

# AGE ESTIMATION IN SHEEP BY RADIOGRAPHIC IMAGE OF RADIUS AND ULNA: MEDICOLEGAL STUDY

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## **Abstract**

*This work was done on 54 sheep (ram) which are apparently healthy and no anatomical deformities to evaluate the medicolegal importance of the radiographic images in determination the age of sheep. The age of the sheep was estimated through the measurement of the lengths and radiographic images of radius and ulna. The radius bone measured  $10.69\pm 0.07$  cm at age of 2 months and reached the maximum length at age of 48 months  $17.72\pm 0.10$  cm. The ulna bone measured  $13.62\pm 0.04$  cm at age of 2 months and reached the maximum length at age of 48 months  $22.94\pm 0.08$  cm. The radiolucent area appeared in the radius and ulna at age of 2-10 months in sheep. Partial union of radius started at age of 16 months in sheep and in ulna started at age of 18 months. The epiphyseal closure of the radius plate occurred at age of 28 months and ulna plate appeared at age of 30 months. The complete closure of the epiphyseal plates appeared at age of 42 month in radius and in ulna at age of 48 months.*

## **Introduction**

Sheep are widely spread in different areas in Egypt and adapted to different climatic conditions even in Delta or in South Egypt and are found in all different farming and production systems. It consume low amount of food because of their small body size if compared to large ruminants (Khalil et al., 2013).

Normal development of bones is very important to estimate the age in experimental animals and diagnose the skeletal diseases in growing animals (Fukuda et al., 1978). Several indicators for the age estimation such as body weight and bone length were also used

Radiology or sonography can play significant role in forensic medical investigation via usage of these images in assessment of forensic physicians, pathologists and anthropologists in mysterious cases related to the law. The radiographic images must be of a high quality for admission as credible evidence in all legal uses of radiologic imaging (Kremer et al., 2008 and Myke et al., 2010). Image techniques are very important tools in forensic science. Although the forensic and medical examiner are not specialist than radiologist but they can judge the image to the medico legal side. The forensic specialists need the radiograph for additional proof or for presentation in the court (Kahana and Hiss, 2009).

The studies of the bone radiography play a new role in modern legal medicine/forensic medicine and archaeozoology now day's. Most of these studies focus on the bone ossification characters (Gudea and Stefan 2013).

The aim of the current study is to evaluate the age of the sheep via the radiographic image of the radius and ulna

## **Material and methods**

This work was done on 54 male sheep (Ram), their age ranged from 2 months to 4 years (according to animal's records, ear tags and dentition). Three ram were used in each age. They were apparently healthy and not suffered from any diseases or anomalies by physical and clinical investigations sheep (Balady breeds) were collected from different small ruminant farms in Kalubia Governorate: Farm of Faculty of Veterinary medicine, Farm of Faculty of Agriculture, Benha University and Farm of Ministry of Agriculture at Moshtoh village.

## **X ray (Radiographic images)**

The radiographic examinations were done for sheep of the present work. For radiographic shot, 100 kilovolts (kv), 60 milliAmperes (mAs) power x-ray digital device held in an accredited centre for diagnostic imaging in Toukh city, Kalubia Governorate for diagnostic imaging. The radiographic images were taken to the radius and ulna of sheep. Each sheep was assessed to ensure they were not lamed and their limbs were free from any external evidence injury or disease.

The images were analyzed using digital system (x-ray device) to determine the bone length (the distance between the proximal to the distal extremities of the bones). The bone length was measured using the digital device. For each image the sheep identity.

The radiography is taken to the sheep in lateral position according to Douglas et al. (1987). Before any examination; the sheep were dried and groomed because of the sheep fleece often contain a large amount of dirt which becomes radiopaque when wet.

## **Results**

### **Radiography of sheep radius and ulna**

The radius was a long bone situated between the humerus and the carpal bones. It composed of one shaft and two extremities. The proximal extremity formed the elbow joint with the humerus while the distal extremity formed the knee joint with the carpal bones. The radius was slightly oblique. The ulna was ill developed long bone; the distal end of the ulna was fused with the radius.

Age of 2-14 months:

The radiographic images of the radius and ulna showed radiolucent appearance in the epiphyseal plate at which no ossification occurred and the epiphyseal plate opened. This occurred at age of 2-10 months of sheep as shown in plate 1 (Fig. A).

There were no significant changes appeared in the radiographic images of radius and ulna at age of 12-14 months compared to the age of 10 months. The differences were in the lengths of radius and ulna. The radius lengths were  $15.97 \pm 0.08$  cm and  $16.66 \pm 0.18$  cm at age of 12 and 14 months respectively. The lengths of ulna were  $21.46 \pm 0.26$  cm and  $21.67 \pm 0.09$  cm at age of 12 and 14 months respectively.

Age of 16-26 months

The appearance of radio opaque area in radiographic images of radius and ulna in the epiphyseal plate at which partial union occurred and this appeared at age of 16 months in radius and at age of 18 months in ulna of sheep as shown in plate 1 (Fig. B).

There were no significant changes appeared in the radiographic images at age of 20-26 months compared to the age of 18 months. The lengths of radius and ulna were  $17.13 \pm 0.10$  cm and  $22.62 \pm 0.19$  cm at age of 26 months in radius and ulna respectively.

Age of 28-36 months

The radiographic images showed that appearance of radiopaque area and disappearance of radiolucent area in radiography of the radius and ulna. The epiphyseal closure (union) occurred between the epiphysis and diaphysis. This appeared at age of 28 months in radius and at age of 30 months in ulna of sheep as shown in plate 1 (Fig. C).

There were no significant changes appeared in the radiographic images at age of 36 months compared to the age of 30 months. The lengths of radius and ulna were  $17.34 \pm 0.08$  cm and  $22.75 \pm 0.07$  cm at age of 36 months in radius and ulna respectively.

### Age of 42-48 months

The complete closure of the growth or epiphyseal plate of the radius and ulna of sheep appeared in the radiographic images as complete union between the epiphysis and diaphysis of the radius and ulna and disappearance of the radiopaque line between the epiphysis and diaphysis.. The complete epiphyseal closure appeared at age of 42 months in radius and 48 months in ulna as shown in plate 1 (Fig .D).

### The radius and ulna lengths

The total lengths of the radius of the sheep were measured as shown in (table 1 chart 1).The statistical analysis showed that a highly significant difference ( $p < 0.01$ ) occurred in the measurement of the radius lengths. In all measurements, the radius lengths were increased with age increased. The radius was gradually increased from  $10.69 \pm 0.07$ cm at the age of 2 months to reach  $17.72 \pm 0.10$  cm at the age of 48months of sheep.

The total lengths of the ulna of the sheep were measured as shown in (table 1 chart 2).There was a highly significant difference ( $p < 0.01$ ) in the measurement of the ulna lengths. In all measurements, the ulna lengths increased with the age increased. The ulna lengths were gradually increased from  $13.62 \pm 0.04$  cm at the age of 2months till reached  $22.94 \pm 0.08$  cm at the age of 48 months.

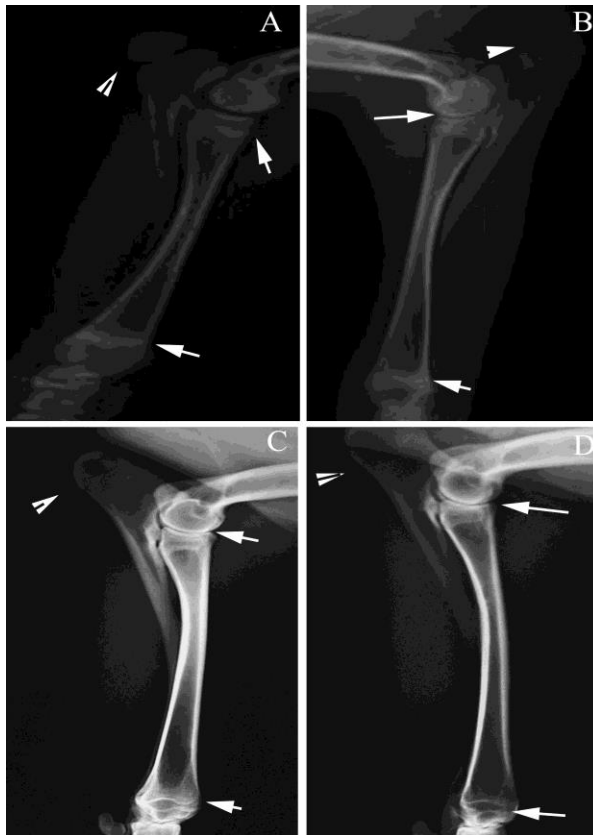


Plate 1(A,B,C,D) showed radiographic images of sheep radius and ulna.

Fig. A): The epiphyseal plates opened at age 2 months.

Fig .B): Partial epiphyseal union appeared at age of 16 months.

Fig .C): Disappearance of the radiolucent area at age 30 months.

Fig .D): Complete epiphyseal closure occurred at age 48 months

Table 1.

The length (cm) of the sheep forelimb bones (humerus-radius-ulna and metacarpal) in relation to their age

Age (month)	Radius(cm)	Ulna(cm)
2	10.69±0.07*	13.62±0.04*
4	13.44±0.14*	14.64±0.07*
6	13.99±0.05	16.68±0.22*
8	14.23±0.08*	19.02±0.06*
10	15.03±0.05	20.18±0.13*
12	15.97±0.08	21.46±0.26
14	16.66±0.18*	21.67±0.09
16	17.01±0.05*	21.92±0.09
18	17.13±0.02	22.34±0.07*
20	17.17±0.06	22.26±0.20
22	17.08±0.03	22.34±0.09
24	17.08±0.04	22.65±0.13
26	17.13±0.10	22.62±0.19
28	17.20±0.06	22.65±0.05
30	17.20±0.07	22.58±0.19
36	17.34±0.08	22.75±0.07
42	17.21±0.07	22.81±0.05
48	17.72±0.10*	22.94±0.08

Means values ±SD of fore limb bones in different ages of sheep represent significant difference. ( $p < 0.01$ )

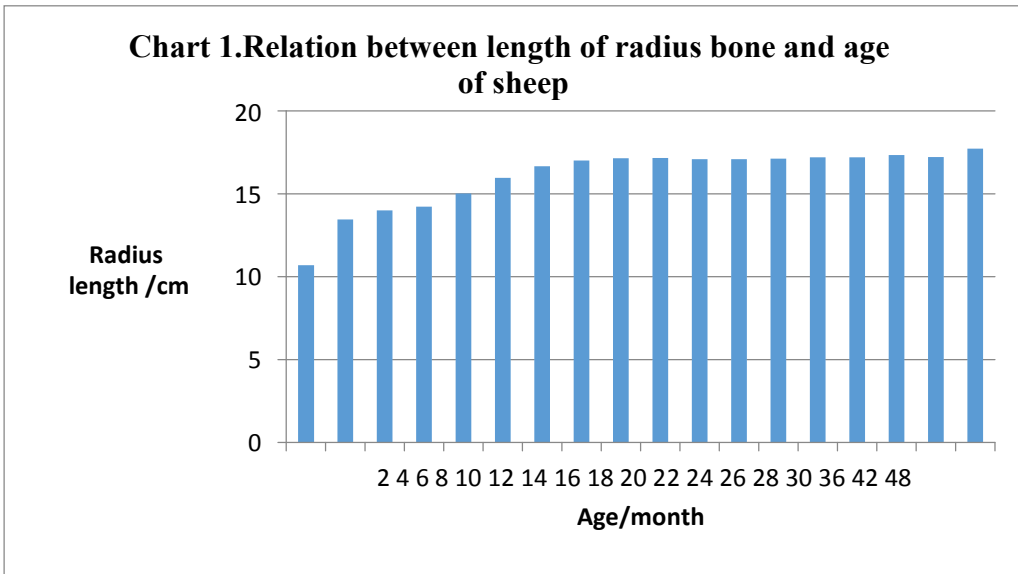


Chart 1: Showing the relation between length of radius bone and age of sheep

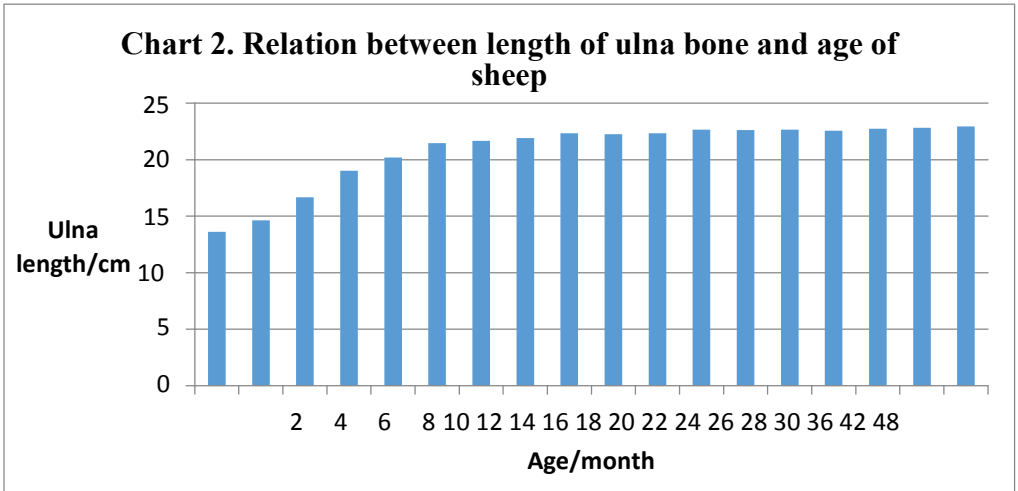


Chart 2: Showing the relation between length of ulna bone and age of sheep

**Discussion**

Radiological imaging is an effective method in estimation of the age of the animals through determination of the ossification and bone epiphyseal closure Asmius et al., 1995 and Gencecep et al., 2002. The endochondral ossification regions of the long bones are epiphyseal plates (growth plates). These epiphyseal plates are existed until the postnatal growth is completed and ossified after the process of postnatal growth (Aytekin 1993 and Aslanbey 2002). In the current work, the determination of the age of animals was done by radiographic examination of the radius and ulna of sheep.

The epiphyseal plates are appeared on radiographic images as radiolucent area between the epiphysis and diaphysis (Kealy and McAllister, 2000).The appearance of radiopaque area in the radiographic images in the epiphyseal plates was considered to be the first signs of epiphyseal closure and the ossification began to occur between the epiphysis and diaphysis of the radius and ulna of sheep.

In the present work, the complete closure of the epiphyseal plates appeared on the radiographic images as the appearance of radiopaque area and disappearance of radiolucent appearance between the epiphysis and diaphysis. This result was in agree with the study of Alpdogan and Gencelep (2012) while this result disagree with the studies of Asimus et al., (1995) and Todhunter et al., (1997) whom identified the complete closure of the epiphyseal plates by the displacement of radiopaque appearance with the radiolucent line between the epiphysis and diaphysis.

The present work was in agreement with the results of Choi et al., (2006) , Das et al., (2009) and Gencelep et al., (2012) in that the rate of bone growth in form of ossification and epiphyseal closure increased with age. The lengths of the the radius and ulna of sheep. In this work gradually increased with advancement of age and this similar to the result of Lochi et al., (2014).

The complete epiphyseal closure in the present work appeared at age of (42-48) months in radius and ulna in the sheep. While the result of Gencelep et al., (2012) recorded the complete epiphyseal closure appeared at the age of 33-35 months in radius and the complete closure of the ulna occurred at age 34-35 months in Mohair goats. Moreover, Saber et al., (1989) whom found that the union of the growth plate of ulna is appeared at the age of 13 months in sheep lambs and the result of Choi et al., (2006) whom recorded the fusion of the epiphyseal plates of the radius and ulna were found at 1 year or more than 1 year in Korean native goat and these differences could be attributed to species differences.

In the present work, the total lengths of the radius and ulna showed a highly significant difference and the radius lengths gradually increased with advancement of age from (10.69±0.07 to 17.72±0.10) cm in sheep. While the study of Gencelep et al., (2012) showed the radius lengths were increased from (7.90 ±0.17 cm to 15.18±0.25cm) in mohair goats.

In our work, the total lengths of the ulna gradually increased with advancement of age from (13.62±0.04 cm to 22.94±0.08 cm) in sheep. While the total lengths of the ulna studied by Gencelep et al., (2012) were increased from (10.75 ±0.025 to 19.76±0.30) cm in mohair goats.

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