GROSS ANATOMICAL AND MOROPHMETRICAL STUDIES TO THE SKULL BONES OF THE LOCAL RABBIT (ORYCTOHGUSCUNICULUS).

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Keywords ; Rabbit ,Skull,Orbital.
(Received 28 January 2013,Accepted 2 October 2013)

ABSTRACT

Ten adult rabbit (5male and 5 female) were used for gross anatomical and biometrical studies .The main characteristics feature of the local rabbit skulls are : in dorsal surface there are a shallow external sagittle crest , the frontal bone has anterior and posterior supraorbital process , the external acoustic meatus is a short wide bony tube directed caudodorsally , the orbita are large , the external surface of the maxilla is pitted by numerous small opening (fenestrated).

A total of 16 linear measurement estimated in the rabbit skulls .There are significant difference between males and females observed in bizygomatic distance , basion-bragma height , maxilla- alveolar length , orbital height and foramen magnum breadth.

INTRODUCTION

The term skull it has been used to describe the entire skeleton of the head . The skull is both a highly modular and a highly integrated structure . The skull is divided into three primary units , the face , neurocranium and basicranium. The brain case provides protection for the brain and opening for cranial nerve connections , the bone of the face provide a location and protection for the organs of special senses and openings for the digestive and respiratory system.The skull is a mosaic of many bones ,mostly paired ,but some median and unpaired , that fit closely together to form a single rigid construction(1 ,2). The shape of the head and skull influence the dynamic of the locomotion and balance . The specific characteristics of a skull often reflect the animal 's methods of feeding and effect on the muscle of mastication(3 ,4,5 ,6 , 7 ,) .Skulls differ largely ,not only between different species and breed but also between individuals of same breed , age and sex(8).

Craniometric studies of the skull of different animal species continue to be a growing area of applied research, the values obtained from such studies a part from being important in osteoarcheological and morphological fields , and to improve clinical diagnosis and regional anaesthesia of the head and treatment of cranial skeletal disorders(9,10 ,11, 12 , 13).

The extensive morphological and osteometric studies of skulls of animal species work was done in goat (12) african giant rat (7) ,dog (3 , 14 ,11,) ,mole rat (15) ,camel(13) ,Japanese wolf (6) anatolian wild sheep (16), Iraqi sheep (17) ,in Bittern and Red falcon (18) , and rabbit (19 ,20 ,21, 22 , 9).

The rabbit is being used increasingly for laboratory investigations , and there is a relatively little information on the skull morphology of the rabbit , therefore this study is done which aim to provide baseline data and morphological study for the bones of the rabbit skulls .

MATERIALS AND METHODS

A total of ten(10) adult rabbit (finished the molar eruption) , 5 males and 5 females were used for this study . The rabbit were slaughtered at the atlanto- occipital joint and the skulls were prepared according to Enzyme – active detergent technique (23).

The skull measurement was carried out in 16 items with electronic digital verinier caliper , the nomenclature of measurement and landmarks were based on (5, 15 ,24 , 25 , 26 , 27,28)Fig(1,2,3) .The measurements and landmarks abbreviations and definition were arranged in Table (1) and (2).(29) was used for terminology.

Table (1): List of the landmarks of the skull and their abbreviations

Landmarks	abbreviations	Definitions
1-Bragma	b	The ectocranial midline point where the coronal and sagittal sutures intersect
2-Euryon	eu	The ectocranial points on opposite sides of the skull that form the termini of the line of greatest cranial breadth (paird)
3-Nasion	n	The point of intersection between the frontonasal suture and the midsagittal plane
4-Prosthion	pr	The most anterior point in the alveolar processes of the maxillae
5-Zygion	zy	The most lateral point on the zygomatic arch (paird)
6-Glabella	g	The most anterior midline point on the frontal bone above the frontonasal suture
7- Opisthocranion	op	The most posterior point of the skull not on the external occipital protuberance
8-Basion	ba	The midline point on the anterior margin of the foramen magnum
9- Opisthion	o	The midline point at the posterior margin of the foramen magnum
10-Ectomolare	ecm	The most lateral point on the outer surface of the alveolar borders of the maxilla , often opposite the middle of the second molar tooth (paired)

Table (2) list of the skull measurements with their abbreviations and definitions

Measurements	Abbreviations	Definitions
1-cranial length	g-op	Distance between glabella(g) and opisthocranion (op)
2-Cranial breadth	Eu-eu	Maximum width of skull perpendicular to midsaggittal line
3-Bizygomatic	Zy-zy	Direct distance between most lateral point on zygomatic arches
4-Basion bregma height	Ba-b	Direct distance from the lowest point on the anterior margin of foramen magnum to the bregma
5-Cranial base length	n-ba	Direct distance from nasion (n) to basion(ba)
6-Basion-prosthion length	Ba-pr	Direct distance from basion (ba) to prosthion(pr)
7-Maxillo-alveolar breadth	Ecm-ecm	Maximum breadth across the alveolar borders of the maxilla at the level of themaxillary molars
8-Maxillo-alveolar length	Pr-alv	Direct distance from prosthion to alveolon
9-Facial height	n-pr	Direct distance from nasion (n) to prosthion(pr)
10-Frontal breadth	Ft-ft	Direct distance between the two fronto-temporale points
11-Orbital breadth	d-ec	Laterally sloping distance from dacryon (d) to ectoconchion(ec).
12-Orbital height	Orb-h	Directdistance between the superior and inferior orbital margins
13-Foramen Magnum length	Ba-o	Direct distance from basion (Ba) to Opisthion(O).
14- Foramen Magnum breadth	Fm-br	
15-Tympanic bulla height	TB-h	
16-Tympanic bulla breadth	TB-br	

RESULTS

The gross anatomical results : the skull as a whole :

The posterior nuchal surface of the skull is formed by the composite occipital bone (fusion of supra-occipital ,paired lateral exoccipitals and ventral basioccipital) , it is pierced by the foramen magnum which at each side bears the occipital condyles ,there is hypoglossal canal in fossa condylaris ,the juglar process of the occipital bone closely attached to tympanic bulla (fig.4), There is external occipital crest .

The dorsal surface of the skull is formed by the dorsal surface of the occipital , small inter parietal ,paired parietal ,paired frontal , and paired nasal bones . The dorsal surface of the skull is separated from the nuchal surface by a distinct and sharp nuchal crest. The shallow external sagittal crest lying from the nuchal crest to

the half distance of frontal bones . The frontal bones have an anterior and posterior dorsolaterally situated supra-orbital processes , supra-orbital foramen was absent.(Fig.4).

At the lateral surface caudally ,the inverted cone-shape Mastoid portion of periotic bone is visible at the posteriolateral aspect of the cranium , the external acoustic meatus is a short wide bony tube with large opening directed caudodorsally .The temporal fossa is broadly continuous with the orbita. The orbita are large according to the size of the skull.

The facial skeleton of the rabbit is elongated with marked incisive diastema . The incisive bones have postriorly directed robust dorsal processes passing above the maxillae . There is a large infraorbital foramen in the vertical plate of maxilla ,situated above and anterior to the anterior most premolar tooth.

The external surface of the maxilla is pitted by numerous small openings (Fenestrated). (fig.4).

The ventral aspect of the skull is formed by the medially situated basioccipital ,basisphenoid ,and presphenoid bones rostral to foramen magnum and the ventral aspect is continued by the paired palatine bone , whose caudal ends are notched and articulate with the two laminae of the pterygoid process of the alisphenoid bone . The hard palate is formed by the palatine bones which can be seen medial to the alveolar processes of the maxilla , ventral portions of the maxilla and incisive bone , the palatine foramen present near the first molar tooth ,the rostral part of hard palate pierced by the long and narrow paired incisive foramina which are continuous across the median line in their caudal third.(Fig.3).

Results of measurement values : The mean value and standard deviation of measurements of the skulls are shown in Table (1) .In skulls of males and females rabbits eleven (11) measurement items e.g: (g-op , eu-eu , n-ba , ba-pr , ecm-ecm , ft-ft , n-pr , d-ec , ba-o , TB-L , TB-B) showed no significant difference between male and female .

Significant sexual differences of the rabbit skull were found in (5) items: e.g (zy-zy , pr-alv ,fm-l)female showed significantly greater values than in males at ($p<0.05$)and at($p<0.01$). While the male rabbit showed greater significant value than the female in (ba-b and ba-b) measurements at ($p<0.05$).

Table (3) :skull measurements in male and female rabbits

Measurements / sex	Mean	St.Dev.	S.E.	
1-g-op				
Male	4.364	0.325	0.15	
Female	4.422	0.280	0.13	
2- eu-eu				
Male	2.520	0.122	0.054	
Female	2.518	0.0918	0.041	
3-Zy-Zy				●
Male	2.856	0.469	0.21	
Female	3.446	0.176	0.079	
4-ba-b				●
Male	2.714	0.158	0.071	
Female	1.820	0.158	0.071	
5-n-ba				
Male	4.800	0.314	0.14	
Female	4.688	0.291	0.13	
6-ba-pr				
Male	6.260	0.517	0.23	
Female	6.422	0.343	0.15	
7-ecm-ecm				
Male	2.520	0.237	0.11	
Female	2.626	0.153	0.069	
8-pr-alv				•
Male	3.094	0.273	0.12	
Female	3.392	0.137	0.077	
9-n-pr				
Male	1.812	0.125	0.056	
Female	1.800	0.137	0.061	
10-ft-ft				
Male	3.324	0.196	0.088	
Female	3.362	0.291	0.13	
11-d-ec				
Male	2.232	0.165	0.074	
Female	2.168	0.108	0.049	
12-orb-h				●
Male	1.982	0.0901	0.040	
Female	1.888	0.0327	0.015	
13- ba-o				
Male	1.0620	0.0602	0.027	
Female	1.0780	0.0638	0.029	
14-fm-l				
Male	0.9700	0.0300	0.013	
Female	1.0520	0.0342	0.015	
15-TB-L				
Male	0.978	0.121	0.054	
Female	1.0460	0.0699	0.031	
16- TB-B				
Male	0.9520	0.0597	0.027	
Female	1.0040	0.0428	0.019	

●Significant difference at ($p<0.05$).
•Significant difference at ($p<0.01$).

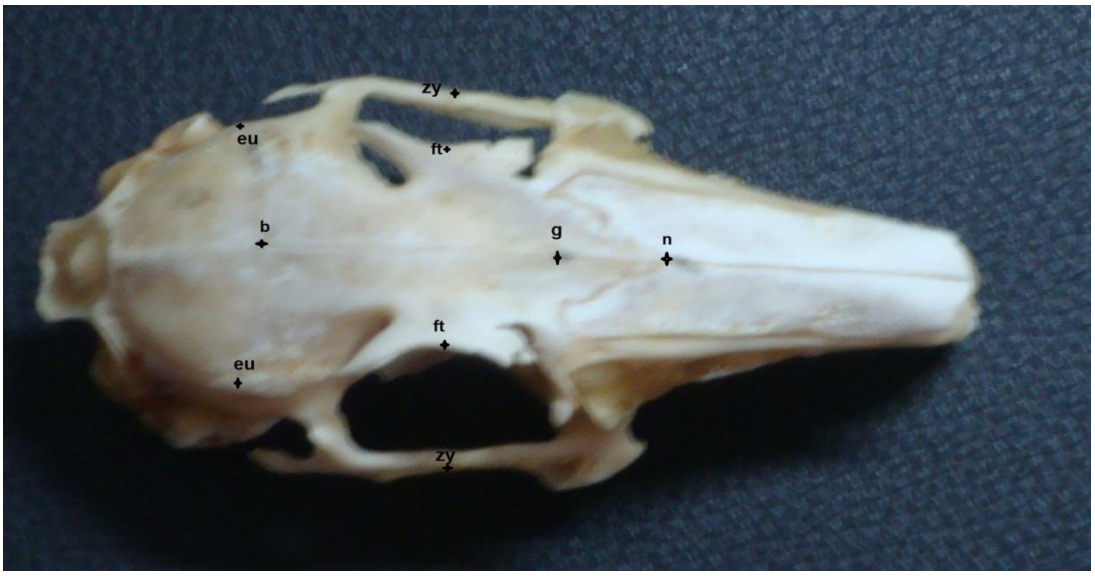
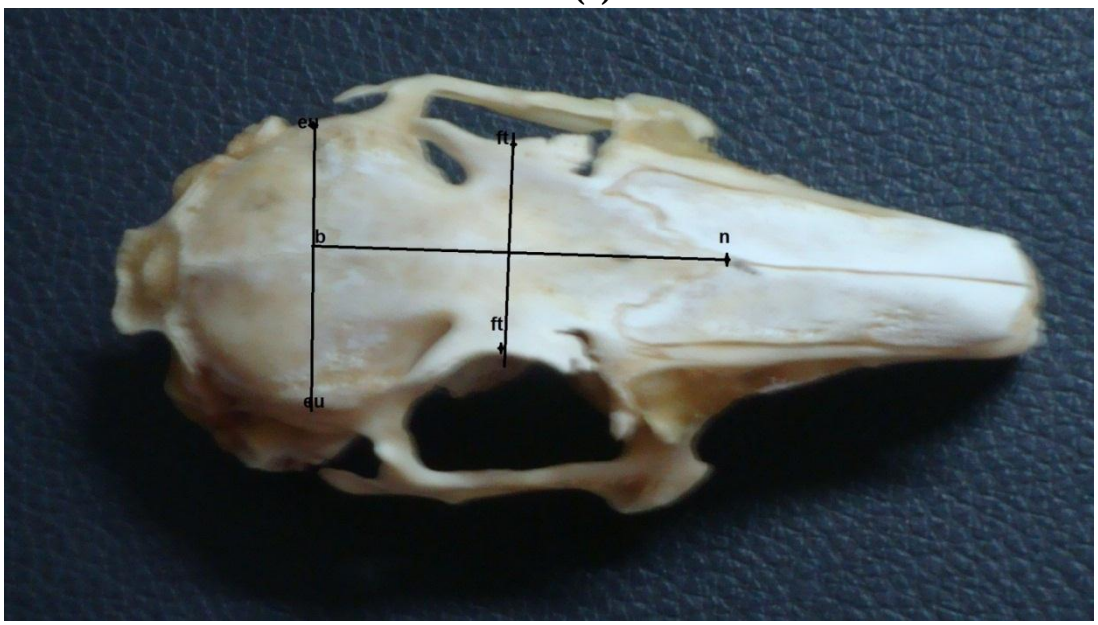


Fig (1):Dorsal surface of rabbit skull show the skull landmarks which listed in tabel (1)



Fig(2):Dorsal surface of rabbit skull show the some of the linear measurments which listed in table (2).

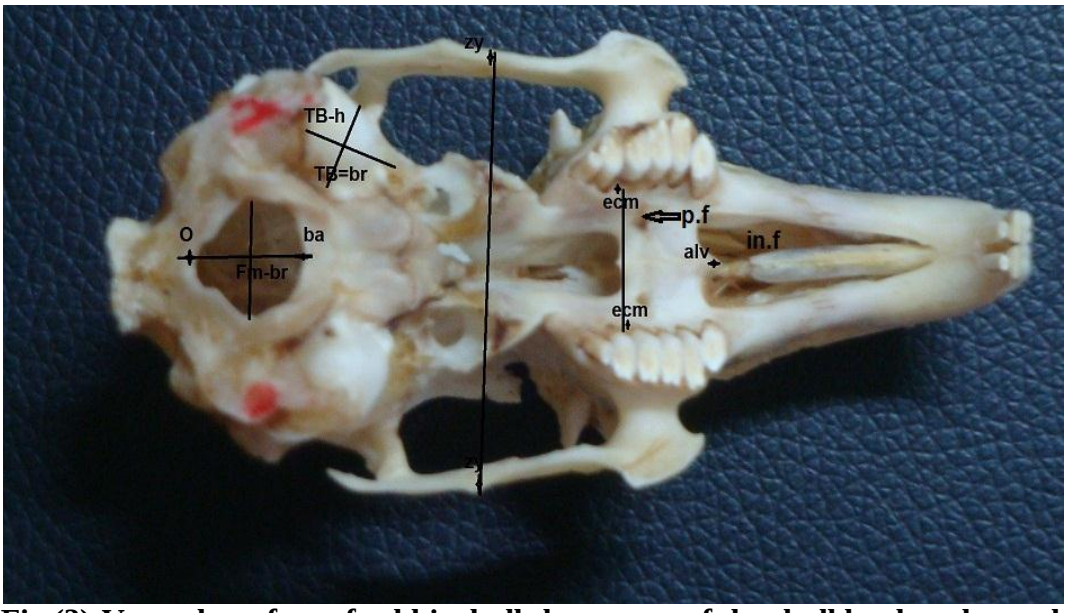


Fig (3):Ventral surface of rabbit skull show some of the skull landmarks and linear measurments which listed in tabel (1 and 2).

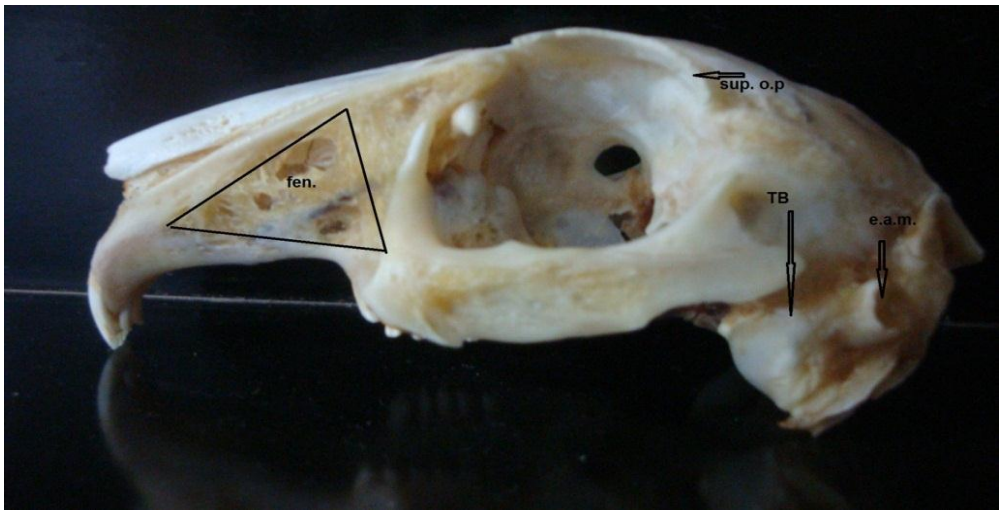


Fig (4):Lateral surface of rabbit skull : fen:fensteration of the maxilla ,sup.o.p:supraorbital process,TB:tympanic bulla,e.a.m:external acoustic meatus

DISCUSSION

From our results appear that the skull of the local rabbit the nuchal surface was separated from dorsal surface by external occipital protuberance . In the skull of the mole-rat there was a significant nuchal crest lying horizontally at the caudal border of the osparietale , the nuchal planum was broad and there was no cristaloccipitale (15).

The sagittal and occipital crest develop greatly in males ferret skull and remain relatively flat in female (25).The external sagittal crest was well developed in raccon dogs than in badgers (Hidaka1998).In the skull of sahel ecotypes goats the external occipital protuberance was very obvious in female than the male (12).

The results of this study observed that the frontal bones of the rabbit skull have anterior and posterior dorsally situated supra orbital process .The ferret skull had a rostral supraorbital process of frontal bone (25).(30) reported that the skull lacking supra orbital process was of collared Pika (Ochotonacollaris) while the flat skull with

narrow and strap like supra orbital process was of white tailed Jack rabbit .Rabbit and Pikas skulls tend to have pronounced supra orbital processes (Large ridges of bones over the eye socket) (31).In cat skull the frontal bones each bearing a lateral post orbital process (32).

From the results of this study appear that the tympanic bulla of the rabbit skull was braced postriorly by mastoid process (inverted cone –shaped)and by para jugular process of the occipital, the prominent round tympanic bulla continue dorslly in to a short wide bony tube with large opening the external acoustic meatus .

This results was resemble the results that stated by (10)in the rabbit. The mastoid process of the temporal bone was not formed in raccon dogs ,badgers had a marked protruded process , the external acoustic pore opened directly at the tympanic bulla in raccon dogs but badgers had a cylindrical process around the margin of pore as stated by (14).(32)reported that in the skull of cat the external auditory meatus at posterior base of the zygomatic arch and this opening continue in to a hollow cavity the middle ear contained in the prominent smooth swelling the tympanic bulla. The bulla tympanca was well developed in Mole –Rat skull and there was a small ventromedially directed spinous process on the medial border of this bulla and on the bulla tympanica (15) . (33) reported that the mountain Beaver skull (Order Rodentia) had a flask like shaped auditory bulla ,and the Towsend's mole had incomplete auditory bulla.(34) reported that the basic anatomy of the rabbit tympanic bulla was similar to that of the dog and cat . The tympanic bulla was compressed with blunt edges seen ventral to the squamous part and rostral to the large jugular processes of the occipital bone in the skull of the Sahel Ecotypes of goat (12) .

In the present study in the rabbit skull we observed that the maxilla extend for word from the orbit , its lateral zygomatic process form the anterior aspect of the zygomatic arch .The vertical lateral portion of the maxilla is fenestrated with large irregularly shaped open areas. Agreements exist between this results and results of (20 , , 31 , 33).

Also (33) added that in the skull of Pronghom(Order Artiodactyla) there were rostral fenestrae (openings bounded by maxilla , nasals , lacrimal , and frontal bones) engled medially as they extend for word and in Mule and White –Tailed Deer the rostral fenestrae angled laterally as they extend for word. .

In the cat the zygomatic arch formed by the zygomatic process of the zygomatic of maxilla ,the anterior base of this zygomatic process was penetrated by the infra orbital canal .The zygomatic process support the Jugal which bear the up word directed postorbital process , the zygomatic process of the jugal (the posterior end of the jugal) form a scarf (overlapping) with zygomatic process of the temporal bone (32).

From the results of this study appear that premaxilla of the rabbit inserted the roots of two pairs of incisors two labially and second smaller and there was a large diastema . This result is in agreemenit with the results of (33 , 35).

In study the skull of rabbit showed no significant difference between male and female in eleven (11)items of measurements e.g: g-op , eu-eu , n-ba , ba-pr , ecm-ecm , ft-ft , n-pr , d-ec , ba-o ,TB-L , TB-B .

Sexual dimorphisms were detected in (zy –zy, pr-alv, fm –l) female showed significantly greater values than males , while male rabbit showed greater significant value than the female in (ba-b , and ba-o).

In Harbour porpoise skull the females have significantly larger skulls than males (36).In Pekinese dogs the males skull larger than female (37) , in male raccon and Badgers dogs also showed significantly greater value than in female (14) ,

(39)reported that the male rats skull there were significantly larger than female . (39) reported that length of the neurocranium were used in the determination of sex of male in the skull of German shepherd dogs .

In the Iraqi sheep skull the ewes have longer skull than their rams (17) .In orbital morphometry of the African giant rat the male had greater orbital height and length than female(7).

دراسة تشريحية عيانية و قياسية لعظام جمجمة الأرنب المحلي

قسمة مظفر صالح

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الخلاصة

استخدمت عدد(10)عشرة من الحيوانات البالغة (5ذكور 5أناث) للدراسة العيانية والقياسية .أظهرت نتائج الدراسة العيانية بأن السطح الظهري لجمجمة الأرنب المحلي تميز بوجود عرف سهمي خارجي ضحل ,ويحمل العظم الجبهي نتوء فوق حجاجي (أمامي وخلفي).تميز الصماخ السمعي الخارجي بأنه أنبوب عظمي عريض وقصير باتجاه ظهري خلفي ,الحجاج كبير كما تميز العظم الفقمي بوجود فتحات عديدة .

أظهرت نتائج الدراسة القياسية وجود اختلافات معنوية في بعض القياسات بين ذكور وإناث الأرنب المحلي

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