The Cranial Nerves of *Mabuya quinquetaeniata* III: Nervus Trigeminus

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Abstract: The present study deals with the nervus trigeminus of *Mabuya quinquetaeniata*. The results showed that the nervus trigeminus has one root, and two separate ganglia, a maxillomandibular ganglion and an ophthalmic one. The maxillomandibular ganglion is continuous with the ophthalmic ganglion. The lateral part of the ventromedial division of the trigeminal root gives off the anguli oris nerve and nerves to the adductor mandibularis externus and the pseudotemporalis muscles. The constrictor dorsalis nerve innervates the protractor pterygoideus, levator pterygoideus, and depressor palpbrae inferioris muscles. It has no anastomosis with ramus palatinus of the nervus facialis. The ramus frontalis is connected with the lacrimal plexus. The ramus nasalis anastomoses with the ethmoidal ganglion and divides into its to rami lateralis and medialis nasi within the nasal capsule. The ramus maxillaris gives off lacrimal and temporal branches in the postorbital region. In the orbital region, it is termed infraorbital nerve and gives off a nerve to the Harderian gland, the supralabial gland and the upper teeth. It fuses with the ramus palatinus lateralis of the nervus facialis. It receives an anastomosing branch from the ramus palatines medialis and fuses with the ramus palatines intermedialis for a short distance. It carries ganglionic cells at the point of fusion. It enters the maxilla as superior alveolar nerve and gives off nerve to the narial muscles. The ramus mandibularis gives off nerves to the pseudotemporalis and pterygomandibularis muscles. It gives off the ramus cutaneous recurrens and then enters the primordial canal as the inferior alveolar nerve, where it gives off a mixed nerve and a sensory one and then receives the chorda tympani (N.VII). The mixed nerve (the inferior alveolar nerve + chorda tympani) gives rise to the rami intermandibularis oralis, intermandibularis medius (ramus paralingualis) and intermandibularis caudalis. The ramus intermandibularis medius is connected with the ramus lingualis lateralis (N.XII). The ramus intermandibularis caudalis gives motor fibres to the intermandibularis muscle.

[Abdel-Kader, T. G.; Ali, R. S. and Ibrahim, N. M. **The Cranial Nerves of *Mabuya quinquetaeniata* III: Nervus Trigeminus]** Life Science Journal, 2011; 8(4):650-669] (ISSN: 1097-8135). http://www.lifesciencesite.com.

Key Words: *Mabuya*, Cranial nerves, Nervus trigeminus

1. Introduction

The neuroanatomy of reptiles is one of the important subjects of herpetology. The neuroanatomical characters are very important not only phylogenetically but also systematically, functionally, and behaviourally. Despite of these important characters, the cranial nerves of reptiles in general and those of lizards in particular have not received adequate interest by investigators. The first valuable work was that of Fischer (1852). This work though of an early date, is still useful for the investigators.

The nervus trigeminus is one of the mixed general nerves that carries both sensory and motor fibres. The distribution of these fibres shows a contradiction in different species. Among reptiles, not only, the origin of (number of roots), ganglia and branches of this nerve vary among different species, but also, the types of fibers carried by it and its distribution.

The nervus trigeminus was studied in *Varanus bivittatus* by Watkinson (1906), *Anolis carolinensis* by Willard (1915), *Ctenosaura pectinata* by Oelrich (1956) and *Chalcides ocellatus* by Soliman and Hegazy (1969).

Also, Mostafa (1990a) gave an account on the nervus trigeminus of *Acanthodactylus opheodurus*. In addition, Dakrory (1994, 2011) presented a detailed study on the cranial nerves of the limbless lizard *Deplometopon zarudnyi* and *Uromastyx aegyptius*, respectively. Abdel-kader (2005) gave a detailed study on the cranial nerves of the blind snake *Leptotyphlops cairi*.

It is obvious from this brief review that studies on the cranial nerves in general and the nervus trigeminus particularly in the family Scincidae are very few compared to the huge number of species in this family. This stimulated us to study the cranial nerves of *Mabuya quinquetaeniata*. The study also aims to analyze the fibre components of the nervus trigeminus and to show the relation between it and the other cranial structures.

2. Material and Methods

The heads of two young specimens of *Mabuya quinquetaeniata* were decalcified using EDTA solution then mounted and embedded in paraffin wax and serially sectioned transversely at 12 µm thick. The serial sections were stained with Malory's Triple Stain (Pantin, 1946).

The transverse sections were drawn with the help of a projector microscope. From these drawings an accurate graphic reconstruction for the nervus trigeminus was made, together with the nervus facialis in a lateral view. In order to show the relations of the nerves to the different parts of the head, several sections were photomicrographed.

3. Results

In *Mabuya quinquetaeniata*, the nervus trigeminus originates from the lateral side of the medulla oblongata by one stout root (Figs. 1& 2, RO.V). The trigeminal root runs forwards, within the cranial cavity passing medial to the lower edge of the auditory capsule, lateral to the medulla oblongata and ventral to the trochlear nerve. Thereafter, the trigeminal root leaves the cranial cavity through incisura prootica. This incisura (Fig. 3, IP) is located ventral to the anterior edge of the auditory capsule (AC) and dorsolateral to the lateral edge of the basisphenoid bone (BSP). The incisura prootica is separated from the facial foramen by the prefacial commissure. During its exit from the cranial cavity, the root of the nervus trigeminus (Figs. 1 & 3) divides into two divisions: a dorsolateral sensory division (DLD.RO.V) and a ventromedial mixed one (VMD.RO.V).

The dorsolateral sensory division extends anterolaterally to enter the maxillomandibular ganglion from its ventral side. This ganglion (Figs. 3, 4 & 6, G.MM) lies in the incisura prootica ventromedial to the anterior edge of the auditory capsule (AC), medial to the adductor mandibularis externus muscle (M.ADME), dorsal to the ventromedial division of the trigeminal root (VMD.RO.V) and lateral to the nervus trochlearis (N.IV). The maxillomandibular ganglion is a round-shaped structure as it appears in the serial transverse sections, its anterior end is continuous with the posterior part of the ophthalmic ganglion (Fig. 1). The ganglion receives a fine branch from the lateral part of the ventromedial division (Fig. 1, R.CM.LP.VMD.RO.V +G.MM). From the lateral side of the maxillomandibular ganglion arises the ramus maxillaris (R.MX) dorsolaterally and the ramus mandibularis (R.MN) ventrolaterally (Figs. 1, & 4).

The ventromedial division (Figs. 1 & 3) extends anterolaterally passing ventromedial and then, ventral to the dorsolateral division and divides into two parts; a medial part (MP.VMD.RO.V) and a lateral one (LP.VMD.RO.V). The medial part, which represents the ramus ophthalmic profundus (Figs. 1 & 4, R.OPH), runs forwards passing ventromedial to the dorsolateral division then to the maxillomandibular ganglion and medial to the lateral part. Shortly forwards it continues being surrounded by the anterior part of the maxillomandibular ganglion. Just at the anterior end of the latter ganglion, it enters the ophthalmic ganglion (Figs. 1 & 5, G.OPH). This ganglion is oval in shape and its posterior end is confluent with the anterior end of the maxillomandibular ganglion. The ophthalmic ganglion (Fig. 5, G.OPH) lies extracranially being ventrolateral to the cranial wall, ventral to the nervus trochlearis (N.IV), dorsal to the protractor pterygoideus muscle (M.PPT) and medial to the pseudotemporalis muscle (M.PST). From the anterior end of the ganglion, the ramus ophthalamicus profundus originates as one trunk (Fig. 1, R.OPH).

The lateral part of the ventromedial division (Figs. 1 & 3, LP.VMD.RO.V) extends forwards passing lateral to the medial part and ventral to the maxillomandibular ganglion. Here, it gives off a dorsal fine branch to the latter ganglion as previously mentioned (Fig. 1, R.CM.LP.VMD.RO.V+G.MM). This part runs anterolaterally passing ventral to the maxillomandibular ganglion, lateral to the medial part of the ventromedial division, dorsal to the protractor pterygoideus muscle and medial to the adductor mandibularis externus muscle. Here, it gives off a medial nerve which represents the constrictor dorsalis nerve (Figs. 1 & 6, N.CD). Shortly after that, the main lateral part of the ventromedial division continues giving off a dorsal nerve to the adductor mandibularis externus muscle (Fig. 1, N.ADME) and a fine nerve which fuses with the ramus mandibularis (Fig. 1, R.CM.LP.VMD.RO.V+MN). The remainder of this part divides into a dorsal nerve and a ventral one. The dorsal nerve represents the anguli oris nerve (Figs. 1 & 6, N.AO) while the ventral nerve enters the pseudotemporalis muscle (Fig. 1, N.PST).

Anguli Oris Nerve

From the lateral part of the ventromedial division of the nervus trigeminus. After its origin, it passes medial to the adductor mandibularis externus muscle and lateral to the maxillomandibular ganglion (Figs. 1 & 6, N.AO). Here, the anguli oris nerve divides into two nerves. The two nerves run anterodorsally passing dorsal to the protractor pterygoideus muscle and ventrolateral to the maxillomandibular ganglion. Thereafter, they pass lateral to the levator pterygoideus muscle, ventral to the ramus maxillaris of the nervus trigeminus and medial to the adductor mandibularis externus muscle (Fig. 7, N.AO). Shortly anterior, one of the two nerves enters the levator pterygoideus muscle to end between its fibres (Fig. 1, N.LPT). The other nerve continues its course forwards passing ventral to the ramus maxillaris and medial to the adductor mandibularis externus muscle. After a long anterior course, it gives off a dorsal fine branch to the adductor mandibularis externus muscle (Fig. 1, N.ADME). Anterior to the origin of the previous branch, the main nerve extends forwards till it enters the posterior orbital region. Here, it divides into a lateral nerve and a medial one. The lateral nerve (Fig. 1, N.CU+SLG) ramifies and ends in the skin and the supralabial glands. The medial one extends anteromedially to end in the supralabial glands (Fig. 1, N.SLG).

Constrictor Dorsalis Nerve (NV4)

This nerve arises from the lateral part of the ventromedial division of the trigeminal root as previously mentioned (Figs. 1 & 6, N.CD). This nerve runs forwards, for a short distance, passing ventral to the maxillomandibular ganglion and lateral to medial part of ventromedial division. Here, it gives off a ventral nerve which extends forwards to enter the protractor pterygoideus muscle (Fig. 1, N.PPT).

The constrictor dorsalis nerve runs forwards ventral to the maxillomandibular ganglion then to the ophthalmic ganglion and dorsal to the protractor pterygoideus muscle. Thereafter, it continues extending ventromedial to the levator pterygoideus muscle and dorsal to the protractor pterygoideus muscle. Here, it gives off a dorsal nerve to the former muscle where it terminates (Fig. 1, N.LPT). Anterior to the origin of the previous nerve, the main nerve runs forwards for a long distance to enter the depressor palpbrae inferioris muscle, where it ramifies and ends between its fibres (Figs. 1, N.DPI).

Ramus Ophthalmicus Profundus

The ramus ophthalmicus profundus originates from the dorsomedial part of the anterior end of the ophthalmic ganglion as one trunk as previously mentioned (Figs. 1 & 6, R.OPH). It runs anteriorly for a distance and then divides into its two main rami: (Figs. 1 & 7) a dorsolateral ramus frontalis (R.FR) and a ventromedial ramus nasalis (R.NA).

Ramus Frontalis

Anterior to its separation from the ramus ophthalmicus profundus, the ramus frontalis (Figs. 1 & 7, R.FR) extends forwards in the dorsal direction passing dorsolateral to the ramus nasalis, ventrolateral to the membranous cranial wall and dorsomedial to the depressor palpbrae inferioris muscle. Thereafter, the ramus frontalis continues anteriorly extending dorsal to the latter muscle, medial to the levator pterygoideus muscle, lateral to the membranous cranial wall and dorsolateral to the ramus nasalis. More forwards and just posterior to the orbit, the ramus frontalis shifts dorsally passing lateral to the membranous cranial wall and medial to the adductor mandibularis externus muscle (Fig. 8, R.FR). Just ventral to the frontal bone, the ramus frontalis gives off several branches which run somewhat posterior and anastomose with the lacrimal plexus (Fig. 1, R.CM.FR+LCP). Thereafter, the ramus frontalis enters the orbital region and gives off a lateral branch. This branch extends forwards passing ventral to the frontal bone and gives off another lateral branch to the skin of the upper eye lid (Fig. 1, N.CU). The main lateral branch runs anteriorly in the lateral direction to end in the lacrimal gland (Fig. 1, N.LCG). Afterwards, the ramus frontalis runs anteriorly medial to the lacrimal gland and lateral to the cranial membranous wall giving off two successive branches to the skin of the upper eye lid (Fig. 1, Nn.CU). Thereafter, it gives off two successive branches to the meninges inside the cranial cavity (Fig. 1, Nn.ME). More anteriorly, the ramus frontalis gives off several successive branches to the skin of the upper eye lid (Fig. 1, Nn.CU). After a long anterior course, it gives off successive branches to the skin dorsal to the mid line region (dorsal to the nasal bone) and terminates in this region (Fig. 1, Nn.CU).

Ramus Nasalis

Anterior to its separation from the ramus ophthalmicus profundus, the ramus nasalis (Figs. 1& 7, R.NA) runs anteriorly passing dorsal to the depressor palpbrae inferioris muscle, ventral to the membranous cranial wall and ventromedial to the ramus frontalis. Thereafter, it passes dorsal to the bursalis muscle, ventromedial to both ramus frontalis and nervus trochlearis. Here, it gives a ventromedial branch, which is the radix ciliaris longa (Figs. 1 & 7, RCL). This runs anteriorly to enter the ciliary ganglion from its dorsolateral side (Fig. 1, G.CIL).

Anterior to the origin of the radix ciliaris longa, the ramus nasalis continues forwards passing dorsal to the bursalis muscle, lateral to both the rectus superior muscle and the ramus superior of the nervus oculomotorius and ventromedial to the nervus trochlearis. More forwards, the ramus nasalis passes medial to the rectus lateralis muscle, dorsal to the bursalis muscle and ventral and then lateral to the rectus superior muscle and the ramus superior of the nervus oculomotorius. Thereafter, it passes medial to the eye ball, ventral to the rectus superior muscle, lateral to the rectus medialis muscle and dorsal to the nervus opticus. More anteriorly, the ramus nasalis continues passing medial to the eyeball, ventromedial to the rectus superior muscle, ventral to the nervus trochlearis and lateral to the rectus medialis muscle. At the anterior half of the orbital region, the ramus nasalis continues forwards passing ventral to the medial edge of the obliquus superior muscle, dorsal to the rectus medialis muscle and medial to the eyeball. More forwards, this ramus passes medial to Harder´s gland and lateral to the obliquus superior muscle. Reaching the anterior orbital region, the ramus nasalis passes medial to Harder´s gland and lateral to the interorbital septum. Entering the orbitonasal region, the ramus nasalis continues anteriorly passing ventromedial to sphenethmoidal commissure, lateral to the interorbital septum, medial to the eyeball and dorsolateral to the origin of the obliquus inferior muscle. Shortly anterior, the ramus nasalis gives off a dorsal branch to the blood vessel (Fig. 1, N.BV). Shortly after that, the ramus nasalis gives off a lateral cutaneous branch. This branch (Fig. 1, N.CU) pierces the prefrontal bone and ramifies and terminates in the skin in front of the eyeball (Fig. 1, Nn.CU). Immediately anterior to the origin of the previously described branch, the main ramus nasalis receives an anastomosing branch from the ethmoidal ganglion of the nervus facialis (Figs. 1 & 9, R.CM.NA+G.ET). At the point of connection with the ramus nasalis, the communicating branch carries few ganglionic cells. These cells represent a small dorsal part of the ethmoidal ganglion (Fig. 9, GC). Anterior to the connection, the ramus nasalis enters the nasal region passing through the foramen olfactorium evehens. After a long anterior course, the ramus nasalis divides intracapsularly into its two rami: the ramus medialis nasi (Figs. 1 & 10, R.MNA) and the ramus lateralis nasi (Figs. 1 & 10, R.LNA). There are a few ganglionic cells at the point of the division (Fig. 1, GC).

Ramus Medialis Nasi

Anterior to its separation from the ramus nasalis, the ramus medialis nasi (Figs. 1 & 10, R.MNA) extends, medial to the ramus lateralis nasi (R.LNA), ventromedial to the parietotectal cartilage (PTC) and lateral to the olfactory bulb (OL.BU). After a long anterior intracapsular course, this ramus shifts its course to pass dorsomedial to the olfactory epithelium and ventromedial to the parietotectal cartilage. More anteriorly, the ramus medialis nasi runs medial to the olfactory epithelium and lateral to the internasal septum. Thereafter, this ramus continues forwards passing medial to the olfactory epithelium (OL.EP), lateral to the internasal septum (S.IN) and dorsolateral to the septomaxillary bone (SMX). More forwards, it passes through a canal in the latter bone (Fig. 11, R.MNA). After a long anterior course and just opposite to the anterior end of the vomeronasal organ, the ramus medialis nasi leaves the septomaxillary canal and continues forwards passing ventromedial to the vestibule of the olfactory organ. More and more forwards, this ramus leaves the nasal capsule through the foramen apicale (Fig. 12, F.APC). Anterior to this foramen, the ramus medialis nasi runs anteriorly passing dorsal to the premaxillary bone and lateral to the nasal bone giving off three successive branches, to the blood vessels (Fig. 1, Nn.BV) and the teeth (Fig. 1, N.TE). After a short anterior course, the ramus medialis nasi seperates into two rami; one dorsal to the other: the ramus premaxillaris superior (Fig. 1, R.PMXS) dorsally and the ramus premaxillaris inferior (Fig. 1, R.PMXI) ventrally.

Ramus Premaxillaris Superior

The ramus premaxillaris superior (Fig. 1, R.PMXS) runs anteriorly in the dorsal direction, till it reaches the anterior extremity of the snout. During that, it gives off several branches to the skin at the ventral rim of the nasal capsule (Fig. 1, Nn.CU). Finally, this ramus terminates in the skin covering the anterior extremity of the snout.

Ramus Premaxillaris Inferior

The ramus premaxillaris inferior (Fig. 1, R.PMXI) runs forwards medial to the anterior part of the nasal capsule and dorsal to the premaxillary bone. After a short distance, it gives rise to six nerves to the skin of the anterior region of the nasal capsule (Fig. 1, Nn.CU). Thereafter, the remaining of this ramus ramifies and ends in the skin of the lips and the anterior edge of the snout (Fig. 1, Nn.CU).

Ramus Lateralis Nasi

After the separation of the ramus lateralis nasi from the ramus nasalis (Figs. 1 & 10, R.LNA), it passes lateral to the ramus medialis nasi, dorsal to the olfactory epithelium and ventral to the parietotectal cartilage. After a long anterior course in this position, the ramus lateralis nasi pierces the parietotectal cartilage to become dorsal to its lateral margin. Thereafter, the ramus lateralis nasi runs anterolateraly being lateral to the parietotectal cartilage and dorsomedial to the nasal gland (Fig. 13, R.LNA). After a short distance, it gives off a dorsal branch which runs dorsal to the pareitotectal cartilage and divides giving off two divisions; one lateral to the other. Both divisions pierce the nasal bone to give off several branches to the skin above the cranium medially and above the nostril laterally (Fig. 1, Nn.CU). The ventral branch arises from the ramus lateralis nasi and enters the nasal gland from its dorsal side. Thereafter, this ramus gives off a small lateral branch to innervate the skin lateral to the nasal gland (Fig. 1, Nn.CU). While the ramus lateralis nasi passing through the gland follicles, it gives off many fine branches innervating the nasal gland (Fig. 1, Nn.NAG). After a long anterior course, it leaves the nasal gland from its anterior end and turns laterally to end in the skin lateral to the nasal region as many fine branches (Fig. 1, Nn.CU). Finally, this ramus ends as fine nerves in the narial muscle (Fig. 1, Nn.NR).

Ramus Maxillaris (N.V2)

The ramus maxillaris (Figs. 1 & 4, R.MX) originates from the dorsolateral corner of the maxillomandibular ganglion. It extends anterolaterally, in the dorsal direction, passing ventral to the levator pterygoideus muscle, medial to the adductor mandibularis externus muscle and dorsal to both the ramus mandibularis and the anguli oris nerve. Thereafter, it continues passing lateral to both the levator pterygoideus muscle and the posterior end of the pseudotemporalis muscle (Fig. 5, R.MX). After a long anterior distance in this position, it gives off two successive branches. These two branches represent the rami lacrimalis (Figs. 1 & 8, R.LC) and temporalis (Figs. 1 & 8, R.TM).

Ramus Lacrimalis

After its separation from the ramus maxillaris, the ramus lacrimalis (Figs. 1 & 8, R.LC) runs anteriorly passing medial to the adductor mandibularis externus muscle (M.ADME), lateral to the levator pterygoideus muscle (M.LPT) and dorsal to both the ramus temporalis (R.TM) and the ramus maxillaris (R.MX). More forwards, the ramus lacrimalis passes dorsomedial to the adductor mandibularis externus muscle, ventrolateral to both the levator pterygoideus muscle and the ramus frontalis of the nervus trigeminus and dorsal to the ramus temporalis. Thereafter, the ramus lacrimalis passes dorsomedial to the ramus temporalis and ventrolateral to the lacrimal gland. Here, it gives off a branch which joins another branch from the ramus frontalis for a short distance and then separate again into two branches; one passes posteriorly to join the lacrimal plexus (Fig. 1, R.CM.LC+LCP) and the other ends in the skin of this region (Fig. 1, N.CU). Shortly after that, the ramus lacrimalis gives off another cutaneous branch for the skin (Fig. 1, N.CU). Shortly anterior, it anastomoses with the ramus frontalis of the nervus trigeminus through a fine branch (Fig. 1, R.CM.FR+LC). Anterior to the origin of this branch, the ramus lacrimalis gives off another branch for the skin. Finally, it ends as two fine nerves in the lacrimal gland (Fig. 1, Nn.LCG).

Ramus Temporalis

After its separation from the ramus maxillaris, the ramus temporalis (Figs. 1 & 8, R.TM) passes dorsomedial to the adductor mandibularis externus muscle (M.ADME), dorsal to the ramus maxillaris (R.MX), ventral to the ramus lacrimalis (R.LC). Thereafter, this ramus passes dorsal to the adductor mandibularis externus muscle, ventral to the lacrimal gland and ventrolateral to the eyeball. More forwards, the ramus temporalis passes dorsal to the adductor mandibularis externus muscle and lateral to the eyeball. Here, it gives off three successive branches to the skin lateral to the eyeball (Fig. 1, Nn.CU). After that, it runs in the ventrolateral direction passing lateral to the eyeball giving off a lateral branch which ramifies and distributes on the skin lateral to the eyeball (Fig. 1, N.CU). Finally, the ramus temporalis continues anteriorly giving rise to many successive branches to the skin lateral to the eyeball (Fig. 1, Nn.CU).

Anterior to the origin of the previously described branches, the ramus maxillaris continues forwards passing in the ventromedial direction till it enters the orbital region as the infraorbital nerve. In the orbital region, the infraorbital nerve (Figs. 1 & 14, N.IO) runs anteriorly passing lateral to the eyeball, medial to the adductor mandibularis externus muscle and dorsal to the anguli oris nerve. Thereafter, it continues forwards passing dorsal to the anterior end of the pterygoid bone, dorsolateral to the depressor palpbrae inferioris muscle and ventrolateral to the eyeball. Here, it gives off a fine branch for the skin just posterior to the eye (Fig. 1, N.CU). Shortly after that, it receives an anastomosing branch from the ramus palatinus lateralis of the nervus facialis (Figs. 1 & 15, R.CM.IO+PAL). Here, the infraorbital nerve carries few ganglionic cells. Shortly anterior, this nerve continues passing ventrolateral to the eye ball and dorsal to the depressor palpbrae inferioris muscle. Here, it gives off four successive branches to the skin of the lower eyelid (Fig. 1, Nn.CU). Thereafter, the infraorbital nerve continues anteriorly passing ventral to the eyeball and medial to the jugal bone giving rise to lateral and medial branches. The lateral branch extends anterolaterally to end in the skin of the lower eyelid (Fig. 1, N.CU). The medial branch extends anterodorsally to enter and end in Harder′s gland (Fig. 1, N.HDG). Anterior to the origin of the previous branches, the infraorbital nerve gives off two or three successive branches for the skin of the check and the lower eyelid and the teeth (Fig. 1, Nn.CU+TE). After a forward course, the infraorbital nerve gives off a ventral branch, which ramifies and ends in the palatal epithelium medial to the dental lamina (Fig. 1, N.EP). Another two branches arise from the nerve and pass to the palatal epithelium (Fig. 1, Nn.EP). Shortly forwards, the infraorbital nerve receives a large branch from the medial palatine ramus (Figs. 1 & 16, R.CM.IO+PAM). The infraorbital nerve carries few ganglionic cells at the point of this fusion. The infraorbital nerve gives off a branch for the duct of Harder′s gland (Fig. 1, N.HDG).

Reaching the orbitonasal region, the infraorbital nerve continues anteriorly passing lateral to the palatal process of the palatine and dorsal to the medial end of the palatal process of the maxilla. Here, it receives the intermediate palatine ramus forming a common nerve (Figs. 1 & 17, CO.N). Anterior to this connection, the common nerve enters the nasal region passing dorsal to the palatal process of the maxilla, ventrolateral to the nasal duct and ventromedial to the prefrontal bone. Here, the common nerve separates into the infraorbital nerve (Figs. 1 & 18, N.IO) laterally and the ramus palatinus intermedialis (Figs. 1 & 18, R.PAI) ventromedially. The infraorbital nerve runs forwards passing dorsal to the palatal process of the maxilla, ventromedial to the cartilage ectocapsularis, ventrolateral to the olfactory chamber and dorsolateral to the ramus palatinus intermedialis. Shortly anterior, it gives off a lateral branch, which penetrates the maxilla and ramifies in the check and the upper lip (Fig. 1, N.CU).

The main nerve runs forwards passing medial to the previously described branch giving rise to a fine nerve which penetrates the maxillary bone laterally to end in the skin of the check lateral to the maxilla (Fig. 1, N.CU). Shortly forwards, the infraorbital nerve enters the maxillary bone through the superior alveolar foramen as the superior alveolar nerve.

The superior alveolar nerve (Figs. 1 & 19, N.SAV) extends anteriorly within the maxillary bone giving rise to a lateral branch. This branch extends anterolaterally leaving the maxilla. Lateral to the latter bone, it ramifies and ends in the skin covering the bone laterally (Fig. 1, N.CU). Shortly forwards, the main nerve divides into two branches, one lateral and the other medial. The lateral branch leaves the maxilla laterally to end in the skin covering its lateral side (Fig. 1, N.CU). The medial branch runs anterolaterally to leave the maxillary bone. Lateral to the latter bone, this branch divides into a ventral and a dorsal nerve. Both nerves run forwards lateral to the maxilla and ramify to innervate the skin lateral to the maxillary and premaxillary bones and posteroventral, ventral and anteroventral to the nostril (Fig. 1, Nn.CU). The medial branch gives off a medial nerve to the narial muscles (Fig. 1, N.NR).

Ramus Mandibularis (N.V3)

The ramus mandibularis (Figs. 1, 4 & 6, R.MN) arises from the ventromedial side of the maxillomandibular ganglion and runs anteroventrally receiving a branch from the lateral part of the ventrolateral division of the trigeminal root. Anterior to this connection, the ramus mandibularis gives off a ventral branch for the pterygomandibularis muscle (Fig. 1, N.PTM). Thereafter, the ramus mandibularis runs anteriorly passing dorsolateral and then lateral to the protractor pterygoideus muscle, ventrolateral to the maxillomandibular ganglion and medial to the adductor mandibularis externus muscle. Here, it gives off a ventral branch for the pseudotemporalis muscle (Fig. 1, N.PST).

Anterior to the origin of the pseudotemporalis nerve, the ramus mandibularis passes medial to the adductor mandibularis externus muscle, ventrolateral to the levator pterygoideus muscle and dorsolateral to the pterygomandibularis muscle. Thereafter, the ramus mandibularis continues anteriorly running medial to the adductor mandibularis externus muscle and lateral to the pterygomandibularis muscle. Here, the ramus mandibularis gives rise to a ventral nerve; the ramus cutaneous recurrens (Figs. 1 & 20, R.CUR). This ramus passes posteriorly running through a foramen excavated in the supra-angular bone of the mandible (Fig. 20, R.CUR). Thereafter, the ramus cutaneous recurrens passes ventral to the adductor mandibularis externus muscle and lateral to the supra-angular bone. More postriorly, the ramus cutaneous recurrens extends posterodorsally passing lateral to the adductor mandibularis externus muscle. Finally, it ends in the skin covering the lateral side of the latter muscle as fine branches (Fig. 1).

Anterior to the origin of the ramus cutaneous recurrens, the ramus mandibularis continues anteriorly in the ventral direction passing ventromedial to the adductor mandibularis externus muscle, lateral to the pterygomandibularis muscle and dorsal to the mandible. Thereafter, the ramus mandibularis passes ventromedial to the adductor mandibularis externus muscle, ventrolateral to the pseudotemporalis muscle and dorsolateral to the mandible. More anteriorly, the ramus mandibularis enters the primordial canal (Fig. 21, PRC) of the mandible through the primordial fossa (Fig. 21, PRF) as the inferior alveolar nerve (Fig. 21, N.IAV). This nerve extends forwards inside this canal giving off a ventromedial mixed; sensory and motor branch (Fig. 1, N.MI). This branch runs anteriorly passing ventral to Meckel's cartilage and after a short course anteriorly, it leaves the primordial canal through a foramen excavated in the ventromedial side of the angular bone. After its exit, this branch runs anteriorly, passing dorsolateral to the intermandibularis muscle and ventromedial to the mandible. Thereafter, it penetrates the latter muscle giving off two lateral branches to it (Fig. 1, Nn.IM). More anteriorly, the main branch runs ventral to the intermandibularis muscle giving off a medial branch to the intermandibularis muscle (Fig. 1, N.IM). The main branch continues forwards passing ventral to the intermandibularis muscle to terminate in the skin lateral and ventrolateral to the mandible and ventral to the latter muscle (Fig. 1, N.CU).

Shortly anterior, the inferior alveolar nerve gives off a lateral branch (Fig. 1, N.CU+ILG). After a long course inside the primordial canal, this branch leaves it through a foramen excavated in the ventrolateral side of the dentary bone. Ventrolateral to the bone, this branch extends forwards giving off a lateral branch to the infralabial gland (Fig. 1, N.ILG). Shortly forwards, the main branch gives off a lateral nerve to the skin of the lower lip (Fig. 1, N.CU). Thereafter, the main branch continues its anterior course giving rise to several cutaneous branches to the skin lateral to the infralabial gland (Fig. 1, Nn.CU). The main branch, finally achieves its final distribution in the infralabial gland (Fig. 1, N.ILG).

Anterior to the origin of the previously described branches, the inferior alveolar nerve continues forwards passing lateral to both Meckel's cartilage and chorda tympani of the facial nerve. Thereafter, the main nerve continues passing ventromedial to the chorda tympani (Fig. 22, CT&N.IAV). After a short course anteriorly, the chorda tympani fuses with the inferior alveolar nerve forming a mixed nerve (Figs. 1 & 15, N.MI). The mixed nerve carries few ganglionic cells at the point of fusion; these cells represent the mandibular ganglion (Fig. 1, G.MN).

After a long anterior course within the primordial canal, the mixed nerve (inferior alveolar nerve and the chorda tympani nerve) gives rise to a large branch; the ramus intermandibularis caudalis.

Ramus Intermandibularis Caudalis

After its separation from the mixed nerve, the ramus intermandibularis caudalis (Figs. 1 & 23, R.IMC) runs forwards inside the primordial canal, in the ventromedial direction till it leaves the canal through a foramen in the angular bone (Fig. 23, R.IMC). After its emergence, this ramus extends anteriorly passing ventrolateral to intermandibularis muscle and medial to the mandible. Here, the ramus intermandibularis caudalis gives off a posterior branch. This branch extends backwards medial and ventral to the mandible, where it ramifies into numerous fine nerves to the skin of this region (Fig. 1, N.CU). After that, the main ramus gives off two nerves which enter the intermandibularis muscle, where they ramify and end between its fibres (Fig. 1, Nn.IM). Thereafter, the ramus intermandibularis caudalis continues forwards being ventromedial to the dentary bone until it reaches the anterior extremity of the lower jaw. During this course, it gives off eight successive nerves to the skin covering the dentary bone ventrally and laterally (Fig. 1, Nn.CU). Finally, the remainder of the ramus intermandibularis caudalis ramifies and terminates in the skin of the anterior extremity of the lower jaw (Fig. 1, Nn.CU).

Anterior to the origin of the ramus intermandibularis caudalis, the mixed nerve gives off a medial branch (Figs. 1 & 24, Rr.IMO+IMM). This branch runs forwards within the primordial canal till it leaves this canal through a foramen in the dentary bone (Fig. 24). After its exit, this branch extends forwards for a short distance and then divides into two large branches: a lateral ramus intermandibularis oralis (Figs. 1 & 25, R.IMO) and a medial ramus intermandibularis medius (Figs. 1 & 25, R.IMM).

Ramus Intermandibularis Oralis

The ramus intermandibularis oralis runs anteriorly in the dorsomedial direction passing medial to the mandible and lateral to the lingual gland. It gives many fine branches (about eight branches) to the lingual gland (Fig. 1, Nn.LGG) and two branches to the epithelium lining the corner of the mouth (Fig. 1, Nn.EP). Afterwards, this ramus extends in the dorsomedial direction, giving off several branches to the epithelium lining the corner of the mouth and the dental lamina (Fig. 1, Nn.CU+DE). Finally, this ramus ends as fine nerves in the taste buds and the epithelium lining the corner of the mouth (Fig. 1, Nn.TB+EP).

Ramus Intermandibularis Medius

The ramus intermandibularis medius or ramus paralingualis (Figs. 1 & 25, R.IMM), runs posteriorly in the dorsolateral direction passing lateral, then, dorsal to the intermandibularis muscle till it fuses with the ramus lingulalis lateralis of the nervus hypoglossus (Fig. 1). The fibres of this ramus are carried to their final fate by the rami of the nervus hypoglossus. From the above description, it is clear that, the fibres of the chorda tympani carried by the inferior alveolar nerve are more or less divided into two portions; one portion incorporates with the intermandibularis oralis, while the other portion combines with the intermandibularis medius or the ramus paralingualis.

After seperation of the ramus intermandibularis medius and the ramus intermandibularis oralis from the inferior alveolar nerve, the latter continues anteriorly inside the primordial canal (Fig. 25, N.IAV). After a long anterior course on this canal, it gives off a lateral branch. This branch (Fig. 1, N.CU+ILG) runs anteriorly and divides into two nerves; one lateral to the other. The lateral nerve runs anteriorly leaving the canal through a foramen in the dentary bone to end in the skin lateral to the latter bone (Fig. 1, N.CU). The medial nerve runs anteriorly through the canal giving off a lateral branch. This branch runs anteriorly to end in the infralabial gland (Fig. 1, N.ILG). The medial nerve continues anteriorly till it leavs the canal passing ventral then lateral to the infralabial gland and finally terminates in the skin lateral to the gland.

Anterior to the origin of the previously described branch, the inferior alveolar nerve continues inside the primordial canal for a long course (Figs. 18 & 19, N.IAV). After this course, it gives off a fine lateral branch. This lateral branch runs anteriorly passing lateral to the inferior alveolar nerve. After a long distance anteriorly, this branch leaves the canal through a foramen in the dentary bone. This branch terminates in the skin lateral to the latter bone (Fig. 1, N.CU). More anteriorly, the inferior alveolar nerve gives off two lateral branches which leave the primordial canal through the same foramen in the dentary bone to innervate the skin lateral to it (Fig. 1, Nn.CU). After a long forwards course, the inferior alveolar nerve leaves the canal through a foramen in the dentary bone and divides into a dosolateral branch and ventromedial one (Fig. 1). The dorsolateral branch extends anteriorly and branches to innervate in the most anterior infralabial gland and the skin covering this region (Figs. 1, N.CU+ILG). The ventromedial branch runs forwards and ramifies in the skin of the lower jaw at its anterior tip (Fig. 1).

4. Discussion

In this study, the nervus trigeminus of *Mabuya quinquetaeniata* arises by one root. This root shows a distinct separation into two divisions. This is the common condition among lacertilians as in *Chalcides ocellatus* (Soliman and Hegazy, 1969), *Tarentola mauritanica* (Soliman and Mostafa, 1984), *Acanthodactylus opheodurus* (Mostafa, 1990a), in *Agama pallida* and *Ptyodactylus hasselquistii* (Abdel-Kader, 1990*), Diplometopon zarudnyi* (Dakrory, 1994), *Acanthodactylus boskianus* (El-Ghareeb, 1997), *Agama sinaita* (Ramadan, 2009) and *Uromastyx aegyptius* (Dakrory, 2011). However, the nervus trigeminus separates into three roots in *Anolis carolinensis* (Willard, 1915). On the other hand, in some ophidians, the nervus trigeminus originates by two separate roots in both *Eryx jaculus* and *Cerastes vipera* (Hegazy, 1976) and *Spalerosophis diadema* (Mostafa, 1990b). However, three roots were found in *Psammophis sibilans* (Hegazy, 1976) and in *Natrix tessellate* (Dakrory and Mahgoub, 2005). A single trigeminal root was found in *leptotyphlops cairi* (Abdel-Kader, 2005) and in *Telescopus dhara* (Abdel-Kader, 2006).

In birds, the nervus trigeminus arises by two separate roots in *Upupa epops*, and by a single root in both *Passer domesticus* and *Streptopelia senegalensis* (Soliman *et al*., 1986). Also, it arises by a single root in *Gallinula chloropus* (Abdel-Kader, 2000) and in *Merops albicillis* (Abdel-Kader and Fathy, 2002).

In mammals, the nervus trigeminus arises by two separate roots; a large sensory root and a small motor root (Qurinig, 1950; Weichert, 1958; Gasser and Wise, 1972). Earlier, Bandy (1932) reported the existence of an accessory sensory root for the nervus trigeminus in mammals. This root was referred to as an intermediate root which was described in man (Jannetta and Rand, 1966; Vidić and Stefanatus, 1969) and in dog (Augustine *et al*., 1971).

In this study, the protractor pterygoideus, levator pterygoideus and depressor palpebrae inferioris muscles represent the constrictor dorsalis muscles. According to Edgeworth (1935), a depressor palpebrae inferioris muscle is found in lacertilians and crocodilians. However, Lakjer (1926) and Brock (1938) said that a depressor palpebrae inferioris muscle is absent in the geckos. In ophidians, the depressor palpebrae inferioris muscle is commonly lacking (Underwood, 1970; Haas, 1964 & 1968; Hegazy, 1976; Mostafa, 1990b). Also, this muscle is absent in Chelonia (Soliman, 1964).

Regarding reptiles, the constrictor dorsalis muscles are commonly present. However, these muscle are absent in Chelonia (Lakjer, 1926; Poglayen- Neuwall, 1953a; Soliman, 1964). The constrictor dorsalis muscles are present in Plagoistomi, Teleostomi and Saurapsida but absent in Holocephali, Dipnoi, Amphibia and Mammalia (Edgeworth, 1935).

In *Mabuya quinquetaeniata* studied, the constrictor dorsalis nerve is an extension of the motor trigeminal root. This condition is common in the ophidians and is quite different from what was found in majority of lacertilians so far described. Among most lacertilians, the constrictor dorsalis nerve arises directly from the trigeminal (maxillo-mandibular) ganglion (Polglayen-Neuwall, 1954; Soliman and Mostafa, 1984; Abdel-Kader, 1990). On the other hand, the constrictor dorsalis nerve is an extension of the motor trigeminal root in *Chalcides ocellatus* (Soliman and Hegazy, 1969), *Acanthodactylus opheodurus* (Mostafa, 1990a), *Ptyodactylus hasselquistii* (Abdel-Kader, 1990) and in *Diplometopon zarudyi* (Dakrory, 1994). Also, Among ophidians, the constrictor dorsalis nerve is an extension of the motor trigeminal root as present in *Psammophis sibilans*, *Eryx jaculus* and *Cerastes vipera* (Hegazy, 1976) in *Spaleorsophis diadema* (Mostafa, 1990b) and in *Leptotyphlops cairi* (Abdel-Kader, 2005). In *Elaphe obseleta*, however, the constrictor dorsalis nerve or the pterygoid division as termed by Auen and Langebartel (1977) arises as a stalk from the ventral surface of the trigeminal ganglion.

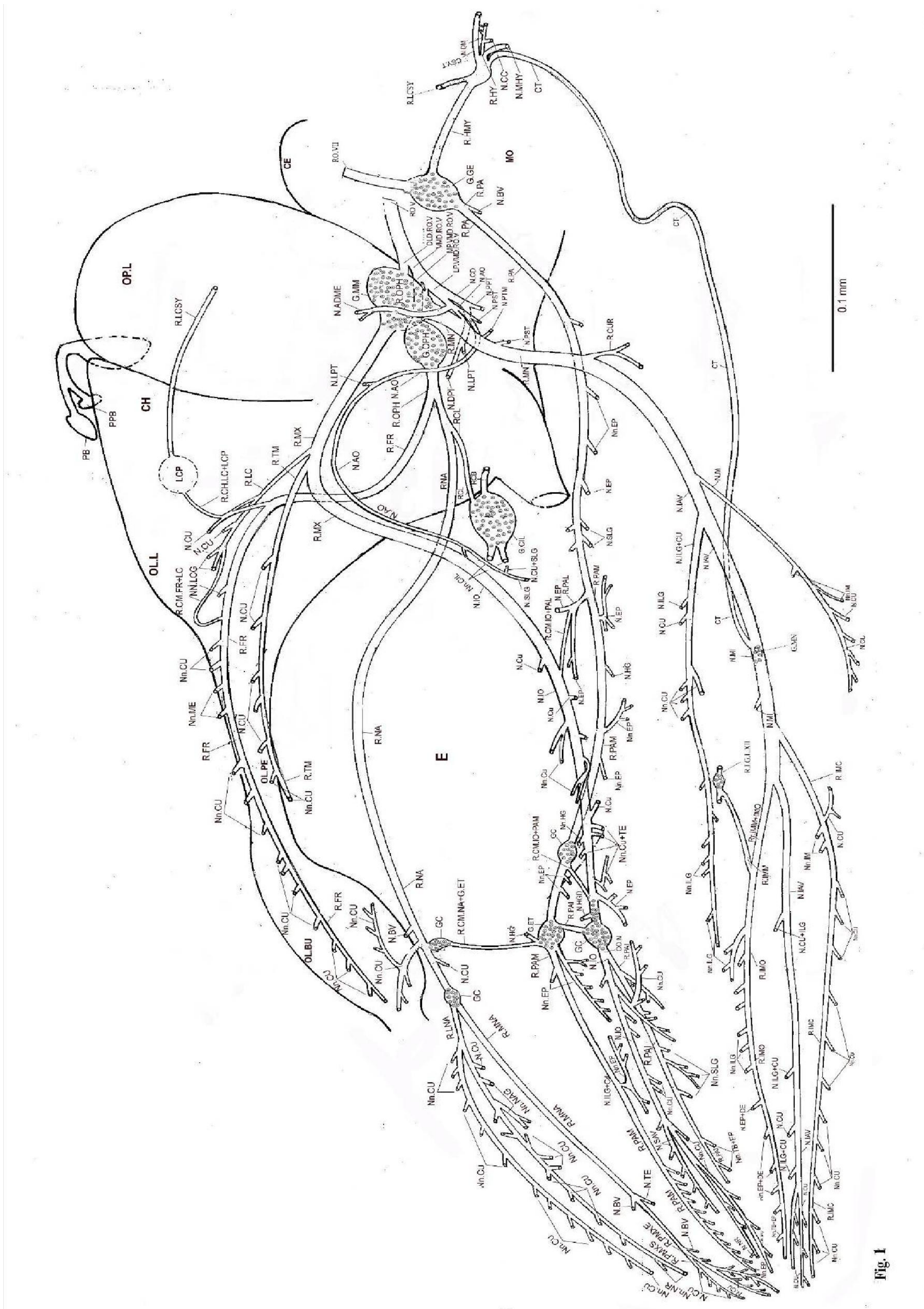


Fig. 1: Graphic reconstruction of the nervi trigeminus and facialis in a lateral view.

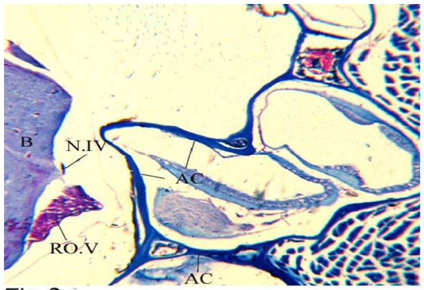


Fig. 2

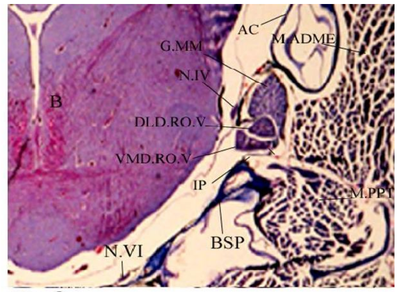


Fig. 3

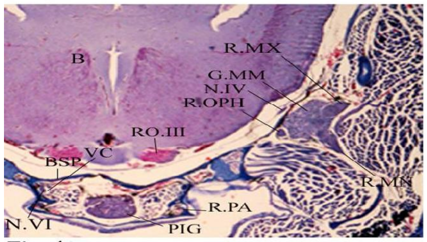


Fig. 4

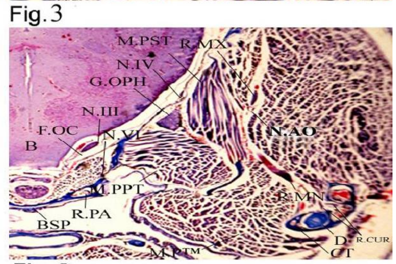


Fig. 5

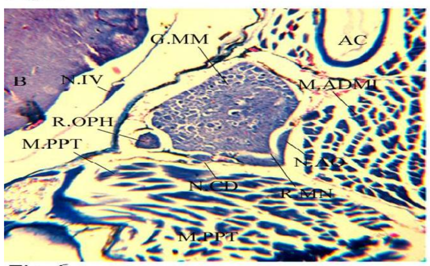


Fig. 6

Fig. 7

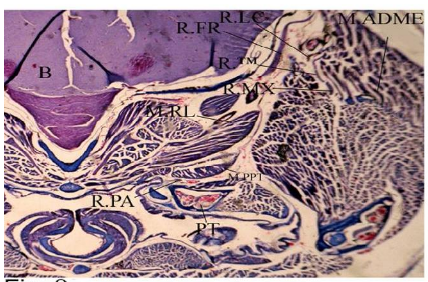


Fig. 8

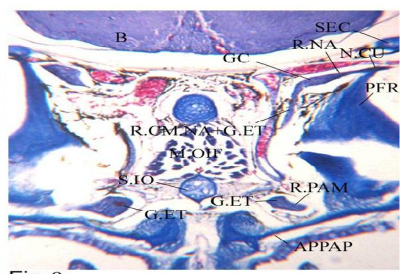


Fig. 9

Fig. 2: Photomicrograph of a part of a transverse section passing through the otic region showing the the origin of the nervus trigeminus from the brain.

Fig. 3: Photomicrograph of a part of a transverse section passing through the anterior part of the otic region showing the division of the trigeminal root into the dorsolateral and the ventromedial divisions, the maxillomandibular ganglion.

Fig. 4: Photomicrograph of a part of a transverse section passing through the postorbital region showing the origin of the rami maxillaris and mandibularis of the nervus trigeminus from the maxillomandibular ganglion and the ramus palatinus of the nervus facialis passing through the vidian canal.

Fig. 5: Photomicrograph of a part of a transverse section passing through the postorbital region showing the position of the ophthalmic profundus ganglion. The course of the rami maxillaris and mandibularis of the nervus trigeminus and the passage of the ramus cutaneus recurrens through the mandible. It also demonstrates the the passage of the ramus palatinus of the nervus facialis through vidian canal within the basisphenoid bone.

Fig. 6: Photomicrograph of a part of a transverse section passing through the anterior part of the otic region showing the maxillomandibular ganglion, the ophthalmic profundus ramus, the constrictor dorsalis and anguli oris nerves. It also demonstrates the origin of the ramus mandibularis from the maxillomandibular ganglion.

Fig. 7: Photomicrograph of a part of a transverse section passing through the postorbital region showing the course of the rami frontalis and nasalis. It also illustrates the radix ciliaris longa, the ramus maxillaris and the anguli oris nerve.

Fig. 8: Photomicrograph of a part of a transverse section passing through the postorbital region showing the passage of the rami frontalis, maxillaris, lacrimalis and temporalis.

Fig. 9: Photomicrograph of a part of a transverse section passing through the orbitonasal region illucidating the ethmoidal ganglion, the ramus nasalis and the communicating branch in-between.

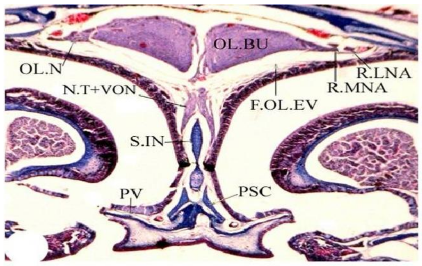


Fig.10

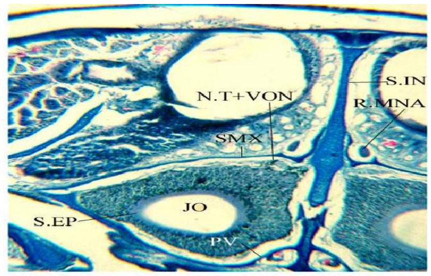
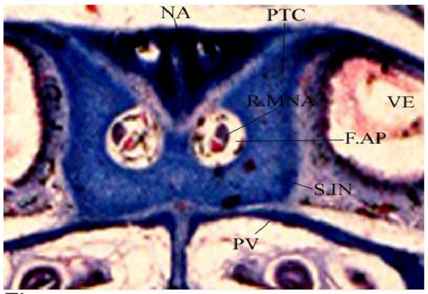


Fig.11



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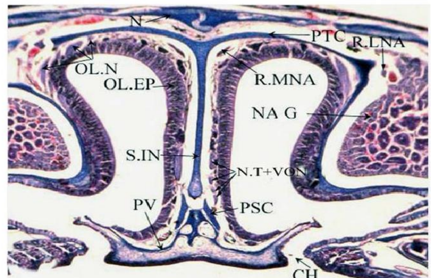


Fig.13

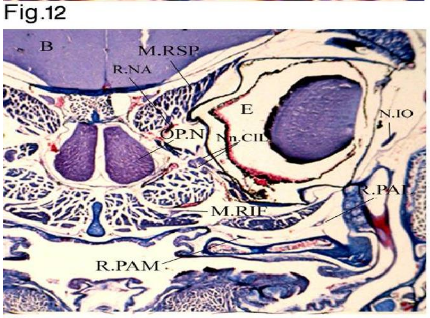


Fig. 14

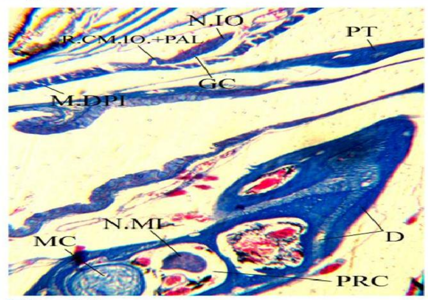


Fig. 15

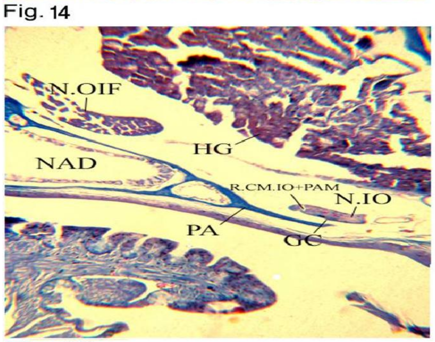


Fig.16

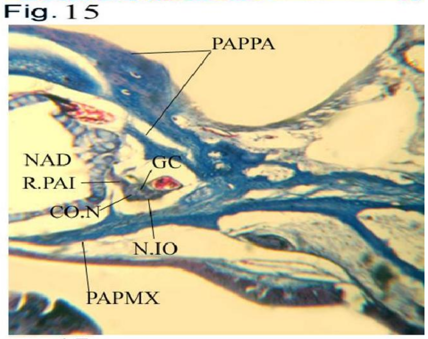


Fig.17

Fig. 10: Photomicrograph of a part of a transverse section of the olfactory region showing the position of rami medialis and lateralis nasi.

Fig. 11: Photomicrograph of a part of a transverse section passing through the olfactory region showing the course of the ramus naslais of the nervus trigeminus in a bony cana of the septomaxillary bone.

Fig. 12: Photomicrograph of a part of a transverse section passing through the olfactory region showing the ramus medialis nasi passing through the foramen apicale.

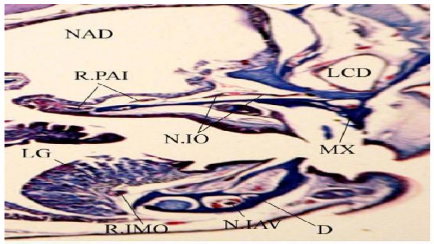
Fig 13: Photomicrograph of a part of a transverse section passing through the olfactory region showing the position of each of the rami medialis and lateralis nasi.

Fig. 14: Photomicrograph of a part of a transverse section passing through the orbital region showing the position of the infraorbital nerve and the rami palatinus lateralis and medialis.

Fig. 15: Photomicrograph of a part of a transverse section passing through the orbital region showing the fusion of the infraorbital nerve and the ramus palatinus lateralis. It also illucidates the passage of the mixed nerve (ramus mandibularis and chorda tympani) through the primordial canal of the mandible.

Fig. 16: Photomicrograph of a part of a transverse section passing through the orbitonasal region showing the communication between the infraorbital nerve and the ramus palatinus medialis.

Fig. 17: Photomicrograph of a part of a transverse section passing through the orbitonasal region showing the fusion of the infraorbital nerve and the ramus palatinus intermedialis.



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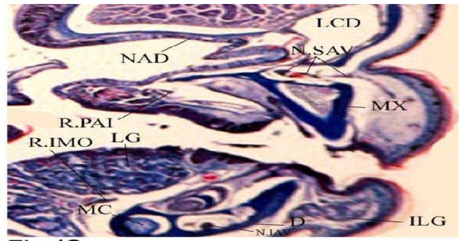


Fig.19

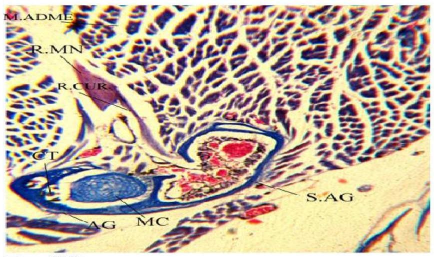
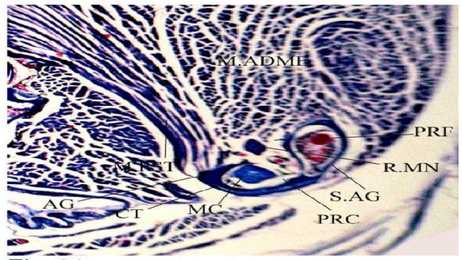


Fig.20



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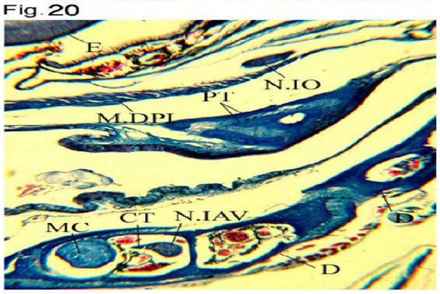


Fig.22

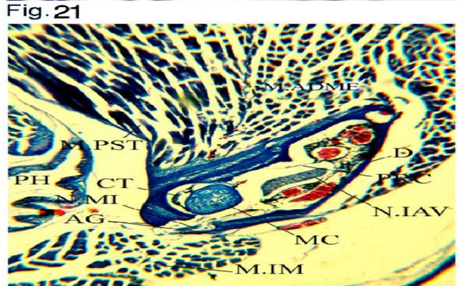
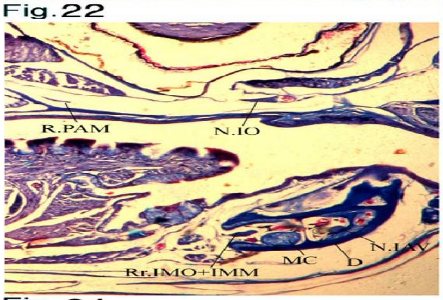


Fig.23



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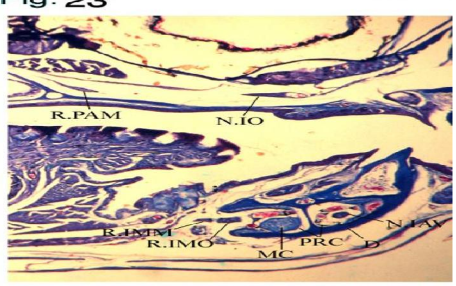

Fig.25

Fig. 18: Photomicrograph of a part of a transverse section passing through the olfactory region showing the infraorbital nerve passing through the maxilla and the intermediate palatine ramus passing to the supralabial gland. It also illucidates the inferior alveolar nerve passing through the primordial canal and position of the ramus intermandibularis oralis.

Fig. 19: Photomicrograph of a part of a transverse section passing through the olfactory region showing both the superior alveolar nerve passing through the maxilla and the position of the intermediate palatine ramus. It also demonstrates the inferior alveolar nerve passing through the primordial canal and the position of the ramus intermandibularis oralis.

Fig. 20: Photomicrograph of part of transverse section passing through the postorbital region showing the origin of the ramus cutaneous recurrens from the ramus mandibularis and its passage through the mandible.

Fig. 21: Photomicrograph of a part of a transverse section passing through the postorbital region showing the entrance of the ramus mandibularis into the primordial canal through the primordial fossa. It also illucidates the passage of the chorda tympani through the same canal.

Fig. 22: Photomicrograph of a part of a transverse section passing through the orbital region showing the position of the infraorbital nerve and the position of both the inferior alveolar nerve and the chorda tympani.

Fig. 23: Photomicrograph of a part of a transverse section passing through the orbital region showing the mixed nerve in the primordial canal giving off the ramus intermanibularis caudalis, the latter leaves the mandible. It also shows the position of the chorda tympani inside the canal.

Fig. 24: Photomicrograph of a part of a transverse section passing through the orbital region showing the origin of the rami intermandibularis oralis and medius, as one nerve, from the ramus mandibularis and their exit from the primordial canal. It also demonstrates the position of the infraorbital nerve and the medial palatine ramus.

Fig. 25: Photomicrograph of a part of a transverse section passing through the orbital region showing the separation of the rami intermandibularis oralis and medius. It also illustrates the position of the infraorbital nerve and the medial palatine ramus.

The absence of the constrictor dorsalis muscles in Chelonia leads to the absence of the constrictor dorsalis nerve as stated by Lakjer (1926), Poglayen-Neuwall (1953b) and Soliman (1964). However, Hoffmann (1890) described a nerve arising from the trigeminal trunk to innervate such muscles in *Chelone*; a case which was denied by Soliman (1964) dealing with the same chelonid.

In this study, there is one constrictor dorsalis nerve to innervate the three constrictor dorsalis muscles. This was found in *Hatteria* (Poglayen-Neuwall, 1954), in *Agama pallida* (Soliman *et al*., 1984; Abdel-Kader, 1990), *Diplometopon zarudnyi* (Dakrory, 1994), *Acanthodactylus boskianus* (El-Ghareeb, 1997) and in *Leptotyphlops cairi* (Abdel-Kader, 2005). However, in Lacertilia, the constrictor dorsalis nerve is represented by two branches in *Tarentola mauritanica* (Poglayen-Neuwall, 1954; Soliman and Mostafa, 1984) and in *Acanthodactylus opheodurus* (Mostafa, 1990a).

In the present study, there is no anastomosis between the constrictor dorsalis nerve and the ramus palatinus of the nervus facialis. This case was also described in gecko *Ptyodactylus hasselquistii* (Abdel-Kader, 1990). On the other hand, this anastomosis was mentioned by many authors in several lacertilians and ophidians. Among Lacertilia, this was described in *Chalcides ocellatus* (Soliman and Hegazy, 1969), *Tarentola mauritanica* (Poglayen-Neuwall, 1954; Soliman and Mostafa, 1984), *Acanthodactylus opheodurus* (Mostafa, 1990a), *Agama pallida* (Abdel-Kader, 1990) and in *Diplometopon zarudnyi* (Dakrory, 1994). About ophidians, the connection between the constrictor dorsalis nerve and the ramus palatinus of the nervus facialis was described by Hegazy (1976) in *Psammophis sibilans*, *Eryx jaculus* and *Cerastes vipera,* by Mostafa (1990b) in *Spaleorsophis diadema* and by Abdel-Kader (2005) in *Leptotyphlops cairi*.

In *Mabuya quinquetaeniata* studied, the trigeminal ganglion is represented by two ganglia; the maxillomandibular and the ophthalmic profundus ganglia. This is the common case in reptiles. Among lizards, this condition was described by Polglayen-Neuwall (1954), Soliman and Mostafa (1984), Abdel-Kader (1990), El-Ghareeb (1997) and by Ramadan (2009). In addition, this case was reported in snakes by Haas (1964 & 1968), Hegazy (1976) and Mostafa (1990b) and by Shiino (1914) in the crocodilian *Crocodilus*.

In other reptiles, the trigeminal ganglion is represented by a single mass; the Gasserian ganglion. This case present in chelonians as recorded by Polglayen-Neuwall (1953a & b) and Soliman (1964) and in the amphisbaenian *Diplometopon zarudnyi* (Dakrory, 1994).

In the present study, the maxillomandibular and the ophthalmic ganglia are connected with each other and are located extracranially. This case was mentioned in *Tarentola mauritanica* (Soliman and Mostafa, 1984), *Agama pallida* and *Ptyodactylus hasselquistii* (Abdel-Kader, 1990), *Diplometopon zarudnyi* (Dakrory, 1994), in *Acanthodactylus boskianus* (El-Ghareeb, 1997) and in *Uromastyx aegyptius* (Dakrory, 2011). However, in *Chalcides ocellatus* (Soliman and Hegazy, 1969), the maxillomandibular ganglion lies intracranially. In Chelonia, the trigeminal ganglion located intracranially in chelonians studied by Polglayen-Neuwall (1953b). In *Chedydra serpentine*, Soliman (1964) said that the posteromedial part of the trigeminal ganglion is located intracranially, while its anterolateral part lies extracranially. In Ophidia, the maxillomandibular and the ophthalmic ganglia are connected with each other and are located intracranially. This was recorded by Hegazy (1976) in *Psammophis sibilans*, *Eryx jaculus* and *Cerastes vipera,* by Mostafa (1990b) in *Spalerosophis diadema.* In some other cases, there is a fusion occures between the trigeminal and geniculate ganglia. This fusion was recorded in *Liotyphlps albirostris* and *Anomalepis aspinosus* (Haas, 1964 & 1968, respectively) and in *Leptotyphlops cairi* (Abdel-Kader, 2005).

In the present study, the trigeminal ganglia (maxillomandibular and ophthalmic) give off three main rami; the ophthalmicus profundus, maxillaris and mandibularis. This was the condition observed in *Chalcides ocellatus* (Soliman and Hegazy, 1969), *Acanthodactylus opheodurus* (Mostafa, 1990a), *Ptyodactylus hasselquistii* (Abdel-Kader, 1990) and in the amphisbaenian *Diplometopon zarudnyi* (Dakrory, 1994). This case, however, is quite different from what was found in the majority of lacertilians so far described, where the constrictor dorsalis nerve arises from the trigeminal ganglion (Poglayen-Neuwall, 1954; Soliman and Mostafa, 1984; Abdel-kader, 1990). In Ophidia, the trigeminal ganglia also give off the same three rami. This case was observed by many authors (Pringle, 1954; Hegazy, 1976; Auen and Langebartel, 1977; Mostafa, 1990b; Dakrory and Mahgoub, 2005; Abdel-Kader, 2005). The condition observed in *Mabuya quinquetaeniata* studied was also mentioned by Hegazy (1976) and Mostafa (1990b) in the ophidians.

In the present study, the anguli oris nerve arises from the main lateral part of the ventromedial division of the nervus trigeminus. This nerve carries both motor and sensory fibres; the motor component passes to the adductor mandibularis extenus and the levator pterygoideus muscles. The sensory fibres are carried to the skin at the angle of the mouth. This agrees with the finding of Poglayen-Neuwall (1954) in all the lizards she studied, Soliman and Mostafa (1984) in *Tarentola mauritanica*, Abdel-Kader (1990) in *Ptyodactylus hasselquistii* and Dakrory (1994) in *Diplometopon zarudnyi*. On the other hand, the anguli oris nerve innervates in addition to the adductor externus muscle, the pseudotemporalis muscle in *Chalcides ocellatus* (Soliman and Hegazy, 1969), *Agama pallida* (Soliman *et al*., 1984; Abdel-Kader, 1990) and in *Acanthodactylus opheodurus* (Mostafa, 1990a).

In Ophidia, there is a branch given by the ramus mandibularis to the adductor externus muscle, it may be homologous to the anguli oris nerve as it carries both motor and sensory fibres. This was described by Hegazy (1976) in *Psammophis sibilans*, *Eryx jaculus* and *Cerastes vipera*, by Mostafa (1990b) in *Spalerosophis diadema* and by Abdel-Kader (2005) in *Leptotyphlops cairi*. However, the anguli oris nerve arises from ramus maxillaris in *Dermochelys coriacea* and from the trigeminal ganglion itself in Chelonia (poglayen-Neuwall, 1953 a & b).

In this study, the ramus ophthalmicus profundus arises from the anterior end of the ophthalmic ganglion as a separate branch, and then it divides into two rami; the ramus frontalis and the ramus nasalis. This case was mentioned among Lacertilia in *Diplometopon zardunyi* (Dakrory, 1994). This condition was recorded in most ophidians as in *Psammophis sibilans*, *Eryx jaculus* and *Cerastes vipera* (Hegazy, 1976), *Elaphe obsolete* and *Thamnophis ordinoides* (Auen and Langerbartel, 1977), *Spalerosophis diadema* (Mostafa, 1990b), *Natrix tessellata* (Dakrory and Mahgoub, 2005) and in *Leptotyphlops cairi* (Abdel-Kader, 2005). However, in most lacertialians, the ramus ophthalmicus arises as two separate rami; frontalis and nasalis (Soliman and Hegazy, 1969; Soliman and Mostafa, 1984; Mostafa, 1990a; Abdel-Kader, 1990; El-Ghareeb, 1997).

In the present study, the ramus frontalis is in connection with the lateral cranial sympathetic ramus through the lacrimal plexus. This is the case mentioned in all the lacertilians so far described (Underwood, 1970; Soliman and Mostafa, 1984; Mostafa, 1990a; Dakrory, 1994; Ramadan, 2009). On the other hand, in the Agamid *Uromastyx aegyptius* (Dakrory, 2011) the connection is described with the ophthalmic ganglion and not with the ramus frontalis.

In this study, the ramus nasalis anastomoses once with the medial palatine ramus of the nervus facialis in the orbitonasal region where the latter carries the ethmoidal ganglion. Howevere, in Chelonia, there is no connection between the ramus nasalis and the ramus palatinus of the nervus facialis in the anterior orbital region (Soliman, 1964). The same result was found in *Diplometepopon zarudnyi* (Dakrory, 1994). On the other hand, in *Chalcides ocellatus* (Soliman and Hegazy, 1969) and *Acanthodactylus opheodurus* (Mostafa, 1990a), there are two anastomosis; where the medial palatine ramus is connected with both the ramus nasalis and the ramus medialis nasi (ramus premaxillaris inferior). The anastomosis between the ramus medailis nasi and the ramus maxillaris recorded in the amphisbaenian *Diplometopon zarudnyi* (Dakrory, 1994) was not recorded in the present study. Among ophidians, the latter connection was reported in *Eryx jaculus* and *Cerastes vipera* by Hegazy (1976) and in snake *leptotyphlops cairi* (Abdel-kader, 2005).

Concerning Reptilia, Underwood (1970) stated that the connection between the ramus nasalis and the medial palatine ramus is a common character among Lacertilia. This connection was mentioned by Soliman and Hegazy (1969), Soliman and Mostafa (1984), Mostafa (1990a), Abdel-Kader (1990), Dakrory (1994) and El-Ghareeb (1997). Concerning Ophidia, such anastomosis was found in *Psammophis sibilians*, *Eryx jaculus* and *Cerastes vipeira* (Hegazy, 1976), *Spalerosophis diadema* (Mostafa, 1990b) and in *Leptotyphlops cairi* (Abdel-Kader, 2005).

In the present study, the ramus nasalis divides into two main branches; the ramus lateralis nasi and the ramus medialis nasi. This division occures in the nasal capsule "intracapsullarly" and the ramus lateralis nasi emerges from the nasal capsule through the foramen epiphaniale. This agrees with the condition found in *Cordylus cordylus* (Van Pletzen, 1946), *Chalcides ocellatus* (Soliman and Hegazy, 1969), *Tarentola mauritanica* (Soliman and Mostafa, 1984), *Acanthodactylus opheodeurus* (Mostafa, 1990a), *Ptyodactylus hasselquistii* (Abdel-Kader, 1990), *Diplometopon zarudnyi* (Dakrory, 1994) and *Acanthodactylus boskianus* (El-Ghareeb, 1997). In *Rhampholeon platyceps* (Frank, 1951), *Microsaura pumila* (Engelbrecht, 1951), *Agama pallida* (Abdel-kader, 1990), *Agama sinaita* (Ramadan, 2009) and in *Uromastyx aegyptius* (Dakrory, 2011) the division is extracapsullar and the ramus lateralis nasi does not enter the nasal capsule and therefore the foramen epiphaniale is absent. The same was found in *Agama atra* and *Agama hispida* (Malan, 1946). However, Barry (1953) stated that the ramus nasalis in *Agama hispida* neither spilt into its two known branches nor enters the nasal capsule. On the other hand, Eyal-Giladi (1964) reported that, in *Agama stellio*, the ramus nasalis divides extracapsular and the ramus lateralis nasi leaves the nasal capsule through the foramen epiphaniale. This agrees very well with the condition found in *Calotes versicolor* (Ramaswami, 1946).

In Ophidia, the ramus nasalis divids extracapsullary and the ramus lateralis nasi enters the cavity of the nasal capsule and then leaves it through the foramen epiphaniale. This found in Liotyphlops albirostris (Haas, 1964), *Psammophis sibilans*, *Eryx jaculus* and *Cerastes vipeira* (Hegazy, 1976), *Spalerosophis diadema* (Mostafa, 1990b) and in *Leptotyphlops cairi* (Abdel-Kader, 2005). On the other hand, in *Causus rhombeatus* (Pringle, 1954) and *Natrix tessellata* (Dakrory and Mahgoub, 2005) the division of the ramus nasalis into its two main branches is extracapsular but the ramus lateralis nasi does not enter the cavity of the nasal capsule.

Among Chelonia, the ramus nasalis divides intracapsular in *Emys lutaria* and the ramus lateralis nasi emerges from the the nasal cavity through the foramen orbitale magnum (De Beer, 1937). In *Crocodilus biporcatus* (De Beer, 1937), the ramus lateralis nasi does not enter the nasal capsule and so the foramen epiphaniale is absent.

In the present study, the ramus medialis nasi enters the nasal capsule through the fenestra olfactoria advehens and gets its exit from the nasal capsule through the foramen apicale. This is the usual condition among lacertilian species (Soliman and Hegazy, 1969; Soliman and Mostafa, 1984; Mostafa, 1990a; Dakrory, 1994). In *Calotes versicolor* (Ramaswami, 1964) the two apical foramina are fused, conseqeuently, a single foramen is present through which the right and left rami medialis nasi pass. In *Varanus monitor* (Bellairs, 1949) and in *Ptydactylus hasselquistii* (Abdel-Kader, 1990), there is no distinct foramen apicale, and the ramus medialis nasi passes between the cupole anterior of the nasal capsule and the rostral process of the nasal septum. However, in *Chalcides ocellatus*, El-Toubi and Kamal (1959) described that the presence of a short channel for the emersion of the ramus medialis nasi and the external opening of which is regarded as the foramen apicale.

Among Ophidia, the absence of the foramen apicale is a common character in ophidian chondrocranium (Pringle, 1954; El-Toubi *et al*., 1973; Hegazy, 1976; Mostafa, 1990b). Pringle (1954) explained the lacking of the foramen apicale in snakes considering that it may be confluent with the fenestra narina.

In this study, the ramus maxillaris gives off immediately after its origin and while passing in the postorbital region and before entering the orbit as infraorbital nerve, two rami; temporalis, lacrimalis. On the othere hand, a third ramus palpebralis inferioris posterioris was desecribed in *Chalcides ocellatus* (Soliman and Hegazy, 1969) and in *Acanthodactylus ophedunus* (Mostafa, 1990a). However, the ramus lacrimalis is absent in *Agama pallid* (Soliman *et al*., 1984; Abdel-Kader, 1990). The ramus lacrimalis was found to be lacking in the ophidians studied by Hegazy (1976), Mostafa (1990b), Abdel-Kader (2005) and Dakrory and Mahgoub (2005). It is also absent in *Tarentora mauritanica* (Soliman and Mostafa, 1984), in *Ptydactylus hasselquistii* (Abdel-Kader, 1990).

Among Ophidia, the ramus maxillaris fuses with the ramus palatines of the nervus facialis before entering the orbit as found in *Psammophis sibilans, Eryx jaculus* (Hegazy, 1976), *Natrix tessellata* (Dakrory and Mahgoub, 2005) and in *Leptotyphlops cairi* (Abdel-Kader, 2005). This fusion is not observed in the scincid species studied, as well as in any other lacertilians so far described.

In the present study, the infraorbital nerve while passing in the orbital region fuses with the lateral palatine ramus and receives an anastomsing branch from the medial palatine ramus. In the orbitonasal region, it fuses for a short distance with the intermediate palatine ramus. The anastomosis of the infraorbital nerve with the ramus palatinus and its branches, before the former leaves the orbit, was mentioned in *Varanus monitor* (Bellairs, 1949), *Tarentola mauritanica* (Soliman and Mostafa, 1984), *Agama pallida* (Soliman *et al*., 1984; Abdel-Kader, 1990, *Acanthodactylus opheodurus* (Mostafa, 1990a), *Diplometopon zarudnyi* (Dakrory, 1994) and in *Acanthodactylus boskianus* (El-Ghareeb, 1997).

In Ophidia, the infraorbital nerve anastomosis with the ramus palatinus of the nervus facialis in *Psammophis sibilans*, *Eryx jaculus* (Hegazy, 1976), *Elaphe obsolete*, *Thamnophis ordinoides* (Auen and Langebartel, 1977) and in *Natrix tessellata* (Dakrory and Mahgoub, 2005), while in *Spalerosophis diadema* (Mostafa, 1990b) this anastomosis was absent.

In the studied *Mabuya quinquetaeniata*, the infraorbital nerve leaves the orbit through the superior alveolar foramen to enter the maxillary bone as the superior alveolar nerve. This is the case mentioned in most lizards and snakes and may be a common character among Squamata (Hegazy, 1976; Soliman *et al*., 1984; Abdel-Kader, 1990; Dakrory, 1994, 2011; Ramadan, 2009).

In *Mabuya quinquetaeniata* studied, the ramus mandibularis carries both motor and sensory fibres. It receives its motor component from the ventromedial division of the trigeminal root. This condition was also found in *Chalcides ocellatus* (Soiman and Hegazy, 1969), in *Tarentola mauritanica* (Soliman and Mostafa, 1984), in *Acanthodactylus opheodurus* (Mostafa, 1990a) and in *Diplometopon zarudnyi* (Dakrory, 1994).

In Ophidia, the ramus mandibularis connected with the nervus facialis, directly after its origin from the Gasserian ganglion. The ramus mandibularis anastomoses with both the ramus palatinus and the ramus hyomandibularis in *Psammophis sibilans* (Hegazy, 1976), with the ramus hyomandibularis in *Eryx jaculus and Spalerosophis diadema* (Hegazy, 1976; Mostafa, 1990b, respectively) and with the geniculate ganglion in *Cerastes vipera* (Hegazy, 1976). This condition is not found in lacertilians so far described, since no mention of such connection was recorded. However, such connection was found in mammals, as in gorilla (Raven, 1950), in certain mammals (Bowden *et al*., 1960), and in the baboon embryos (Gasser and Wise, 1972).

In this study, the ramus cutaneous recurrens arises as a single nerve from the ramus mandibularis before the latter enters the primordial canal. It seems to be a common character among Lacertilia as mentioned in *Ophisaurus* and *Chameleo* by Poglayen-Neuwall (1954), in *Agama pallida* by Soliman *et al.* (1984) and Abdel-Kader (1990), in *Agama siniata* by Ramadan (2009) and in *Uromastyx aegyptius* (Dakrory, 2011).

In Ophidia, the condition differs from that found in Lacertilia, as the ramus cutaneous recurrens arises from the inferior alveolar nerve with the ramus cutaneous externus as a single nerve, then they separate outside the primordial canal as it was mentioned in *Psammophis sibilans and Eryx jaculus* (Hegazy, 1976). However, the ramus recurrens is not present in both *Cerastes vipera* (Hegazy, 1976) and *Natrix tessellata* (Dakrory and Mahgoub, 2005).

In the present study, the ramus cutaneous recurrens passes through a special foramen in the supra-angular bone. This is a common character among Lacertilia, as mentioned by several authors (Poglayen-Neuwall, 1953a; Soliman and Hagazy, 1969; Soliman and Mostafa, 1984; Soliman *et al*., 1984; Abdel-Kader, 1990; Mostafa, 1990a; Dakrory, 1994). However, Fuchs (1931) showed that this ramus passes between the supra-angular and articular bones in *Podocnemis expansa* and between the supra-angular and dentary bones in *Hatteria*.

In this study, the ramus cutaneous recurrens is entirely sensory, as it carries somatic sensory fibres. This was also found in all reptiles so far described. On the other hand, this ramus carries motor fibres beside the somatic sensory fibres to the adductor posterior muscle in *Tupinambis* and *Amphibolurua* (Poglayen-Neuwall, 1954), and to the adductor externus muscle in the *Psammophis sibilans* (Hegazy, 1976).

In the present study, ganglionic cells are detected at the point of fusion of the ramus alveolaris inferior (the continuation of the ramus mandibularis within the primordial canal) and the chorda tympani. Lubosch (1933) found a ganglion at the place, where the chorda tympani fuses with the ramus alveolaris inferior in Sauropsida. Such condition was mentioned in other lacertilians by Willard (1915), Soliman and Hegazy (1969), Soliman *et al.* (1984) and Abdel-Kader (1990), Mostafa (1990a) and by Dakrory (2011) and in the ophidians *Psamophis sibilants* and *Cerastes vibra* (Hegazy, 1976) and *Splaerosophis diadema* (Mostafa, 1990b).

On the other hand, this ganglion is represented by a few ganglionic cells found in the mixed nerve (the inferior alveolar nerve + chorda tympani) at the origin of the intermandibularis medius or the ramus paralingualis in *Tarentola mauritanica* (Soliman and Mostafa, 1984), *Ptyodactulus hasselquistii* (Abdel-Kader, 1990) and in *Diplometopon zarudnyi* (Dakrory, 1994).

In *Mabuya quinquetaeniata* studied, it is clear that, the fibres of the chorda tympani carried by the inferior alveolar nerve are more or less divided into two portions; one portion incorporates with the intermandibularis oralis, while the other combines with the intermandibularis medius or the ramus paralingualis. From the anatomical point of view, it seems that the ramus lingulis of the nervus hypoglossus receives the majority of the fibres of the chorda tympani carried by the ramus intermandibularis medius. This seems to be very common among the reptiles so far described, except in the chelonians. In the turtles *Chelydra serprntina* and *Chelone imbricate* (Soliman, 1964), such an anastomosis is not present.

In the present study, the motor components of the ramus mandibularis innervate the pterygomandibularis, the pseudotemporalis and the intermandibualris muscles. Similar to the preset study, the adductor mandibularis externus muscle receives an additional branch from the anguli oris nerve in *Podoenemis expania* (Fuchs, 1931), all the lizards studied by Pogalen-Neuwall (1954), *Chalcides ocellatus* (Soliman and Hegazy, 1969), *Tarentola mauritanica* (Soliman and Mostafa, 1984), *Agama pallid* and *Ptyodactulus hasselquistii* (Soliman *et al.,* 1984; Abdel-Kader, 1990) and in *Acanthodactylus opheodurus* (Mostafa, 1990a).

In the present study, the intermanidbularis muscle is innervated by the ramus mandibularis (the intermandibularis caudalis nerve). The intermandibularis caudalis nerve carries, in addition to its motor componants, somatic sensory fibres to the skin of the mandible. This was also the case found in *Tarentola mauritanica* (Soliman and Mostafa, 1984), *Agama pallida* (Soliman *et al*., 1984; Abdel-kader, 1990), *Ptyodactylus hasselqustii*

(Abdel-Kader, 1990) and in *Acanthodactylus opheodurus* (Mostafa, 1990a).

In Ophidia, the condition is different, where the intermadibularis muscle is doubly innervated. This is the case found in the snakes studied by Hegazy (1976) and Mostafa (1990b). In this respect, Edgeworth (1935) said that the intermadibularis muscle of Sauropsida is innervated by the ramus mandibularis, and in some Lacertilia, its posterior part is innervated by the ramus hyoideus (N.VII). On the contrary, Brock (1938) found that the intermandibularis muscle is entirely innervated by the trigeminal nerve in amniotes.

The nervus trigminus carries somatic sensory and visceral motor fibres is a matter of no doubt, as it is reported by several authors (Romer, 1962; Soliman and Hegazy, 1969; Soliman and Mostafa, 1984; Soliman *et al*. 1984; Abdel-Kader, 1990; Mostafa, 1990a & b). Kappers *et al*. (1960), on the other hand, mentioned that the nervus trigeminus does not supply the mucous epithelium and does not contain visceral sensory fibres. They added that the sensory fibres carried by the nervus trigeminus are purely somatic afferent. Goodrich (1930) stated that the visceral sensory fibres, when present in the trigeminal branches, are generally supposed to have been derived from the facial nerve.

It is clear from the previously detailed anatomical study of the serial sections of *Mabuya quinquteaniata* that the trigeminal branches carry, in addition to the somatic sensory and visceral motor fibres, visceral sensory and vegetative fibres. The visceral sensory fibres, which are mentioned here, are of general type and have nothing to do with the taste. The vegetative fibres are carried to the nervus trigeminus by means of the ramus palatines of the nervus facialis and the lateral cranial sympathetic ramus. To answer the question, whether all visceral sensory fibres are transmitted to the trigeminal branches from the nervus facialis, as it is the view which has been advanced, or some of them are developed from the trigeminal ganglion, the following may throw some light in solving this problem. In the present study, the anastomosing branches, which are supposed to carry the visceral sensory and vegetative fibres to the trigeminal branches, are too fine, if compared with the rami given by the trigeminal branches to the glands and the mucous epithelium. Example to this is the chorda tympani which carries the visceral sensory and the sympathetic fibres from the nervus facialis to the ramus mandibularis, this nerve is small to carry all sensory fibres given by the ramus mandibularis to the mucous epithelium and glands found at the floor of the mouth.

According to these anatomical observations, it can be said that the trigeminal rami probably derive some of their visceral sensory fibres from the trigeminal ganglion. These fibres are added to the visceral sensory fibres transmitted to the rami from the nervus facialis and nervus hypoglossus.

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11/11/2011

LIST OF ABBREVIATION

AC	:	Auditory capsule.
AG	:	Angular bone.
B	:	Brain.
BSP	:	Basisphenoid bone.
CO.N	:	Common nerve.
CT	:	Chorda tympani.
CT&N.IAV	:	Chorda tympani & inferior alveolar nerve.
D	:	Dentary bone.
DLD.RO.V	:	Dorsolateral division of trigeminal root.
E	:	Eye.
F.APC	:	Foramen apicale.
G.CIL	:	Ciliary ganglion.
G.ET	:	Ethmoidial ganglion.
G.GE	:	Geniculate ganglion.
G.MM	:	Maxillomandinular ganglion.
G.MN	:	Mandibular ganglion.
G.OPH	:	Ophthalmic ganglion.
GC	:	Ganglionic cells.
HDG	:	Hardeŕs gland.
IP	:	Incisura protica.
JO	:	Jacobsońs organ.
LGG	:	Lingual gland.
LP.VMD.RO.V	:	Lateral part of ventromedial division of the trigeminal root.
M.ADME	:	Adductor mandibularis externus muscle.
M.DPI	:	Depressor palpbrea inferioris muscle.
M.IM	:	Intermandibualris muscle.
M.LPT	:	Levator pterygoideus muscle.
M.PPT	:	Protractor pterygoideus muscle.
M.PST	:	Pseudotemporalis muscle.
MC	:	Meckel′s cartilage.
MP.VMD.RO.V	:	Medial part of ventromedial division of the trigeminal root.
MX	:	Maxillary bone.
N.ADME	:	Nerve to adductor mandibularis externus muscle.
N.AO	:	Anguli oris nerve.
N.BV	:	Nerve to blood vessel.
N.CD	:	Constrictor dorsalis nerve.
N.CU	:	Nerve to skin.
N.CU+ILG	:	Nerve to skin and infralabial gland.
N.CU+SLG	:	Nerve to skin and supralabial gland.
N.DPI	:	Nerve to depressor palpbrae inferioris muscle.
N.EP	:	Nerve to epithelium.
N.EP+DE	:	Nerve to epithelium and dental lamina.
N.HDG	:	Nerve to Hardeŕs gland.
N.IM	:	Nerve to intermandibularis muscle.
N.IM+CU	:	Nerve to intermandibularis muscle and skin.
N.IAV	:	Inferior alveolar nerve.
N.ILG	:	Nerve to infralabial gland.
N.IO	:	Infraorbital nerve.
N.LCG	:	Nerve to lacrimal gland.
N.LPT	:	Nerve to levator pterygoideus muscle.
N.MI	:	Mixed nerve.
N.NR	:	Nerve to narial muscle.
N.PPT	:	Nerve to protractor pterygoideus muscle.
N.PST	:	Nerve to pseudotemporalis muscle.
N.PTM	:	Nerve to pterygomandibularis muscle.
N.SAV	:	Superior alveolar nerve.
N.SLG	:	Nerve to supralabial gland.
N.T+VON	:	Nervi terminalis and vomeronasali.
N.TE	:	Nerve to teeth.
NA	:	Nasal bone.
NA.G	:	Nasal gland.
N.IV	:	Nervus trochelaris.
N.V	:	Nervus trigeminus.
N.VI	:	Nervus abducense.
N.XII	:	Nervus hypoglossus.
Nn.BV	:	Nerves to blood vessel.
Nn.CIL	:	Ciliary nerves.
Nn.CU	:	Nerves to skin.

Nn.CU+DE	:	Nerves to skin and dental lamina.
Nn.CU+TE	:	Nerves to skin and teeth.
Nn.EP	:	Nerves to epithelium.
Nn.HDG	:	Nerves to Harder's gland.
Nn.IM	:	Nerves to intermandibularis muscle.
Nn.LCG	:	Nerves to lacrimal gland.
Nn.LGG	:	Nerves to lingual gland.
Nn.ME	:	Nerves to meninges.
Nn.NAG	:	Nerves to nasal gland.
Nn.NR	:	Nerves to narrial muscle.
Nn.SLG	:	Nerves to supralabial gland.
Nn.TB+EP	:	Nerves to taste buds + epithelium.
OL.BU	:	Olfactory bulb.
OL.EP	:	Olfactory epithelium.
PAAMX	:	Palatal process of maxilla.
PAPPA	:	Palatal process of palatine.
PRC	:	Primordial canal.
PRF	:	Primordial fossa.
PTC	:	Parietotectal cartilage.
R.CM.FR+LC	:	Ramus commuincans between the ramus frontalis and the ramus lacrimalis.
R.CM.FR+LCP	:	Ramus commuincans between the ramus frontalis and the lacrimal plexus.
R.CM.IO+PAL	:	Rramus communicans between the ramus intermandibularis oralis and the ramus palatinus lateralis.
R.CM.IO+PAM	:	Ramus communicans between the infraorbital nerve and the medial palatine ramus.
R.CM.LC+LCP	:	Ramus communicans between the ramus lacrimalis and the lacrimal plexus
R.CM.LP.VMD.RO.V+G.MM	:	Ramus communicans between lateral part of ventromedial division (N.V) and maxillomandinular ganglion.
R.CM.NA+G.ET	:	Ramus communicans between the ramus nasalis and the ethmoidal ganglion.
R.CUR	:	Ramus cutaneous recurrens.
R.FR	:	Ramus frontalis.
R.IF.III	:	Ramus inferior.
R.IMC	:	Ramus intermandibularis caudalis.
R.IMM	:	Ramus intermandibularis medius.
R.IMO	:	Ramus intermandibularis oralis.
R.LC	:	Ramus lacrimalis.
R.LCSY	:	Lateral cranial sympathetic ramus.
R.LNA	:	Ramus lateralis nasi.
R.MN	:	Ramus mandibularis.
R.MNA	:	Ramus medialis nasi.
R.MX	:	Ramus maxillaris.
R.NA	:	Ramus nasalis.
R.OPH	:	Ramus ophthalmicus profundus.
R.PA	:	Ramus palatinus.
R.PAI	:	Ramus palatinus intermedialis.
R.PAL	:	Ramus palatinus lateralis.
R.PAM	:	Ramus palatinus medalis.
R.PMXI	:	Ramus premaxillaris inferior.
R.PMXS	:	Ramus premaxillaris superior.
R.TM	:	Ramus temporalis.
RCB	:	Radix ciliaris brevies.
RCL	:	Radix ciliaris longa.
RO.V	:	Nervus trigeminus root.
RO.VII	:	Nervus facialis root.
Rr.IMO+IMM	:	Rami communicans between the ramus intermandibularis oralis and intermandibularis medius.
S.IN	:	Internasal septum.
S.IO	:	Interorbital septum.
VC	:	Vidian canal.
VMD.RO.V	:	Ventromedial division of the trigeminal root