Developmental studies on the neurocranium of the intermediate stages of Coturnix coturnix japonica(Phasianidae,Galliformes).

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ABSTRACTS

Study of the intermediate stages of *Coturnix coturnix japonica* reveals the following events:-

1.The intertrabecular bar extends in a dorsal direction to form firstly the nasal septum then later the interorbital one.
2.The hypophyseal incisura converts into a hypophyseal fenestra.
3.The anterior orbital cartilage begins to disappear completely at the end of these stages.
4.The paranasal cartilage has an isolated center of chondrification.
5.Also the parietotectal cartilage emerges from a separate center of chondrification apart from the nasal septum.
6.Both of conchae atrioturbinal and maxilloturbinal cartilages have the same center of chondrifiction which is the venteral surface of the parietotectal cartilage.
7.Paries lateralis nasi originates from the union of the paranasal cartilage and the parietotectal cartilage.
8.The lateral wall of the nasal capsule in the posterior region (planum antorbitale) is developed.
9.The metotic cartilage has two centers of chondrification; lateral and medial one.
10.Fusion of the cochlear and canalicular portions of the auditory capsule takes place.
11.Both of fenestra ovalis and foramen perilymphaticum are developed as reabsorption in pre-existence cartilage.
12.The promontorium is formed at the end of these stages.
13.The posterior edge of the occipital arch fails to fuse in the mid –line to form the tectum synoticum at the end of the intermediate stages .

INTRODUCTION

The present work is the second paper in the series to throw the light on the development of neurocranium of *Coturnix coturnix japonica*.This bird is another member of *Galliformes* and belogs to family *Phasianidae*.The first paper was the studyof the optimum stage for the same species (Abd-El-Hady ,2008) .

MATERIAL AND TECHNIQUE

The investigated intermediate stages of the neurocranium of the present study is of bird *Coturnix coturnix japonica* .This bird belongs to order Galliformes .The embryos of this bird were collected from the project of quail rared at the agriculture college ,Cairo University .The embryos were removed from the shells carefully .Then ,they were fixed as soon possible in an aqueous Bouin's solution for at least 12 hours .The embryos were stained in toto with Boraxcarmine , then serially sectioned (10 M. and 15 M.in thickness) .The serial sections were counterstained with

Picroindigocarmine .The sections of the chosen intermediate stages embryos were 31,35,43,46 and 49 mm.total body length.Only two stages(35 mm. and 49 mm.) were drawn by the projector with a magnification of 40 x.From the sections the graphic reconstructions of the neurocranium were drawn and described.

OBSERVATIONS

First stage:

The total body length of embryo:35mm.

Figures: 1,2,3,4,5,6,7,8 and 9

1-The Basal Plate and Occipital Region:

The basal plate becomes rectangular in shape with a narrow antero-medial edge .Its width and length grow in anterior and posterior directions .At lateral direction the auditory capsule abute the basal plate along the main axis(anterior-posterior direction) as can be shown in figures 1 and 2 .The anterior and posterior margins of the basal plate are increased in their thickness .Until this stage the occipital condyle is not developed .The degree of chondrofication of basal plate is more advanced than the early stage.But there is a histological differentiation between its different parts , where the posterior edge of the basal plate consists of a chondrified cells and the prochondrin cells occupy the anterior part .Accordingly the line of demarcation between the acrochordal cartilage and the basal plate is still pronounced (figs.,1 and 2).

When the present stage is established the degree of lordosis of the basal plate becomes more minimized than in the early stages .The basal plate connects postero-laterally with the occipital arch without any line of demarcation .This arch comprises from the fusion of the four occipital arches .This case leads to an increase in the extension of the lateral edge of the basal plate .Also ,the number of the hypoglossal foramina is still fixed (three in number) as shown in figures 1 and 2 .The notochord of the present stage penetrates both the basal plate and the acrochordal cartilage ,then projects by its tapering end in the hypophyseal fenestra .The notochord firstly occupies a centeral position then dorsally .It changes its course in the posterior region to return the centeral position and finally takes a venteral course .The notochord has a tapering anterior end projects in the hypophyseal fenestra for a short distance.

The acrochordal cartilage of the present stage acquires more chondrified material than before .It has an pronounced expansion toward the lateral directionto give the pila antotica (figs.,1,2,3 and 6, ACR.C.,PIL.ANT.).It becomes more chondrified than the early stages .The demarcation of boundary for both acrochordal cartilage and pila antotica is the position of the oculomotor foramen .The oculomotor nerve penetrates the cartilage and represents as a limit between the two mentioned cartilage (figs., 1 and 6 ,N.III.).Also,the abducens nerve is encountered in a short canal before leafing the cranial cavity across the incisura prootica .Two mentioned canal for oculomotor and abducens nerves are situated at the antero- lateral edge of the basal plate below the contact between the acrochordal cartilage and the pila antotica (figs., 2 and 3,ACR.C.,BAS.PL.,PIL.ANT.,N.III.,N.VI.).

When the present stage is established the posterior orbital cartilage becomes heavily chondrified element .Its extension becomes more wider than the early stage because there is more deposition of the chondrin matrix in its undifferentiated area .Also,there is no real limitation between the pila antotica and the posterior orbital cartilage due the fact that the two cartilages have the same center of chondrification that is the acrochordal cartilage.At the sametime, it can be seen from figure 3 that the

trochlear nerve has been enclosed in a short canal located at the antero-lateral side of the posterior orbital cartilage.In the present stage and through the anterior part of the fissure metotica the glossopharyngeal nerve(N.IX.) leaves the cranial cavity .Also, the vagus and spinal accessory nerves pass through a certain foramen which situated at the lateral part of the basal plate (fig.,2,FOR.N.X.&XI.).This foramen is established by the growing of the lateral process from the postero-lateral edge of the basal plate .By extension of this process, the glossopharyngeal,vagus accessory nerves become separated.This leads to the latter nerve becomes fitted in a depression on the lateral surface of the basal plate (foramen jugulare).By the continuous development in the lateral process leads to the fusion of this cartilage .The fusion takes place between the medial edge of this process which is the medial anlage of the metotic cartilage and the basal plate posterior to the site of emergence of the vagus accessory nerve.The anterior border of this process forms the commissural praevagalis .Finally, this process by the progress of development unites with the lateral anlage of the metotic cartilage.This union acts as a bridge below the fissura metotica (figs.,2 and 9 ,M.A.MET.C.,COM.PRV.).

2-*The Auditory Capsule:*

The most pronounced character for the present stage is the union between the two entities of the auditory capsule (cochlear and canalicular portions).This observation is a common avian character and takes place by the formation of a floor, posterior and anterior walls,since the ventro-medial wall of the cochlear portion extends laterally.The union process accomplished finally by the fusion with the medial extension of the venteral edge of the canalicular part and hence, the anterior and posterior walls unite together.According to the fusion process between the two entities the cochleo-canalicular fissure has been closed.At the same time the facial nerve grows in an antero-ventral direction.This nerve passes over the prefacial commissure which connects the ventral border of pila antotica with the dorsal edge of the cochlear part (figs.,3 and 7,N.VII.,PREF.COM.,PIL.ANT.,COCH.PR.).

Due to the development of the auditory capsule of the present stage the cochlear part increases in size ,length and encroaches on the lateral edge of the basal plate.The encroachment is achieved through the development of the basicapsular commissure (figs.,1,2 and 8 BC.COM.).When the medial wall of the cochlear part grows over the level of cochlea ,the roof of the cochlear part is formed. But there is no roof for the canalicular part.

The cochleo-canalicular fissure of the present stage decreases in size to represent as a vacuity between the medial the medial border of the canalicular portion and the lateral one of the roof of the cochlear part .The rest of this fissure divides into two foramina ,the anterior foramen for the passage of all branches of the auditory capsule , while the other foramen for the entrance of the ductus endolymphaticus (figs., 1 and 9).

In the present stage of *Coturnix* there are two prominentiae for the auditory capsule.These are the prominentiae cochlearis and the semicircularis lateralis (figs.,1,2 and 3 PROM.COCH.,PROM.SC.L.).

When the present stage is established ,two commissures are developed .These are basicapsular commissure and the prefacial one. These commissures help the fixation of the auditory in its position.The basicapsular commissure encroached the cochlear portion on the lateral wall of the basal plate,while the prefacial one is used for the fixation of the cochlear part to the ventral border of the pila antotica .This commissure is not well developed in this stage (figs.2,3 and 8).

In relation to the delimitation of the incisura prootica, in the present stage is achieved through the fusion of the cochlear part,the basal plate,the acrochordal cartilage and the posterior orbital cartilage (fig. 3,INC.PR.).From the incisura prootica all the branches of the trigeminal nerve and the abducens one leave the cranial cavity.In the present stage,the incisura is limited dorsally by the postero-ventral border of the pila antotica and the posterior orbital cartilage,medially by the lateral edge of the basal plate and poseriorly by the cochlear part of the auditory capsule.

In the present stage of *Coturnix*,the metotic cartilage emerges from two centers of chondrification which arise at the same time.The dorsal center is the lateral anlage of metotic cartilage ,while the ventral one is its medial anlage (figs.,3,7 and 8 L.A.MET.C.,M.A.MET.C.).The two anlagen appear as two nodules, they elongated and fused together then finally united with the lateral edge of the basal plate.The union of the metotic cartilage with the basal plate leads to formation of a small space called cavum metoticum.It constricted between the metotic cartilage laterally and the canalicular medially.

As can be seen from figure 2, the foramen perilymphaticum develops on the wall between the cochlear and the canalicular parts.This foramen arises by the resorption process of pre-existing cartilage of the auditory capsule.The foramen perilymphaticum performs as a passage for the scala tympani from the cavum cochleare to reach the fissura metotica .This fissura has not acquired its fully form because the occipital arch is still short .For this reason the fissura metotica is opened dorsally .The shape of this fissure is a space located between the medial wall of the auditory capsule and the lateral border of the basal plate.

3-The Prechordal Region:

All the elements of the prechordal region in the present stage undergo a high degree of growth and change at the level of chondrification and their relationship with the neighboring elements .When the present stage is reached ,the two trabeculae cranii fused completely with the lateral sides of an intertabecular bar (figs.,1,2 and 3,ITR.B.,T.C.).The two trabecula cranii elongate extensively toward the posterior direction to merge with the polar cartilage .The line of demarcation between the two trabeculae cranii ,an intertrabecular bar and the polar cartilage is not obvious as can be shown from figures 2 and 3 . The polar cartilages of the present stage are well developed and increased in size .The polar cartilage still have the same dome- like shape .Figure 3 reveals that the polar cartilage lies antero- ventral to the acrochordal cartilage .Also ,their long axes come to lie at right angles with the corresponding axis of the basal plate . According to this observation the lateral carotid incisure become more wide .At the same time there is a connection between the ventro- lateral surface of the polar cartilage and the dorsal margin of the processus orbitalis of the quadrate cartilage via the procartilaginous quadratopolar commissure (figs. 3 and 5, S.POL.C.,Q.POL.C.).Hence ,the posterior edge of supra polar cartilage is fused with the dorsal margin of the acrochordal cartilage , where the point of their contact is the center of connection between the acrochordal cartilage and the pila antotica .This leads to conversion of the ophthalmic incisure into an ophthalmic foramen to passage the ophthalmic artery (fig.3 ,FOR.OPTH.).

The intertrabecular bar in the present stage of *Coturnix* attains a highly degree of chondrification .This leads to increase in height ,width and length .Now ,it has a rectangular shape .Also , the fusion of an intertrabecular bar with the medial edge of two trabeculae cranii obliterates the line of the demarcation between these entities

.According to the union of these three elements the hypophyseal incisura converts into the hypophyseal fenestra (figs., 1 and 5 ,HYP.FEN.).It is of importance to mention that the hypophyseal fenestra encloses the pituitary gland .This fenestra is limited posteriorly by the anterior edge of the acrochordal cartilage ,anteriorly by the posterior border of the intertrabecular bar , then laterally by the supra polar cartilage (figs.,1,2 and 5) .

Due to all the previous mention fusion of different elements of the prechordal region , the cranial axis in this area becomes more or less a straight one This means that the cranial flexure is less pronounced than in the early stages .

The interorbital septum emerges as an up growth from the dorsal edge of the intertrabecular bar of the present stage (figs., 1,2 and 3 ,S.INT.).It becomes elevated behind the nasal sacs , then fuses dorsally with the ventral border of the newly formed cartilage (parietotectal cartilage).

The most impotant change in the anterior orbital cartilages of the present stage is attained their final size and length where after the present stage they tend to disappeared.The anterior orbital cartilage proceed their growth in the dorsal direction until they become at the level of the parietotectal cartilage and in lateral direction .In both directions there is no any contact between the anterior orbital cartilage and each of the parietotectal cartilage , nasal septum ,trabeculae cranii and the intertabecular bar (figs.,1,2 and 3).Also,as can be shown from figure 3 the anterior orbital cartilage fails to reach the the anterior border of the posterior orbital cartilage due to the absence of the supra-orbital process of the anterior orbital cartilage.

The present stage of *Coturnix* reveals that the nasal septum starts to chondrify .It emerges as a process from the intertrabecular bar .There is no demarcation line between two entities .This means that the development of the nasal septum has no separate center of chondrification .As an universe avian character ,it seems that the ethmoid region in *Coturnix* exhibits a delaying appearance when compared with other regions of neurocranium .

The present stage discloses that another important element of the ethmoid region starts its first appearance .This is a pair of the paranasal anlagen (figs.,1,2 and 3 ,P.NAS.).They emerge as an isolated rods of dense mesenchyme. They are situated laterally to the posterior part of the nasal sacs .At the same time ,there is no sign of connection between the paranasal cartilage and the nasal septum .Also , the roof of the nasal capsule begins in the present stage of *Coturnix* which is called the parietotectal cartilage (figs., 1,2,3 and 4, PT.C.).It begins in 31 mm. embryo as a small procartilaginous rod one on each side of the nasal septum.In the present stage it grows medially to fused with the dorsal edge of the nasal septum .Hence, the parietotectal cartilage has an isolated center of chondrification .The present stage of *Coturnix* revealed that the parietotectal cartilage begins to give a small duration of the down ward process .

Second stage:

The total body length of embryo: 49 mm.

Figures: 10,11,12,13,14,15,16,17,18,19,20,21 and 22 .

1-The Basal Plate and Occipital Region:

This region is subjected to a considerable change when the present stage was reached.The change includes more length and width to the basal plate .Anteriorly the width of the basal plate tends to decrease (fig., 11,BAS.PL.).This diminishing is due to the encroachment of the cochlear portion of the auditory capsule on its lateral edge, and posteriorly becomes more dilated. Also,the thickness of the medio- posterior edge

of the basal plate is more than the previous stage to form the developed occipital condyle (figs.,10 and 11 ,O.C.).The median dorsal surface of the basal plate is elevated due to the passge of the notochord inside it.The notochord takes a centeral course inside the basal plate for a considerable distance then becomes dorsally again at the end of the basal plate .In the present stage the notochord projects into the hypophyseal fenestra .At the same time the line of demarcation between the basal plate and the acrochordal cartilage is still found but less prounounced.The lordosis phenomenon has been minimized than before in the previous stage.

At the present stage, the three hypoglossal foramina are still preserved their position at the postero-lateral edge of the basal plate .These foramina are enveloped three hypoglossal nerve roots.They leave the cranial cavity through their corresponding foramina .At the same time ,the occipital arch of the present stage increases in width and thickness . It develops in a postero- ventral direction where it stands at the level of the ventral edge of the canalicular part of the auditory capsule (FIGS., 10 and 11,O.A .).In the present stage , the occipital arch from each side starts to curl in ward but still separates from the mid line by a considerable distance (figs., 10 and 11, O.A.). Accordingly the fissure exoccipitocapsularis becomes more narrower than the case of the previous stage (fig., 22, F.EXOCPS.).

2- The Auditory Region :

The region of the auditory capsule of the present stage of *Coturnix* has undergone considerable changes including number of the prominentiae , width , length and the final back rotation of the canalicular portion .This rotation leads the canalicular portion to becoming lies posteriorly to the cochlear part instead being ventrally .Also the canalicular part curved inwards instead of standing parallel to the basal plate by the medial rotation .The posterior part of the auditory capsule on both sides approach each other but without fusion where there is a small distance between them (figs.,10 and 11,PROM.COCH .,PROM.SC.L.).

It is to be mentioned that the chondrification process grows in the walls of the cochlear and canalicular parts of the auditory capsule .One of the most important changes in relation of the foramina of the auditory capsule is the partition of the dorsal part of the cochleo – canalicular fissure by the cartilaginous commissure.This commissure divides the fissure into two foramina : the anterior one for the passage of the branches of the eighth nerve (foramen acousticum), while the posterior foramen for the passage of the endolymphatic duct .As regards the foramen acousticum , it subjects to another subdivision by continuous deposition of the chondrin matrix as a cartilaginous commissure .This last division gives two foramina , the first for the passage of the ramus ampullaris anterior and utriculus and the second one for the passage of all the branches of the auditory nerve (fig., 10,FOR.R.AMP.ANT. &UT.,FOR ACUS.) .

As can be shown from the present stage of *Coturnix* ,the formation of fossa supracochlearis is not completed .It is considered as a roof of the cochlear part of the auditory capsule .The fossa in question lodges the facial nerve to form a groove for passage this nerve .The fossa in the present stage has a very small duration . Also for the complement of this groove there is a small prefacial commissure which is attached medially with the cochlear portion and nearly it envelops the facial nerve (figs.,10 and 19 .FOS.SUP.COCH.,PREF COM.,N.VII.) .

It is evident that the number of prominentiae increases to five .As compared with the previous stage there are two ; prominentiae cochlearis and semicircularis lateralis only .Beside the previous mentioned prominentiae , now in the present stage

there are prominentiae utriculus , semicircularis anterior and semicircularis posterior (figs.,10 and 22 ,
PROM.UT.,PROM.SC.A.,PROM.SC.P.,PROM.COCH.,PROM.SC.L.).In the present stage , the degeneration process in the pre – existing cartilage of the lateral wall of the cochlear portion is proceeded to formation of the fenestra ovalis . This fenestra is a wide foramen for fitness of the stapes of the columella auris , where the lateral wall becomes more thinner before by a continuous depression of stapes in this wall (figs., 11 and 20 ,FEN.OV.,ST.) .

In addition to the previous mentioned fenestra there is another large foramen . This is existed in the latero – venteral wall of cochlear and canalicular portions of the auditory capsule .This is the foramen perilymphaticum (fig.,20 , FOR.PERI .). The length of perilymphaticum foramen is equal to that of fenestra ovalis . Between the two foramina (fenstra ovalis and perilymphaticum foramen) there is a rounded cartilaginous bar which is called the promntorium (figs., 11 and 20, PROMN.).

One of the most interesting cartilaginous element is the cista parotica .It develops from the lateral wall of the cochlear portion as a cartilaginous protrusion which soon takes a concave cup- shaped structure .It acts as an articulating element to lodging the posterior part of the otic process of the quadrate cartilage (figs.,11 ,12 and 19 ,CRS.PA.,P.OT.).

As can be shown from the present stage of *Coturnix* ,there is a great development of the metotic cartilage .It covers completely the ventral border of the canalicular portion . Also the lateral part of the metotic cartilage grows dorsally and fused with the ventral edge of the prominentia semicircularis lateralis . The fusion of two element encircledthe space between them which is called the cavum metoticum (fig.,21, CAV.MET.).Another fusion takes place where the medial edge of the lateral anlagen of the metotic cartilage approaches towards the lateral edge of the medial anlagen of metotic cartilage (lateral edge of the basal plate forms a continuous floor which situates under the canalicular portion of the auditory capsule (fig.21).

According to all these connections between the components of the auditory capsule , the fissura metotica becomes changed in its shape and arrangement .Actually this fissure divides into three foramina ; anterior , posterior and jugulare . The anterior foramen is called aperture medialis recessus scalae tympani .This foramen permites the passing of the glossopharyngeal nerve outside the cranium and leads to the recessus scalae tympani .The extension of this foramen is between the hind border of the basicapsular commissure to the anterior edge of the commissura praevagalis . The posterior foramen is represented by the fissure exoccipitocapsularis .It acts as a barrier between the dorso – lateral edge of the occipital arch and the ventro – medial border of the canalicular part . Again , in the present stage the occipital arch starts to curl inward but there is no fusion in mid line due to presence of a distance between them . Finally the third partition of the fissura metotica is the foramen jugulare which encloses the vagus accessory nerve . It is enclosed by the medial part of the metotic cartilage .

The metotic cartilage and the ventro – lateral border of the prominentia semicircularis lateralis encircled completely the cavum metoticum in the present stage unless a little orifice which situates at the antero – lateral border of the cavum metoticum . This takes place where the dorsal border of the metotic cartilage (cartilaginous ridge becomes to articulate with the ventral edge of the squamosal bone.

3-The Orbital Region :

In the present stage of *Coturnix* and due to the great development for the orbital region ,this region divided into two regions .These are the anterior interorbital region and the posterior sphenotemporal one .The interorbital region connects the nasal capsules ,while the sphenotemporal joins with the basal plate .The components of the interorbital region are the interorbital septum and the sphenethmoid commissure . Firstly the interorbital septum characterized by a high growth than the previous stage . It increases in length and size in anterior to posterior direction .Also , its height is variable where it begins to increase gradually to attain a considerable level .It exceeds the level of posterior orbital cartilage .Then , it continues its height to attain its maximum level ,but it dramatically decreases to reach the level of incisura optica since its height attains the lowest value (fig.12 ,S.INT.,SPHEN.COM..OPT.INC.).

It evident that the intertrabecular bar has a swollen shape in the present stage of *Coturnix* .Also , the borders between this cartilage and two trabeculae cranii are obliterated .Finally , it seems that the three cartilages become a lonely element (figs.,11 and 12, ITR B.).

One of the novelist characters for this stage is the beginning of reabsorption of the pre – existing cartilage in the middle of the interorbital septum to form the fenestra septi interorbital .In the present stage , this fenestra has a small duration and takes ultimate size at the optimum stage (fig.,12, FEN.SEP.INT .) .

When the present stage of *Coturnix* is established , the observation revealed that the anterior orbital cartilage completely disappeared , but its connection with the parietotectal cartilage (sphenethmoid commissura) is still persisted (fig.,12 ,SPHEN.COM.) .By investigation of 40 mm. stage which is younger than the present stage , this commissure begins from a lateral edge of the posterior part of the parietotectal cartilage as a prochondrin matrix .In 46 mm .stage (younger than the present one , this commissure is well developed and becomes more chondrified .

The second portion of the orbital region (the posterior sphenotemporal part) subjects to a great development and changes .Its typical components are the posterior orbital cartilage , acrochordal cartilage , polar and supra polar cartilages as well as pila antotica (figs.,10,11, and 12 ,POS.ORB.C.,ACR.C.,POL.C.,S.POL.C.,PIL.ANT.) .The most important element is the posterior orbital cartilage . It has a high level of growth and chondrification , but its anterior edge suffers from a reabsorption process of the pre-existing cartilage to give a smooth decline surface (fig., 12 ,POS.ORB.C.).This leads to convert the trochlear foramen into a groove at the dorsal edge of the posterior orbital cartilage where the nerve in question becomes uncovered during its passing toward the superior oblique muscle (fig., 18) .Also the fusion of an intertrabecular bar with the two trabeculae cranii leads to more extension of three elements at the posterior direction . This extension minimized the width of the hypophyseal fenestra .Eventaully , the lordosis phenomenon is less pronounced than the previous stage .

As regard to the acrochordal cartilage , it begins to subject to a sort of reabsorption of the pre – existing cartilage especially at its dorsal border .According to this process the oculomotor nerve becomes covering dorsally with one or two layers of cells only (figs.,10 and 12, ACR.C., FOR.N.III.). Also , both the polar and supra polar cartilages become more chondrified than the previous stage . The supra polar cartilage has a long rod shape which situates over the polar cartilage (figs., 10 and 12 ,POL.C.,S.POL.C.).

Also, one of the essential elements of this region is pila antotica .It considered as a lateral continuation of the acrochordal cartilage .It situates between the acrochordal cartilage and the posterior orbital cartilage . There is no limitation between the three cartilages except the passage of the oculomotor nerve in its foramen between the acrochordal cartilage and pila antotica , then the trochlear foramen between pila antotica and the posterior orbital cartilage .Pila antotica has a considerable growth and well chondrified in the present stage (figs.,10 12, and 18 , PIL ANT., ACR.C., POS ORB.C..FOR.N.III.,FOR.N.IV.).

The incisura prootica of the previous stage (35 mm.) is converted to the foramen prooticum in the present stage to lodge the ganglion Gasseri (figs.,10,11,12 and 18,FOR.PRO.).

4-The Ethmoid Region :

The present region is distinguished for the first time in the previous stage .But it is subjected to a great development and growth .Also in the present stage there are other elements are evolved.

The ethmoid region composed of two nasal capsules and the nasal septum separates between two capsules .This septum is extended from the dorsal border of the intertrabecular bar in up ward direction for a considerable length.By histologically examination the base of the nasal septum is well chondrified but , the dense mesenchyme tissues are filled the up ward distance .

The examination of the nasal septum of the present stage revealed that there are three positions along the nasal septum subject to the resorption in the pre – existing cartilage to forf three fenestrae.These are fenestra septalis nasi at the anterior part ,then two craniofacial fenestrae anterior and posterior one (figs.,10,11 and 12,FEN.SEP.N.,CRA.FAC.AN.,FEN.CRA.FAC.POS.,S.N.). The three fenestrae do not attain their final width in the present stage since they still at the beginning. Also , there are differences in their extension where the fenestra septalis nasi and the craniofacial fenestra anterior are more smaller than the craniofacial fenestra posterior .Both craniofacial fenestrae start at 40 mm. embryo and the fenestra septalis nasi begins at 46 mm. embryo.

The prolongation of the nasal septum in anterior direction give rise the prenasal process (figs.,10,11 and 12,PRN.P.).Also , there is a histological differentiation between the nasal septum and the prenasal process .The prenasal process tends to increase its hight toward the posterior direction.

As regard to the roof and base of the nasal capsule ,the parietotectal cartilage and solum nasi attain a considerable degree of chondrification .This takes place due to the rapid growth of the parietotectal cartilage above the posterior region of the nasal sacs .In the present stage , it starts as two pear – shaped nodule ,then grows rapidly in its diameter and its center becomes evacuated .Finally it takes a pear shape and extends medially to united together at the mid line above the nasal septum (figs.,10,11,12 and 13 ,PT.C.).The point of union of the parietotectal cartilage fused with the dorsal tip of the nasal capsule .This oval shape cartilage starts to divide horizontally at the level of beginning of the nasal vestibule .the upper portion forms the parietotectal cartilage while the lower part is represented as the solum nasi .The parietotectal cartilage and the solum nasi grow in opposite direction , the first cartilage rises down ward to fuse with the paranasal cartilage , while the solum nasi develops upward to reach the of the nasal vestibule .Then , it suffers from the degeneration of its lower horizontal part while its upward part proceeds the great growth to fuses with the down ward edge of the parietotectal cartilage to complete the anterior part of the lateral wall of the nasal capsule in the present stage (fig.,14).The

parietotectal cartilage grows more anteriorly to make its coupla anterior .Now , the parietotectal cartilage extends over most of the closed nasal vestibule and the nasal sac (fig.,14).

Of particular interest is that the sphenethmoid commissure is develops from the lateral edge of the parietotectal cartilage (figs.,12 and 17,SPHEN.COM.).This commissure acts as a connection between the posterior part of the parietotectal cartilage and the anterior orbital cartilage .In the present stage , the latter cartilage becomes degenerated completely.Thus, the fenestra olfactorium evehens is formed (figs., 10 and 17 ,FEN.OLF.EV.) .The olfactory nerve drops downward , through this fenestra , leaving the cranial cavity to enter the nasal capsule .The fenestra is bordered medially by the interorbital septum ,dorsally by the parietotectal cartilage and the sphenethmoid commissure .

The lateral wall of the nasal capsule (paries lateralis nasi) in the present stage is developed as mentioned before from the union of the downward of the lateral edge of the parietotectal cartilage with the paranasal cartilage .Then the up ward edge of solum nasi fused with what remaining of the lateral wall to return again the formation of the lateral wall of the anterior part of the nasal capsule before the fusion of two ends of atrioturbinal cartilage and the solum nasi .Directly before the previous mentioned union , there is a complete covering for the nasal capsule by the paries lateralis nasi .The third part for the lateral wall in the anterior region of the nasal capsule is accomplished by growing of the lateral edge of the parietotectal cartilage down wards at the level of connection of the maxilloturbinal cartilage with the parietotectal cartilage (fig.,16, PT.C.,MAX.TU.C.).

As regard to the first concha of the nasal capsule ,the atrioturbinal cartilageis developed .It arises at 43 mm. embryo (the stage younger than the present one).Itappears in the present stage as a small nodule situated at the center of the pear – shaped cartilage of both the parietotectal cartilage and the solum nasi (figs.,11 and 13 ,ATR.TU.C., PT.C., SOL.N.).It grows rapidly as a curved rod then becomes attached to the ventral side of the parietotectal cartilage (fig.,14).Then, this concha and the rest of solum nasi detached from the lateral wall of the nasal capsule and migrated together toward the nasal septum as the beginning of lamina transversalis anterior (fig.,11, L.T.A.) .

In relation to the second concha of the nasal capsule that is the maxilloturbinal cartilage .Firstly , it develops at 46 mm.embryo (stage younger than the present stage) .In the present stage it is emerged from the ventral surface of the parietotectal cartilage as a procartilaginous dum like shape structure .It is situated between two arms of the nasal cavity (figs., 11 12 and 15 ,MAX.TU.C.,PT.C.).It takes a simple circle form .In the present stage it proceeds its development and drops down wards to be parallel with the nasal septum (fig.,16).

The third concha of the nasal capsule is the concha nasalis .It starts as an invagination in the wall of down ward parietotectal cartilage (lateral wall) .This invagination begins at 46 mm.embryo (younger stage than the present one).The opening of this concha (adietus concha) is directed laterally .Its space is filled by the connective tissues and is called cavum conchale (figs.,12 and 16 ,CN.NAS.,AD.CN., CAV.CN.).

In relation to the lateral wall of the posterior part of the nasal capsule (the planum antorbitale), its first appearance is in 43 mm. embryo as a small procartilaginous nodule . It starts with its processus maxillaries anterior and is ended by its processus maxillaries posterior (figs.,11and 12, PL.AN.,P.MAX.AN.,P.MAX.P.) .The planum antorbitale acts as a barrier between the components of the posterior part of the nasal capsule and the eye ball .Also , the planum antorbitale has a separate

center of chondrification .It grows in posterior direction to form a vertical rod – shaped structure (figs., 10, 11, 12 , 16 and 17 ,PL.AN.) .In the present stage of *Coturnix* , the medial edge of the planum antorbitale is fused with the hind extremity of the lateral wall of the nasal capsule (at two positions , dorsal and ventral one) to form a circle with a very short duration . Then, the medial part of this circle disappears gradually until becomes degenerated completely and the planum antorbitale is only lasted .Also ,there is only a small nodule represents as the processus paraseptalis posterior (figs., 11 and 12,P.PARASEP.P.). This process firstly appears in the present stage . It has no connection with the maxilloturbinal cartilage, but it fuses with the hind extremity of the planum antorbitale.The process in question has a very small duration in the present stage and it is accomplished its final form in the optimum stage .

DISCUSSION

دراسات تطورية على الأطوار المتوسطة للجمجمة العصبية الغضروفية لطائر السلوى (العائلة التدرجية ـ رتبة الدجاجيات)

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انتهت الدراسة الحالية التى تختص بدراسة الأطوار المتوسطة لطائر السلوى الى تطور مجموعة الغضاريف التى ظهرت فى الأطوار المبكرة بالأضافة الى ظهور غضاريف جديدة أخرى وذلك كما يأتى :

١- يمتد غضروف القضيب ما بين الحائزى فى الأتجاة الظهرى ليبدأ فى تكوين كلا من الحاجز بين الأنفى أولا ثم الحاجز بين الحجاجى ثانيا.

٢- تتحول الثلمة تحت النخامية الى الشرفة تحت النخامية.

٣- يتلاشى الغضروف الحجاجى الأمامى تماما عند نهاية الأطوار المتوسطة.

٤- ينبثق الغضروف جار الأنفى من مركز تغضرف منفصل.

٥- يظهر الغضروف الجدارى الشمى لأول مرة من مركز تغضرف منفصل بعيدا عن الحاجز الأنفى .

٦- ينبثق كلا من الغضروف الردهى المفتول والغضروف المفتول الفكى من مركز تغضرف وحيد وهو السطح البطنى للغضروف الجدارى الشمى .

٧- يتكون الجدار الجانبى للمنطقة الأمامية للمحفظة الأنفية من اتحاد الغضروف جار الأنفى والغضروف الجدارى الشمى.

٨- يتكون الجدار الجانبى للمحفظة الأنفية فى المنطقة الخلفية (الصفيحة القبل عينية) من مركز تغضرف وحيد .

٩- يبدأ ظهور الغضروف الأنقسامى من مركزى تغضرف أحدهما جانبى والأخر وسطى المركز .

١٠-يتحد الجزء القوقعى مع الجزء القنائى للمحفظة السمعية .

١١-يتكون كلا من الشرفة البيضاوية والثقب حول الليمفى من عملية اضمحلال غضاريف جدران المحفظة السمعية .

١٢-يتكون غضروف الرعن عند نهاية الأطوار المتوسطة .

١٣-لا يستطيع القوسان القفويان عند نهاية الأطوار المتوسطة أن يتحدا عند خط المنتصف لتكوين السقف الملتحم الذى يتكون فى الطور كامل النمو.