The skeletal growth in dog is directly proportional to the growth of stature specified to the breed. Development of skeletal system of dog starts before birth and continue during post-natal life up to three years (Smith, 1964). The most important part of the skeletal system is the appendicular skeletal system. The development (ossification) of the appendicular skeleton is better studied by the observation of radiographs. Radiography is considered as the most reliable method to evaluate the ossification than any other methods. The method is best as the life of animal is preserved throughout the processes of ossification.

MATERIALS AND METHODS

For the present study, a total of 18 pups of German Shepherd, Pomeranian and non-descript dogs, six each from different litters of either sex and of known age were used. Each puppy was radio-graphed eight times viz; on 15, 30, 45, 60, 90, 120, 150 and 180 days of age to study the radiographic anatomy on the fusion of ossification centres in the developing scapula and humerus bones of right forelimb. They were supplemented the required dose of calcium and multi vitamins up to the completion of this present study. The right thoracic limb was studied in all the puppies. All the puppies were initially radiographed at fifteen days interval and later at one month interval. The radiography was carried out on stallion-60, 60 mA. X-ray machine installed at the Nagpur Veterinary College Hospital, Nagpur. High speed gelatin based Konica X-ray films and cassettes fitted with high intensifying screens were used. Each time, two views, medio-lateral and antero-posterior were taken into consideration.

The voltage and capacity of current was regulated in accordance with thickness of the part to be radiographed. The puppies at first four intervals were radiographed with the exposure factors Kv 45, mA 40 and time of exposure was 0.2 to 0.25 seconds, while puppies at later four intervals were radiographed with the factors Kv 50-55, mA 45 and time of exposure was 0.3 to 0.45 second, for the radiograph. The focal film distance was kept constant and was at 90 cm (36 inches), while the object film distance was minimum. The films were processed as per the standard

ABSTRACT

The present study was carried out on the 18 pups of German Shepherd, Pomeranian and non-descript dogs, six each from different litters of either sex and of known age to study the radiographic anatomy on the fusion of ossification centres in the developing scapula and humerus bones at 15, 30, 45, 60, 90, 120, 150 and 180 days of age, respectively. It was found that the scapula developed from two principal centres of ossification. The centre for the body was present and well developed at the time of birth whereas, the centre for tuber scapulae remained separated from the body of scapula up to the age of 180 days in puppies of all the three breeds, with the exception of two Pomeranian puppies, which showed complete closure of scapular epiphyseal plate at this age. It was observed that the humerus developed from five centres of ossification, where the diaphyseal centre was well developed at the time of birth. The centre for the proximal epiphysis and the lateral condyle appeared at 15 days of age and the centre for the medial condyle appeared at 30 days of age in all the breeds of dogs.

Key words: Dog, Humerus, Ossification centre, Radiographic study, Scapula
methods (Douglas and Williamson, 1972). The films were developed, fixed, washed in running tap water and air dried. The radiographs were observed for the first appearance of centres of ossification, fusion of epiphyseal plates and longitudinal growth of the long bones of thoracic limbs. The appearance of radio opaque area at the appropriate anatomical locations on the radiographs for the first time was considered as the appearance of ossification centre (Hare, 1959). The diaphyseal length of the bone was measured with the help of a metre scale. The diaphyseal length was considered from the proximal epiphyseal border to the distal epiphyseal border of the diaphysis. The radiographs were directly photographed using Pentax camera. The observation thus recorded were analysed statistically as per the method suggested by Snedecor and Cochran (1994).

RESULTS AND DISCUSSION

In the present study, an investigation was made with respect to number, time and sequence of appearance of ossification centres, epiphyseal closure time and longitudinal growth of the bones in dogs.

The scapula developed from two principal centres of ossification i.e one for the body and other for the tuber scapulae. The centre for the body was present and well developed at the time of birth, while the centre for tuber scapulae appeared at 55±3.107 days, 60 days and 52.5±3.36 days of age in German Shepherd, Pomeranian and non-descript dogs, respectively (Figs. 1, 2). The centre for the tuber scapulae could be seen on a medio-lateral view of the scapula. Initially, it appeared as a small rounded spot lying just cranial to the articular fossa of the body of scapula and later it became wedge shaped (Fig. 3). The body of scapula and tuber scapulae were separated from each other by an epiphyseal cartilaginous plate. At 180 days of age, the tuber scapulae was partially fused with the body. The cartilaginous junction between tuber scapulae persisted up to the age of 180 days in all the three breeds (Fig. 4), while in two of the Pomeranian puppies the complete union of tuber scapulae was seen at 180 days of the age (Fig. 5).

The humerus in all the breeds was developed from five ossification centres i.e one each for the diaphysis, proximal epiphysis, lateral condyle, medial condyle and medial epicondyle. The centre for the diaphysis was present and well developed at the time of birth. The centre for the proximal epiphysis appeared at the age of 15 days in German Shepherd, Pomeranian and non-descript dogs (Fig. 1). It was initially ellipsoid and then turned lunate shaped with proximal convex surface and distal, angled concave surface capping the gable-like proximal end of the diaphysis (Fig. 6). At the age of 180 days fusion started from the middle part in all the breeds. The centre for lateral condyle appeared at 15 days of age (Fig. 1) in German Shepherd, Pomeranian and non-descript dogs. While the centre for
medial condyle appeared at 30 days of age (Fig. 7) in German Shepherd, Pomeranian and non-descript dogs the centre for the medial epicondyle appeared quite late by the age of 45 days in German Shepherd, 47.5±2.50 days in Pomeranian and 50±3.17 days in non-descript dogs (Fig. 8). By 180 days of age the fusion of lateral and medial condyles was completed and also partially fused with the diaphysis, while the medial epicondyle was not united either with the lateral condyle or with the diaphysis. In the present study, it was observed that the diaphyseal length of the humerus showed highly significant statistical difference in German Shepherd, Pomeranian and non-descript dogs in all the age groups. The diaphyseal length of the humerus at 15, 30, 45, 60, 90, 120, 150 and 180 days of age was measured and results were tabulated (Table 1).

### References


Smith, R.N. 1964. The pelvis of the young dog. *Veterinary Record* 76: 975-979.


### Table 1. Diaphyseal length of humerus (in cm) in German Shepherd, Pomeranian and non-descript dogs at different days of age

<table>
<thead>
<tr>
<th>Days of age</th>
<th>German Shepherd</th>
<th>Pomeranian</th>
<th>Non-descript</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>3.86 ± 0.04 cm</td>
<td>3.55 ± 0.07 cm</td>
<td>3.50 ± 0.11 cm</td>
</tr>
<tr>
<td>30</td>
<td>5.18 ± 0.07 cm</td>
<td>4.06 ± 0.05 cm</td>
<td>4.65 ± 0.08 cm</td>
</tr>
<tr>
<td>45</td>
<td>7.43 ± 0.14 cm</td>
<td>5.13 ± 0.08 cm</td>
<td>6.28 ± 0.20 cm</td>
</tr>
<tr>
<td>60</td>
<td>9.60 ± 0.20 cm</td>
<td>6.00 ± 0.17 cm</td>
<td>6.68 ± 0.10 cm</td>
</tr>
<tr>
<td>90</td>
<td>12.17 ± 0.46 cm</td>
<td>6.77 ± 0.18 cm</td>
<td>9.17 ± 0.24 cm</td>
</tr>
<tr>
<td>120</td>
<td>--</td>
<td>8.02 ± 0.22 cm</td>
<td>10.5 ± 30.34 cm</td>
</tr>
<tr>
<td>150</td>
<td>14.60 ± 0.18 cm</td>
<td>8.62 ± 0.16 cm</td>
<td>11.23 ± 0.14 cm</td>
</tr>
<tr>
<td>180</td>
<td>15.40 ± 0.08 cm</td>
<td>9.65 ± 0.14 cm</td>
<td>12.17 ± 0.27 cm</td>
</tr>
</tbody>
</table>

**Editorial Board extends sincere thanks to all the referees for their kind co-operation in the evaluation of research manuscripts and regular publication of the journal.**