parietal (pa) is a single and relatively flat element with small curvature in the posterolateral region. Two processes of parietal having divergence posterolaterally, the supratemporal processes that contact the squamosals, the supratemporals, quadrate, otoccipital and the epipterygoid and prootic ventrally and also form lateral margin the supratemporal fossa. The parietal articulates with the frontal anteriorly, the postfrontals dorsolaterally. On the posteroventral surface of the parietal, in the center of the interparietal scale, exist a parietal foramen (Figs. 4 A, C and 5).

The postfrontals (posf) are rather large and somewhat trapezoidal shape that form the posterior rim of the orbits. Articulation is with the postorbital anterolaterally, the squamosal posterolaterally, the supratemporal fossa posteromedially, the frontal anterolaterally (Figs. 4 A, C and 5).

The postorbitals (porb) are triradiate elements and form the posterior rim of the orbit and the dorsal rim of the supratemporal fossa. They articulate with the jugal anteroventrally, the postfrontal medially, the squamosal posteriorly (Figs. 4 A, C).

The squamosals (sq) are long, slender and concave and form the posterolateral border of the supratemporal fossa. They contact with the postorbital anteriorly, the supratemporal posteriorly, the quadrate ventrally and meet somewhat with the otoccipital (Figs. 4 A, C and 5).

The supratemporals (sut) are small and longitudinal bones and are surrounded by supratemporal processes of the parietal and the squamosals. These elements articulate with the quadrate, the otoccipital ventrally (Figs. 4 A, C and 5).
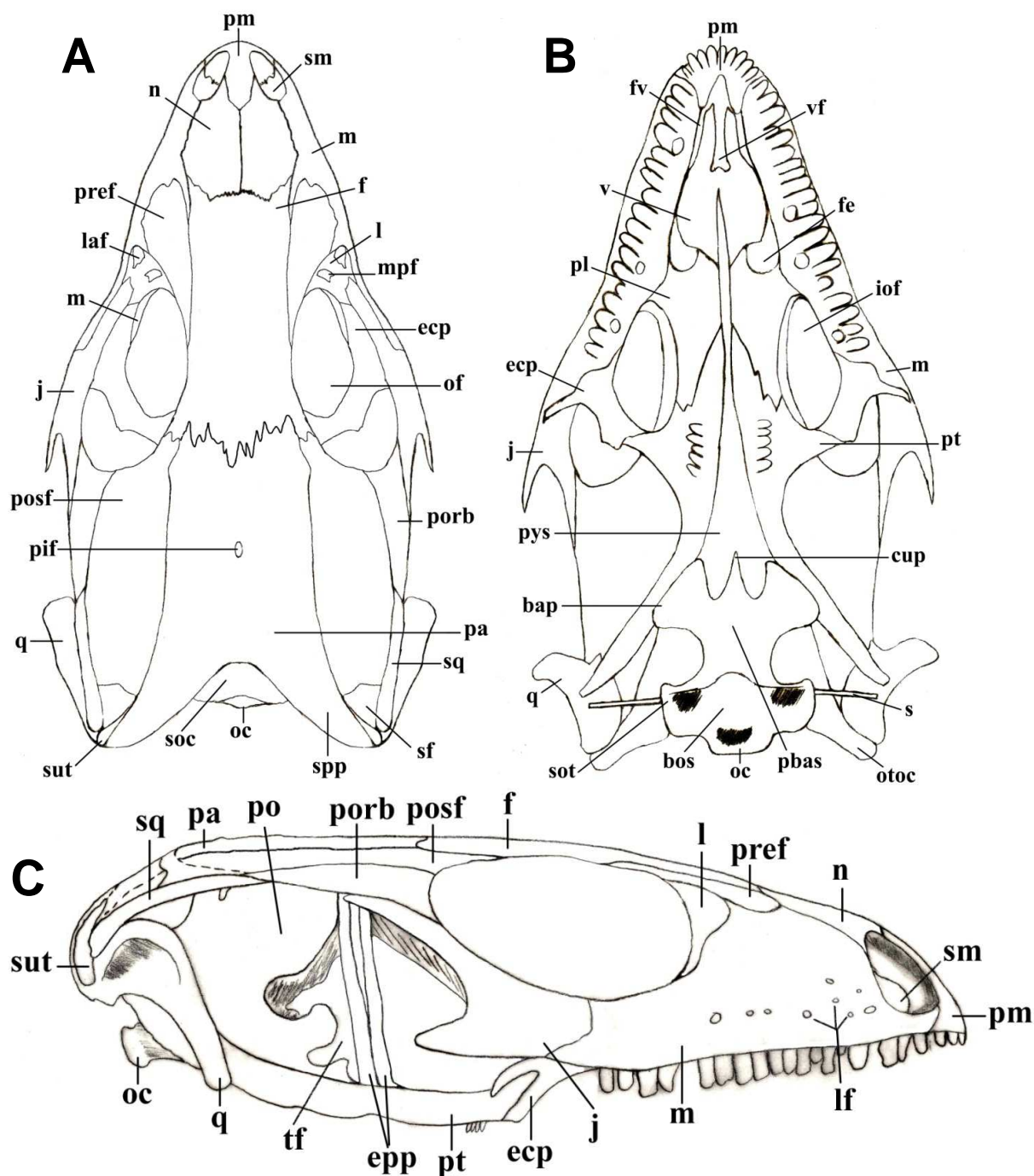
FIGURE 4. Dorsal (A), ventral (B) and Lateral (C) views of the skull in the adult *Lacerta media media*. Abbreviations; bap, basipterygoid process; boc, basioccipital; cup, cultriform process; ecp, ectopterygoid; epp, epipterygoid; f, frontal; fe, fenestra exochoanalis; fv, fenestra vomeronasalis externa; iof, inferior orbital fenestra; j, jugal; l, lacrimal; laf, lacrimal foramen; lf, labial foramina; m, maxilla; mpf, maxilloplatine foramen; n, nasal; oc, occipital condyle; of, orbital fossa; otoc, otoccipital; pa, parietal; pbas, parabasisphenoid; pif, pineal foramen; pl, palatine; pm, premaxilla; po, prootic; porb, postorbital; posf, postfrontal; pref, prefrontal; pt, pterygoid; pys, pyriform space; q, quadrate; s, stape; sf, supratemporal fossa; sm, septomaxilla; soc, supraoccipital; sot, sphenoccipital tubercle; spp, supratemporal process of parietal; sq, squamosal; sut, supratemporal; tf, temporal fossa; v, vomer; vf, vomerine fossa.
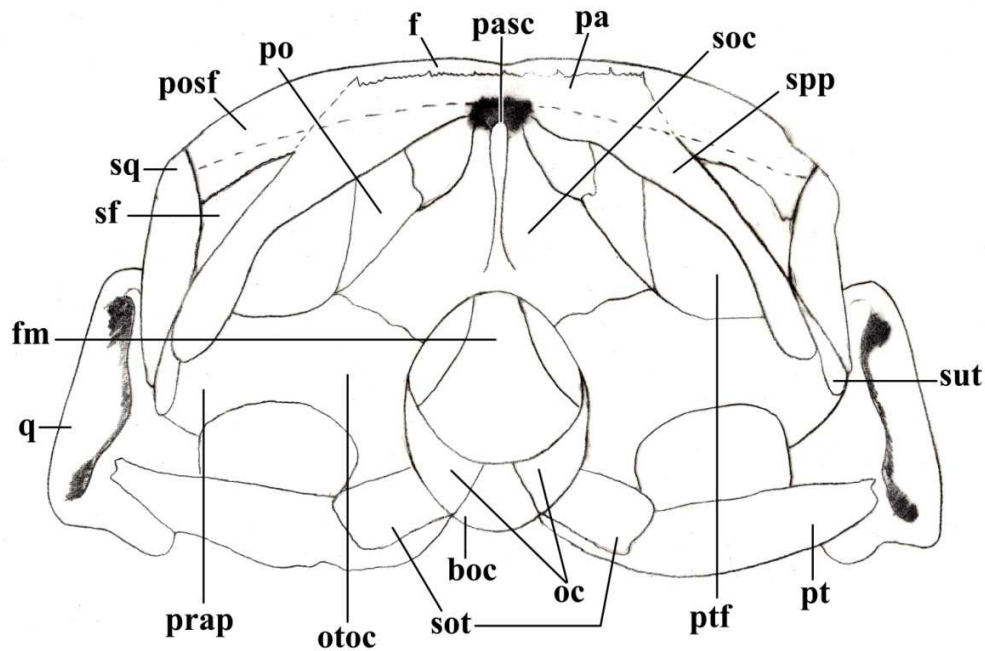
FIGURE 5. Posterior view of the skull in the adult *Lacerta media media*. Abbreviations; boc, basioccipital; fm, foramen magnum; oc, occipital condyle; otoc, otoccipital; pa, parietal; parp, paraoccipital process; pasc, processus ascendens; po, prootic; posf, postfrontal; pt, pterygoid; ptf, post temporal fossa; q, quadrate; sf, supratemporal fossa; soc, supraoccipital; sot, sphenoccipital tubercle; spp, supratemporal process of parietal; sq, squamosal; sut, supratemporal.

The vomers (v) are pear-shaped and cover the anteroventral surface of the skull. They form the medial margin of each fenestra vomeronasalis externa (fv) anterolaterally and each fenestra exochoanalis (fe) posterolaterally. The vomers have a vomerine fossa (vf) in the anterior halve. The vomers articulate with the premaxilla anteriorly and maxilla laterally. Posteriorly they contact with the palatines (Fig. 4 B).

The palatines (pl) are quietly separated by the anterior of the pyriform space and have three processes: the vomerine process articulates with the vomer anteriorly, the maxilla laterally and lateral margin of the vomerine process form posterior and medial border of the fenestra exochoanalis. The pterygoid process forms a second the median margin of the inferior orbital fenestra. The maxillary process articulates with the maxilla laterally, the prefrontal dorsally, ectopterygoid and jugal posteriorly (Fig. 4 B).

The pterygoids (pt) are the largest and most posterior elements of the palate and have 5-10 pleurodont teeth. These elements with the basipterygoid processes of the parabasisphenoids together form posterior margin of the pyriform space and this space separated them. The pterygoids bear three processes: the palatine process articulates with the palatine anteromedially, the transverse process articulates with the ectopterygoid laterally. The palatine and transverse processes form the median and posterior margins of the inferior orbital fenestra, respectively. The quadrate process is medially concave, laterally convex, and extends posterolaterally to contact with the anteromedial portion of the quadrate (Figs. 4 B, C and 5).

The ectopterygoids (ecp) form the posterolateral margin of the inferior orbital fenestra. They have three processes: the anterolateral process contacts the maxilla, the posterolateral process contacts the jugal, and the medial process contacts the ectopterygoid process of the pterygoid (Figs. 4 A, B, C).
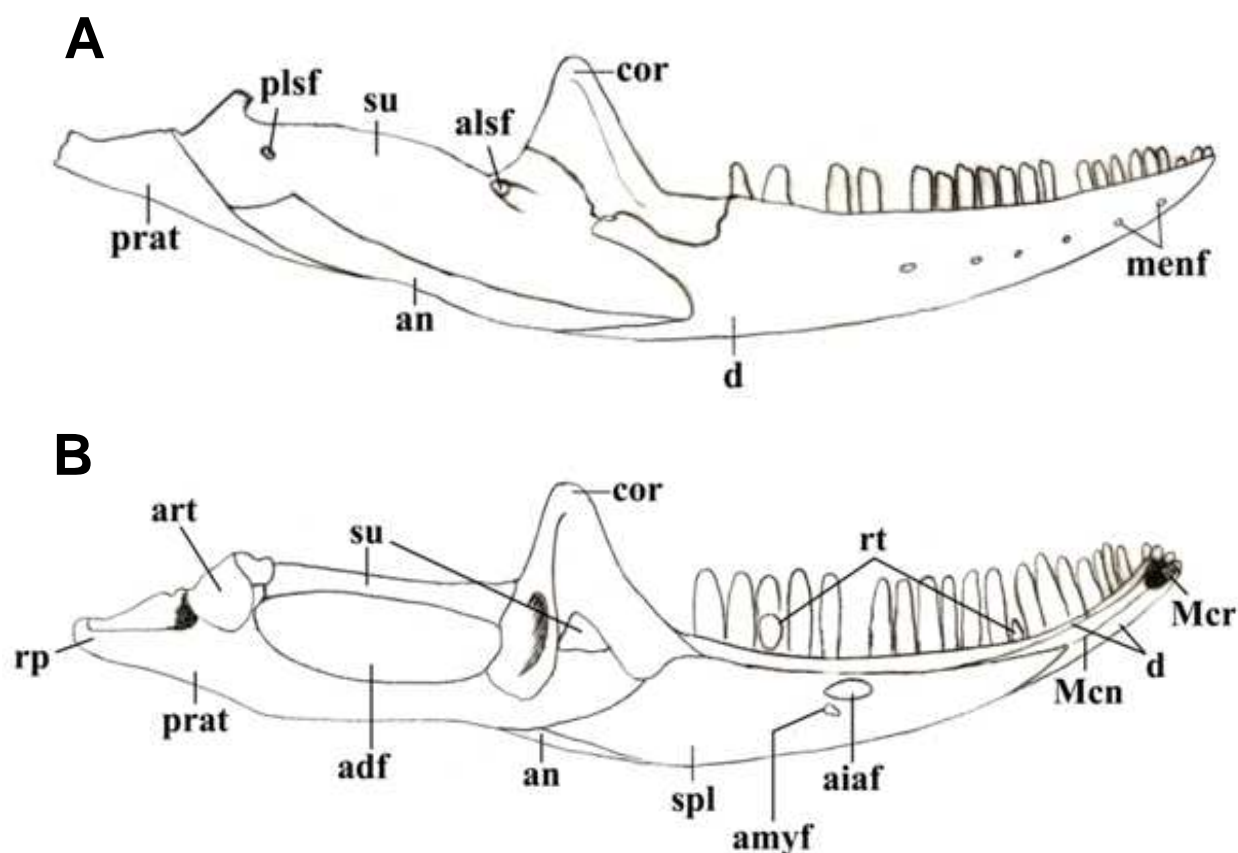
FIGURE 6. Ventral (A) and lateral (B) views of the mandible of the skull in the adult *Lacerta media media.* Abbreviations; adf, adductor fossa; aiaf, anterior inferior alveolar foramen; alsf, anterolateral supra-angular foramen; amyf, anterior mylohyoid foramen; an, angular; art, articular; cor, coronoid; d, dentary; Mcn, indicates Meckel's canal; Mcr, Gray indicates Meckel's cartilage; menf, mental foramina; plsf, posterolateral supra-angular foramina; prat, prearticular; rp, retroarticular process; rt, replacement teeth; spl, splenial; su, surangular.

The epipterygoids (epp) are oblique and columnar bones. The dorsal end of epipterygoids contact with the parietal and the prootics and their ventral end contact with the quadrate process of the pterygoid (Fig. 4 C).

The quadrates (q) are large and the most posterolateral elements in the skull that contact and support the lower jaw. They articulate with the supratemporal dorsomedially, the squamosal dorsolaterally, the otoccipital posteriorly, the pterygoid ventrally (Figs. 4 A, B, C and 5).

The stapes (s) are small and cylindrical bones which fit into the fenestrae ovali (Fig. 4 B).

The basioccipital (boc) locates between the otic capsules and forms the posterior floor of the braincase and the ventral portion of the occipital condyle. This element articulates with the parabasisphenoid anteriorly, the prootics laterally and the otoccipital posterolaterally. In ventral surface, the basioccipital bears two small ventrolateral processes, spheno-occipital tubercle (sot) (Figs. 4 B and 5).

The parabasisphenoid (pbas) forms the anterior floor of the braincase. This element has five processes: on the anterior portion is a long process which extending to the pyriform space, cultiform process (cup), two anterolateral processes that articulate with the quadrate process of the pterygoid by a cartilaginous pad, basipterygoid processes (bap) and the two posterior processes articulate with the basioccipital and prootic posteriorly (Fig. 4 B).

The otoccipitals (otoc) form the posterolateral walls of the braincase and the lateral margins of the foramen magnum and lateral rims of the occipital condyle. They meet the basioccipital posteroventrally, the supraoccipital dorsally, the posterior process of the parietal, the quadrate and the squomusal posteriorly. They contact posterior end of the prootics and cover posterolateral surface of the supratemporal obliquely. The otoccipitals bear lateral paraoccipital processes (parp) (Fig. 5).

The prootics (po) form the posterolateral walls of the braincase and the otic capsules. Articulation is with the basioccipital ventroposteriorly, the parabasisphenoid ventrolaterally, the supraoccipital posterodorsally, the parietal dorsally, the otoccipital posteriorly and the posterodorsal margin of the epipterygoids. They fused with the paraoccipital processes (Figs. 4 C and 5).

The supraoccipital (soc) is a single, saddle-shaped element and forms the posterior roof of the braincase and the superior margin of the foramen magnum (fm). It meets the parietal anterodorsally, the prootic anteroventrally and the otoccipital posterolaterally. Processus ascendens (pasc) is an ascendens process of the anterodorsal margin of the supraoccipital that separated from the parietal by a median cartilaginous and extends under the parietal posteriorly. It forms anteroventral margin of the post temporal fossa (ptf) (Figs. 4 A and 5).

Description of the Mandible Elements of *Lacerta media media*

The dentary (d) forms the main element of the mandible and is the tooth-bearing element of the mandibular bones. It bears 23-27 pleurodont teeth. Meckel's canal from the tip of the splenial penetrates to the dentary and reaches its tip. In lingual surface, the dentary surrounds the splenial, due to the splenial penetrates into the dentary, it has two branchs: The dorsal branch of the thickness is greater and bears teeth. The ventral branch is narrow and extends to the posterior end of the splenial and the angular margin. In Lateral surface, it articulates with the coronoid posterodorsally, with the supra-angular and angular posteriorly. On the anterior half of the dentary contains six mental foramina (menf) of various sizes and shapes (Figs. 6 A, B).

The coronoid (cor) is a triangular element which located behind the tooth row, between the dentary and supra-angular. In lingual surface, this element has three processes: The posterior process articulates with the supra-angular and prearticular, the anterior process articulates with the dentary anteriorly, and splenial ventrally, prearticular and supra-angular posteriorly, and the ventral process that bears a protuberance enclosed by the articular. In lateral surface, it articulates with the dentary anteroventrally, and supra-angular posteroventrally (Figs. 6 A, B).

The angular (an) is placed on both surface of the mandibular ramus. In the lateral surface, it contacts with the dentary anteriorly, supra-angular dorsally, prearticular posteroventrally and the articular posteriorly. In the lingual surface, it is small and contacts with the splenial anteriorly, and with the prearticular dorsally and posteriorly. The posterior mylohyoid foramen (pmyf) exist in the anteroventral portion of angular (Figs. 6 A, B).

The supraangular (sa) covers the dorsal portion of the ramus between coronoid and articular. In lateral view, it articulates with the coronoid anterodorsally, the dentary anteroventrally, the angular ventrally and articular posteriorly. It has two foramina that the larger is the anterolateral supra-angular foramen (alsf), close to the coronoid and the smaller, the posterolateral supra-angular foramen (plsf), is close to the articular. In lingual view it articulates with the coronoid anteriorly and articular ventrally. Posteriorly it forms wall of the adductor fossa (afs) with the prearticular, which is described by these two bones (Figs. 6 A, B).

The prearticular (prar) forms the posterior end of the lingual surface of the ramus. In lingual surface, It articulates with the articular posteriorly, supra-angular dorsally, the anterior and posterior processes of the coronoid anterodorsally, the splenial anteriorly, the angular anteroventrally. Posteriorly, it forms the retroarticular process of the ramus. Posteriorly the chorda tympani fenestra

is close to its proximal end. It forms ventral portion of the adductor fossa. In lateral surface, the prearticular articulates with the angular, supra-angular anteriorly and the articular dorsally (Figs. 6 A,B).

The splenial (spl) is the largest element on the medial anterior portion of the ramus. This element articulates with the dentary anteriorly, anterior lingual process of the coronoid dorsally, prearticular posterodorsally, and angular posteriorly. The anterior end of the splenial forms the posterior rim of the anterior inferior alveolar foramen (aiaf) and also contains the anterior mylohyoid foramen (amyf) which is located under aiaf (Fig. 6 B).

DISCUSSION

To determine what the ancestral lizard or the first lizard may have looked like one must rely on the fossil record and the anatomy of living lizards. Broom (1935) is of the opinion that lizards arose from Eosuchian stock in the Upper Triassic and then later developed osteoderms over the skull and the body regions. In the Middle Mesozoic some primitive groups retained the osteoderms while others lost them; thus giving rise to the living forms which have a variety of skull variations. All of the families within the infraorder Leptoglossa (Sincomorpha) have osteoderms except the family Teiidae. The genus *Ameiva* within this family has os palpabre elements (Fisher and Tanner**,** 1970), which may be suggestive of cranial osteoderms sometime in the past. In families that still retain the osteoderms, Laurtidae and Scincidae, the supratemporal fenestrae are extremely reduced or lost in contrast with the teiids which have large fenestrae. The postfrontals are expanded in the former while in the latter the postfrontals are reduced, lost, or fused with the postorbitals (Nash and Tanner, 1970).

Following is a comparative discussion of the osteological between *Trachylepis vittata* and *Lacerta media media*. The variations observed are: The nasal processes of the premaxilla in *T. vittata* are triangular and broad but in *L. media media*, the nasal process is narrow that penetrate inside the nasal. The premaxilla in *T. vittata* are paired but in *L. media media* is single. The posterior portion of the frontal in *L. media media* is more denticulated than *T. vittata*. The parietal surface in *T. vittata* is somewhat convex but it does not in *L. media media*. The parietal in *T. vittata* covers most the skull roof but this element and the postfrontal together form the skull roof in *L. media media*. The supraoccipital in *L. media media* located under the parietal which are visible from the dorsal surface very little but in *T. vittata* it almost lies along the parietal and contacts the medial posterior processes of the parietal by triangular cartilaginous. The post temporal fossa in *T. vittata* are visible from the dorsal view but it does not see in *L. media media*. The postorbital and the postfrontal bones in *L. media media* form the posterior margin of orbit but in *T. vittata* a clear reduction was observed in the postorbital and it does not contribute in forming orbit and the postfrontal only forms the posterior margin of orbit. In *L. media media* the posterior end of the jugal only contacts the postorbital but it articulates with the postorbital and the postfrontal in *T. vittata*. The jugal is broad in ventral end in *L. media media* that its posterior process extends backward but in *T. vittata* the jugal is a curve-shaped element. In *T. vittata* the squamosal contacts supratemporal process of the parietal posteriorly in other words, the squamosal and supratemporal process of the parietal form posterior portion of the supratemporal fossa but in *L. media media* the supratemporal bone lies between the squamosal and supratemporal process of the parietal that the squamosal and the supratemporal bones form posterior portion of the supratemporal fossa. In *L. media media* the quadrate bears a concave depression that divides it into two unequal portions but this is not the case in *T. vittata*. In *L. media media* the epipterygoid has most slope than that of *T. vittata*. The otoccipital and the paraoccipital processes in *T. vittata* are broader and shorter than those of *L. media media*. The palatines in *T. vittata* are rectangular shape and broad in the entire length and they overlap together medially and anteriorly. These elements are made two plates which both plates are fused along the lateral borders that anteriorly, the dorsal plates articulate with the vomers and the ventral plates articulate with the

maxillae but in *L. media media* the palatines are quietly separated by the anterior of the pyriform space. They are made a plate that the pterygoids penetrate from posterior portion to between the palatines medially and the vomer bones anteriorly. In *L. media media* concave portion of the quadrate process of pterygoid is most oriented down than *T. vittata*. The basipterygoid process in *L. media media* is broad and lies inside concave portion of the quadrate process of pterygoid but this is not the case in *T. vittata*. In *L. media media* the sphenoccipital tubercle is more prominent than *T. vittata*. The prearticular in *T. vittata* is round and broad element and spoon-shape and the retroarticular process is oriented downward but this is not the case in *L. media media* and the retroarticular process is oriented upward. On lateral surface, the coronoid in *L. media media* penetrates inside the dentary but in *T. vittata* it does not penetrate. In *L. media media* the mandible has curvature but this is not the case in *T. vittata*. The anterior inferior alveolar foramen and the anterior mylohyoid foramen in *L. media media* are clearly visible, on lateral surface but in *T. vittata* they are not clearly visible. In *T. vittata* the dentary is narrow and almost straight but in *L. media media* it is broad and curve. On lateral view, in *L. media media* the Meckel's canal is visible but this is not the case in *T. vittata*. In *L. media media* the splenial penetrates more inside the dentary than that of *T. vittata* that extends to near Meckel's canal whereas it does not in *T. vittata*.

CONCLUSIONS

The two species involved in present study belong to families Scincidae and Lacertidae which the differences observed in cranial osteology are distinct and remarkable between the two studied species. Generally the skull in *T.vittata* is thinner and smaller than *L. media media*. Thus, the differences observed are likely due to feeding behavior, the generation of bite force, fighting and defensive behaviors. Finally, this study correspond to phylogenetic and morphological studies to establish the taxonomic status of *T.vittata* and *L. media media*.

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