Radiographic evaluation of antebrachial angular limb deformities in dogs: a clinical study

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Abstract

A total of 121 cases presented with antebrachial angular limb deformities in dogs at Small Animal Orthopaedic outpatient unit of Madras Veterinary College Teaching Hospital from July 2020 to July 2022. These deformities were evaluated by orthopaedic and radiographic examination. The etiology of antebrachial angular deformities was recorded as premature closure of the distal physis of radius and ulna (56, 46.3%), hypertrophic osteodystrophy (HOD) (33, 27.2%), malunion of radius and ulna (22, 18.2%) and retained cartilaginous core of ulna (10, 8.3%). A higher incidence of carpal valgus (85, 70.25%) followed by radius procurvatum and carpus valgus (17, 14.05%), radius procurvatum (14, 11.57%), carpus varus (3, 2.48%) and radius recurvatum (2, 1.65%) were observed. This study provides radiographic evaluation and features of antebrachial angular limb deformities in dogs.

Key words: Hypertrophic osteodystrophy, retained cartilaginous core of ulna, malunion of radius and ulna, carpus valgus, varus

Introduction

The affections of limb are very common in dogs (Phaneendra et al., 2016). The forelimb of the dog is the main weight bearing structure bearing about 60% of the bodyweight. Depending on the size of the dog, the skeletal structures complete growth by 8 to 12 months. Because of this rapid growth rate, significant remodelling alterations are required to achieve appropriate skeletal structural development. Combined retardation of growth at the level of the distal radial and unlar physes results in angulation as excessive radial procurvatum, external torsion and distal radial valgus (Piras, 2012).

Asynchronous growth of radius and ulna may cause deformities like procurvatum/recurvatum, valgus/varus, torsion and length discrepancies of both bones, resulting in joint incongruence, lameness and degenerative joint disease (Coutin et.al., 2013) Excessive radial procurvatum with external rotation, and carpal valgus, potentially leads to osteoarthritis in the carpal and elbow joints results from growth retardation of ulna (Dismukes et al., 2008).

Materials and Methods

All dogs presented with antebrachial angular limb deformities at Small Animal Orthopaedic outpatient unit of Madras Veterinary College Teaching Hospital from July 2020 to July 2022 was recorded and conducted radiographic evaluation. A Konica Minolta Aero Rad 32 of 500 mA machine with bucky was used to obtain radiographs. The lateral and craniocaudal views of the defective antebrachial angular limb including the elbow and carpal joints were used to assess the etiology and type of antebrachial angular limb deformity. The conditions included malunion of radius and/ ulna, premature closure of physis of radius and ulna, hypertrophic osteodystrophy and retained cartilaginous core of ulna.

Results

In the present study a total of 121 (0.7%) dogs with antebrachial angular limb deformities were recorded out of 17,187 canine orthopaedic cases at the small animal orthopaedic outpatient unit of Madras veterinary College teaching hospital, Chennai from July, 2020 to July 2022. The etiological factors for antebrachial angular limb deformity were found to be premature closure of the distal physis of radius and ulna (56, 46.3%), hypertrophic osteodystrophy (HOD) (33, 27.2%), malunion of radius and ulna (22, 18.2%) and retained cartilaginous core of ulna (10, 8.3%).

Radiographic features

Absence of radiolucent line or narrowing of radiolucency at the level of distal physis of radius and ulna in dogs less than 11 months of age was considered as premature closure of distal physis of radius and ulna. Hypertrophic osteodystrophy included a radiolucent line in the metaphysis parallel to a narrow zone of increased radiodensity immediately adjacent to the physis (double physis) and irregular widening of the growth plate. Angulation at the diaphysis to metaphysis of radius and ulna confirmed as malunion of radius and ulna. In retained cartilaginous core of ulna, a radiolucent core (triangle) of cartilage in the distal ulnar metaphysis surrounded by a zone of sclerosis (candle stick appearance) observed as the radiographic feature (Fig.1-4).

During the study, a higher incidence of carpal valgus (85, 70.25%) followed by radius procurvatum and carpus valgus (17, 14.05%), radius procurvatum (14, 11.57%), carpus varus (3, 2.48%) and radius recurvatum (2, 1.65%) were recorded. Craniocaudal radiographic examination of carpus varus and valgus relate to the medial and lateral deviations of the radius from the long axis of the bone with respect to the carpal joint respectively. Lateral radiographic examination of procurvatum and recurvatum refer to the cranial and caudal bowing of the radius respectively (Fig.5-8).

Discussion

In the present study, the most common etiological factor for antebrachial angular limb deformity was found to be premature closure of the distal physis of radius and ulna and was in accordance with the findings of Balfour et al., (2000) and Kushawaha et al., (2005). The synchronised growth of the radius and ulna in the dog is required for appropriate forelimb development. The radius obtains 40% of its length from the proximal physis and 60% from the distal physis, whereas the distal physis contributes 85% of the ulnar length and the proximal physis just 15% (Johnson and Hulse, 2002). Feichtenschilager et al., 2018 opined that growth disturbances of the forelimbs are relatively common in dogs, frequently caused by premature physeal closure. Premature closure of the radial or ulnar physis with continued growth of the non affected bone can result in a severe deviation of limb alignment.

Fig.1 Absence of radiolucent line at the distal physis of radius and ulna indicative of premature closure of distal physis of radius and ulna

Fig.2 Double physis at the metaphyseal area of radius and ulna indicative of hypertrophic osteodystrophy (HOD) of radius and ulna (red arrow-normal physis; black arrow-radiolucent line)

Fig.3 Abnormal angulation (red arrow) at the distal third of radius indicative of malunion of radius

Fig.4 Candle stick appearance (red arrow) at distal metaphysis of ulna indicative of retained cartilaginous core of ulna

Fig.5 Carpal valgus

Fig.6 Capus varus

Fig.7 Radius procurvatum

Fig.8 Radius recurvatum

In the present study, radiographic signs of hypertrophic osteodystrophy were similar to the reports of Baines (2006); Towle Millard and Breur (2012). Baines (2006) reported histological findings as inflammation together with necrosis of the involved metaphyses and subperiosteal haemorrhage in hypertrophic osteodytrophised bones. Towle Millard and Breur (2012) reported vitamin C deficiency, obesity, heredity, inflammation, vaccinations and infection are some of the suggested causes of hypertrophic osteodystrophy in bones. Radiological findings of retained cartilaginous cores of ulna correlated with findings of Baines (2006). Retained cartilaginous cores develop in the central metaphysis as a result of abnormal endochondral ossification accompanied by the retention of cartilage cells. It may result in slow longitudinal development of ulna with malalignment between radial and ulna and causes angular limb deformities in dogs (Baines, 2006).

During this study, a higher incidence of carpal valgus followed by radius procurvatum and carpus valgus, radius procurvatum, carpus varus and radius recurvatum were recorded. Theyse et., al (2005) reported that trauma to the distal growth plate of the ulna in the antebrachium will typically result in radius curvus syndrome with cranial bowing of the radius, exorotation of the antebrachium, and valgus of the carpus as it has high growth rate.

Conclusion

Radiographic features of different etiological factors of antebrachial angular limb deformities in dogs were studied.

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