

## Radiographic Anatomy of the Head of Sheep

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### Abstract

**Objective-** The purpose of this study was to assess and describe the radiographic anatomy of the bony structures in the head of sheep.

**Design-** Experimental study.

**Animals-** Fifteen mature Afshari sheep.

**Procedures-** Radiographs were made out of the head of the animals in lateral and dorsoventral views. Radiographic anatomy was analyzed with results from gross dissection of 5 specimens.

**Results-** Detectable anatomic structures of the head were studied in details and labeled in each radiographic view.

**Conclusion and Clinical Relevance-** The results of this study can help better understanding of the head skeletal components anatomy and their relationships in the head radiography of the sheep.

**Key Words-** Sheep, Radiography, Anatomy, Head, Skull.

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## Introduction

Regarding to the complexity of the head and due to the presence of numerous overlying structures, the radiographic evaluation of the head is slightly difficult. In the last several years, cross-sectional imaging techniques such as computed tomography (CT), magnetic resonance imaging (MRI), and ultrasonography have become more readily available. Such techniques have greatly simplified identification of abnormalities in the head of animals.<sup>1</sup> Despite the enhanced capabilities provided by these imaging modalities, they are less available and also not economically cost benefit in imaging of the sheep skull. Thus, conventional radiography is still the main modality for evaluating the skull region in this animal.

The radiographic anatomy of the skull is unique for each animal species. As such, being able to recognize the similarities and differences among species is important. Despite numerous anatomical studies of the sheep head,<sup>2-4</sup> up to our knowledge, there is no published article about its descriptive radiographic anatomy. There are a few concise radiographic information on the other herbivorous animals,<sup>1,5,6,7,8</sup> which seemed to overlook the anatomical details of the corresponding regions. Besides, some of these studies were done on the defective and diseased heads.<sup>1,5,6</sup>

Since Afshari sheep is one of the most genetically important sheep in Iran, it could be used as a normal radiographic reference for the heads region of this animal species. Absence of valid radiographic references and the difficulty of interpretation in the referral sheep cases was the principle motive of this study.

## Materials and Methods

The heads of 15 mature Afshari sheep were collected from several slaughterhouses in Qazvin, Semnan, Golestan, and Mazandaran provinces in Iran and transferred to the Faculty of Veterinary Medicine, University of Tehran for radiographic evaluation. Lateral and dorsoventral (DV) radiographs with focus-film distance of 100 cm were obtained of all heads. Grid was used to decrease the scattering radiation and a better resolution. The radiographic exposure factors were: 50 miliampere, 0.1 second, 70-75 kilovolts of peak (KVP) for lateral, and 75-80 KVP for DV radiographs. All radiographs were developed and fixed using an automatic processor. Five heads were macerated and cleaned in order to be compared with radiographic images by their relevant gross anatomical structures. A total of three of them were also sectioned transversely, longitudinally, and frontally to have better views of internal components and spatial imagination. The best and most interpretable radiographs in each view were selected. Detectable anatomic structures of the head were studied in details and labeled in each radiographic view.

## Results

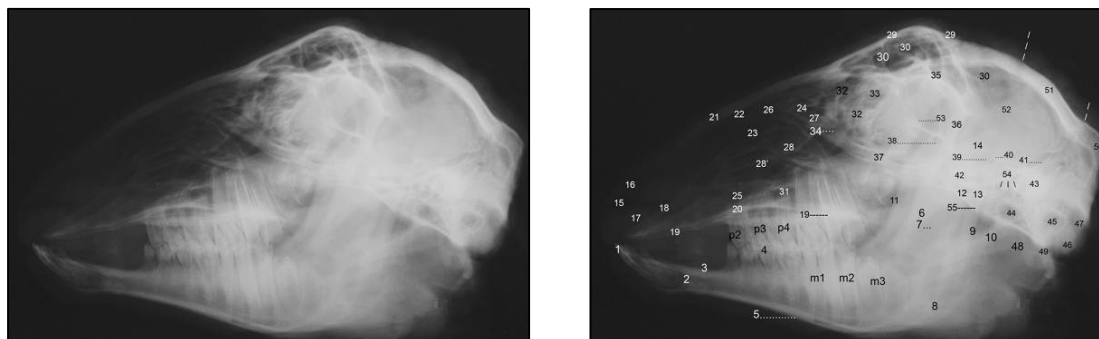
All of the head limits were included in a radiographic film. Representative radiographs and detailed identifiable structures of the sheep's head are shown in figures 1A, B and 2A, B.

### Lateral view

Hard palate was seen as a horizontal radiopaque line. The oblique line which is detached from hard palate about 3 cm in front of the first upper premolar tooth is vomer bone that coursed caudodorsally to reach the ventral border of the orbit (Fig.1, no 20).

The ventral nasal concha is seen as three conical structures in each other which have occupied caudoventral portion of the nasal cavity. The middle concha is seen more caudal and dorsal in

the nasal cavity (Fig.1, no 27). The dorsal nasal concha is separated from the nasal bone by the slit-like dorsal nasal meatus. Ethmolabyrinthes (Fig.1, no 32) are seen superimposed on the rostral part of the bony orbit and the lacrimal sinus is identified as an oval radiolucency on its caudodorsal part (Fig.1, no 33).



**Figure 1.** Lateral view of the sheep head (A) and nomination of the head structures (B).

Oblique dashed lines: place of skull sutures, P2-P4: 2nd – 4th premolar teeth, and m1-m3: 1st – 3rd molar teeth, 1: Incisive teeth, 2: Mental foramen, 3: Inter-alveolar septum, 4: Masticatory surface of teeth, 5: Ventral border of mandible, 6: Mandible, 7: Inferior alveolar canal, 8: angle of 6, 9: Caudal border of ramus of 6, 10: Stylohyoid, 11: Rostral border of 6, 12: Mandibular notch, 13: Condyle of 6, 14: Coronoid process, 15: Nostril, 16: Dorsal lateral cartilage, 17: Ventral lateral cartilage, 18: Nasal process of incisive, 19: Hard palate, 20: Vomer, 21: Nasal bone, 22: Dorsal nasal meatus, 23: Middle nasal meatus, 24: Dorsal branch of 23, 25: Ventral nasal meatus, 26: Dorsal nasal concha, 27: Middle nasal concha, 28: Ventral nasal concha, 28': 28 of other side, 29: Frontal bone, 30: Frontal sinus, 31: Infraorbital canal, 32: Ethmoidal labyrinth, 33: Lacrimal sinus, 34: Nasolacrimal duct, 35: Dorsal border of orbit, 36: Caudal border of orbit, 37: Ventral border of orbit, 38: Optic canal, 39: Hypophysial fossa, 40: Dorsum sellae, 41: Tentorium cerebelli, 42: Zygomatic arch, 43: Petrous part of temporal, 44: Superimposed external acoustic meatus and tympanic bulla, 45: Hypoglossal canal, 46: Occipital condyle, 47: Foramen magnum, 48: Stylohyoid angle, 49: Jugular process, 50: Squamous part of occipital, 51: Parietal bone, 52: Lateral wall of neurocranium, 53: Crista galli, 54: Bony labyrinth of internal ear, 55: External compact layer of skull basilar bones.

Frontal sinus is seen clearly; its caudal extension which have approached the parietal bone, made some radiolucency in the rostral portion of the cranial cavity (Fig.1, no 30).

Petrous part of the temporal bone and its foramen for facial and vestibulocochlear nerves are seen under the tentorium cerebelli as a condensed bony mass (Fig.1, no 43). Just rostral to this mass, bony labyrinth of internal ear is seen – as some radiolucent parts (Fig.1, no 54). The superimposed tympanic bulla and external acoustic meatus are seen ventral to these cells (Fig.1, no 44). Caudal to the external acoustic meatus, the site of exit of hypoglossal nerve is identified (Fig.1, no 45). The radiopaque line appearing in its caudal part, is due to superimposition of right and left hypoglossal foramina.

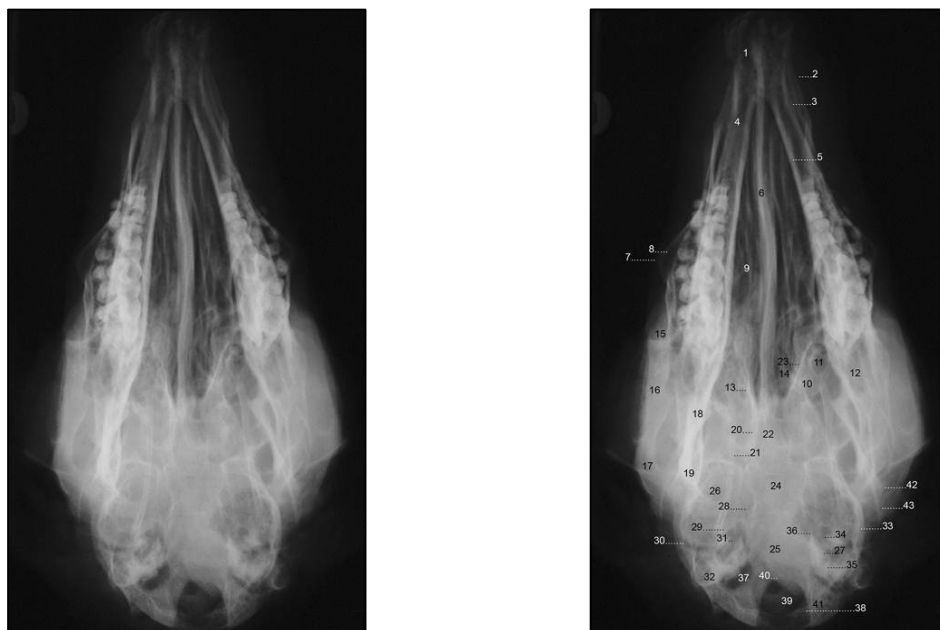
Due to differences in radiopacity, three bones of the cranial roof are identified easily and their sutures are distinguishable as well, (Fig. 1, oblique dashed lines).

#### Dorsoventral view

The lateral (Fig.2, no 8) and caudal (Fig.2, no 12) extensions of maxillary sinus and the nasal septum are the only parts of the nasal cavity which are seen clearly.

The skull base bones, basioccipital, basisphenoid, and presphenoid, are seen clearly, and due to presence of compact bone, their lateral borders are identified as radiopaque lines (Fig.2, no 22, 24, 25).

According to the presence of the bony petrous and occipital condyle, the path of hypoglossal nerve (Fig.2, no 37) is easily recognized. Occipital condyles are also clearly identified as the border of the foramen magnum (Fig.2, no 39)



**Figure 2.** Dorsal view of the sheep head (A) and nomination of the head structures (B).

1: Palatine fissure, 2: Nasal process of incisive, 3: Mandible, 4: Mental foramen, 5: Ventral margin of 3, 6: Vomer and nasal septum, 7: Facial tubercle, 8: Maxillary sinus, 9: Hard palate and conchae, 10: Pterygopalatine fossa, 11: Sphenopalatine foramen, 12: Caudal extension of maxillary sinus, 13: Hamulus, 14: Nasopharynx, 15: Rostral margin of orbit, 16: Ventral margin of orbit, 17: Zygomatic arch, 18: Mandible, 19: Angle of 18, 20: Pterygoid septum, 21: Stylohyoid, 22: Presphenoid, 23: Perpendicular part of palatine, 24: Basisphenoid, 25: Basioccipital, 26: Neurocranial fossa, 27: Petrous part of temporal, 28: Oval foramen, 29: Retroarticular process, 30: External acoustic meatus, 31: Tympanic bulla, 32: Tip of jugular process, 33: Parietal bone, 34: Bony labyrinth, 35: Base of jugular process, 36: Muscular process of temporal, 37: Hypoglossal canal, 38: Nuchal line, 39: Foramen magnum, 40: Margin of 39, 41: Occipital condyle, 42: Mandibular condyle, 43: Coronoid process.

## Discussion

In order to have useful results in a wide breed spectrum, the animals were selected from an Iranian medium size breed (Afshari breed). The skull shape of Afshari breed is the most common shape of the head among the Iranian sheep breeds with a little convex nasal bone.

The Lateral and DV views, which were experienced in this study, are the most common views in veterinary radiography.<sup>9</sup> The positioning of the animal for acquisition of these views was effortless and will be applicable in the field. They represent lots of details of the most structures in the head.

There are a few published studies which have described different disorders of the ruminants head. In these articles the mention has been done on the clinical signs and related radiographic findings of the treated animals.<sup>10-13</sup> Moreover, some head disorders and their radiographic findings have been categorized in cattle.<sup>5</sup> We could not find any other work to describe radiographic anatomy of the head structures in small ruminants. So in the following paragraphs, no comparison with previous works will be done and only the position and extension of the normal bony structures of the sheep head in the obtained radiographs will be discussed.

The differences in size of the cones of ventral nasal concha produced some radiolucent lines between them which should not be mistaken with a duct or meatus. These lines might be considered as good landmarks to distinguish this concha from the middle one. Due to the less

bony compartments and small size of the dorsal nasal concha, it was seen indistinctly in the roof of the cavity.

The borders of bony orbit were not easily detectable, but could be used as landmarks for identification of some other structures. The dorsal border of bony orbit (Fig.1, no 35) was seen as the ventral limit of the frontal sinus, and the ventral border (Fig.1, no 37) was seen as a horizontal line where its caudal extension had determined the compact external layer of the skull basilar bones (Fig.1, no 55). Just rostral to the caudal border in its middle height, the optic canal was seen as a round radiolucency (Fig.1, no 38). In the mid-rostral part of the orbit, a plate like opacity had been made by the perpendicular plate of ethmoid which its caudal border, crista galli, was seen as an oblique line that was showing the limit of the olfactory bulb (Fig.1, no 53).

The lateral wall of neurocranium had less confusable structures and could be categorized into three parts for better explanation: its rostral part, the site of frontal lobe and olfactory bulb, was covered somehow by the orbit which was formerly discussed, the smallest caudal part, behind the tentorium cerebelli (Fig.1, no 41), was the place of cerebellum, and finally the middle part, which was interrupted by the coronoid process of mandible (Fig.1, no 14). Due to the frontal sinus, the latter had a more radiolucent part rostrally and a dense part caudally.

Regarding to the lack of upper incisive teeth, lower teeth and their roots were seen more obvious in DV view than the lateral, but superimposition of lower and upper cheek teeth had made them impossible to be seen obviously.

In the DV view of the nasal cavity, the abaxial aspects were obscured by the mandible and it is only recommended for evaluating the nasal septum which in lateral view covered by dorsal, middle and spiral structure of ventral nasal conchae.

Except the bony labyrinth, the other parts of tympanic bulla were seen more clearly in DV view (Fig.2, no 31). In addition, the relationship with the petrous part of temporal (Fig.2, no 27), space of bulla, and both internal and external acoustic meatuses (Fig.2, no 30) could be better evaluated than lateral view.

## **Acknowledgments**

The authors would like to acknowledge Dr. Alireza Saghi and Davod Faskhoodi for their technical assistances.

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## آناتومی رادیوگرافی سر گوسفند

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**هدف-** هدف این مطالعه، ارزیابی و توصیف آناتومی رادیوگرافی ساختارهای استخوانی سر گوسفند بود  
**طرح مطالعه-** مطالعه تجربی.

**حیوانات-** تعداد پانزده رأس گوسفند نژاد افشاری

**روش کار-** رادیوگرافی از ناحیه سر گوسفندان در نمای جانبی و پشتی- شکمی به عمل آمد. ساختارهای استخوانی مشاهده شده در رادیوگراف ها با نتایج به دست آمده از مقطع گیری آناتومی ۵ نمونه از گوسفندان مورد بررسی مقایسه و مورد آنالیز قرار گرفت.

**نتایج-** جزئیات ساختارهای آناتومیک قابل مشاهده در رادیوگراف ها مشخص و نامگذاری شدند.

**نتیجه گیری و کاربرد بالینی-** نتایج این تحقیق می تواند در فهم بهتر اجزاء آناتومیک ساختارهای استخوانی ناحیه سر گوسفند که با رادیوگرافی قابل بررسی می باشند، کمک نماید.

**کلید واژگان-** گوسفند، رادیوگرافی، آناتومی، سر

