

## **Syndactyly and polydactyly in a mixed-breed dog**

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### **Abstract:**

Polydactyly is the congenital presence of one or more extra digits. The extra digit often does not contain a full complement of bones. Unilateral syndactyly and polydactyl mixed-breed dog was used as a case study. A three-month old unvaccinated intact female mixed breed dog weighing 8 kg, presented with a deformity of the left forepaw was used for this study. The deformity had been present since birth according to the owner. During physical examination the dog was given a lameness score of 0/5 for the affected limb. A complete blood count, and serum biochemistry did not reveal any abnormalities. Radiographs of both distal forelimbs were obtained. These showed Fused 2<sup>nd</sup> and 3<sup>rd</sup> metacarpal bones, a rudimentary metacarpus and a hypoplastic digit located on the axial side of the distal end of the left forelimb. As a result of the lameness score of 0/5 and the owner's lack of interest, a decision was made to monitor the condition and consider surgery once the dog had grown larger. It seems this is the first case of polydactyly associated with syndactyly and the rudimentary metacarpal bone.

### **Case History**

Numerous congenital bone dysmorphologies have been described in animals, including; Amelia, Hemimelia, Syndactyly, Ectrodactyly, Polydactyly etc.

Ectrodactyly, split-hand or cleft-hand is characterized by a paraxial longitudinal deficiency of one or more of the individual elements of the distal end of the limb of a developing embryo (Giofre et al., 2004). It is grossly characterized by longitudinal bony and/or soft tissue cleft in the distal end of the limb (Barrand, 2004).

Polydactyly is the congenital presence of one or more extra digits. The extra digit often does not contain a full complement of bones (Towle et al., 2004).

Polydactyly has been described in veter-

inary literature, examples can be found in horse (Giofre et al., 2004), goat (Al-Ani et al., 1997), foal (Castanjen et al., 2007), bird (Crosta et al., 2002), cattle (Castanjen et al., 2001), arctic foxes (Gugolek et al., 2011), roe deer (Chapman et al., 2005) and cat (Lockwood et al., 2009). Ectrodactyly is also reported in veterinary literature, especially in dogs (Carrig et al., 1981; Bingel et al., 1997; Innes et al., 2001; Barrand, 2004) and cat (Searle, 1953).

To the author's knowledge, this is the first case of polydactyly associated with syndactyly and the rudimentary metacarpal bone.

### **Clinical Presentation**

Three months old, unvaccinated intact female mixed breed dog weighing 8 kg presented with a deformity of left forepaw was used for this study. The deformity had been present



Figure 1. Palmar view of the affected paw showing the Separated Metacarpal Pads.



Figure 2. Carniodorsal view of the affected paw showing the cleft and 4th digital pad with 2 nail.



Figure 3. Dorsopalmar View of the distal end of left forelimb. Note Fused 2<sup>nd</sup> and 3<sup>rd</sup> Metacarpal bones, rudimentary Metacarpal and hypoplastic digit located on the axial side of digit IV.



Figure 4. Laterolateral View of the distal end of left forelimb. Note two fused Metacarpal bones, rudimentary Metacarpal and hypoplastic digit.

since birth according to the owner. The dog was in good general condition. Body condition score was 3.5. The owner reported that the acute onset of lameness occurred at the beginning of exercise.

Orthopedic examination of the left forepaw revealed separated metacarpal pad and one of the digital pads had two digits (Figs. 1 and 2). Palpation of the paws, carpus and elbow of the limb did not elicit pain. No soft tissue mass was palpated and the dog was given a lameness score of 0/5 (None) for the affected limb.

### **Diagnostic Testing**

A complete blood count, and serum bio-

chemistry, did not reveal any abnormalities. Radiographs of both distal forelimbs were obtained. These showed Fused 2nd and 3rd metacarpal bones, a rudimentary metacarpal and a hypoplastic digit located on the axial side of distal end of the left forelimb. Rudimentary metacarpal bone was presented at the proximal part of the 4th metacarpal bone. Soft tissue separation occurred between the 3rd and 4th metacarpal bone. A hypoplastic digit was located between digit III and IV in dorsopalmar and laterolateral view (Figs. 3 and 4). The right forepaw and both elbows were radiographically normal.

As a result of the lameness score of 0/5 and

the owner's lack of interest, a decision was made to monitor the condition and consider surgery once the dog had grown larger.

### Assessments

Congenital deformities of the upper extremity in humans are common, occurring in as many as 1 in 626 live births. The developments of the human upper extremity is first visualized with the appearance of the limb bud at 26 days of life and continues through approximately 47 days, when the joints of the hand develop (Dalusiki et al., 2001).

In dogs and cats, limb formation occurs from day 23 of gestation to approximately day 35. Limb formation is an intricate process that includes limb bud, limb elongation, digit formation, and bone and joint formation (Towle et al., 2004). Embryonic limb bud development commences with a projection of mesoderm covered by ectoderm (Kenneth, 2010).

Three mesodermal rays (Ulnar, radial, and central) contribute to the formation of the pectoral limb. Disturbances of one or more rays or of the signaling centers will result in perturbations of the corresponding components of bone and associated soft tissue (Kenneth, 2010).

In humans, radial ray deficiency affects the paraxial border of the limb. This deficiency can range from mild thumb hypoplasia to complete absence of the radius; ulnar deficiency is four to ten times less common than radial deficiency and affects the postaxial border of the limb (Kozin, 2003).

Barrand (2004) and Lockwood et al. (2009) noted that the radial ray forms the radius, associated carpal bones and first digit.; the central ray forms the carpal and metacarpal bones and phalanges of digit II; and the ulnar ray forms the ulna, associated carpal bones, metacarpal bones and phalanges of digits III, IV and V.

It seems that no case of forelimb polydactyly has been reported in dog, except a case of the Norwegian Lundehund breed whose repre-

sentative have dewclaws on the front and hind limb (Gugolek et al., 2011). Polydactyly is an autosomal dominant trait in both animals and humans (Kozin, 2003; Gugolek et al., 2011). It has been suggested that *shh* and *msx-1* genes are involved in the development of polydactyly along with retinoic acid (Towle et al., 2004).

In humans, polydactyly is divided into a typical variety. The supernumerary digit is either well developed in type A, rudimentary and pedunculated in type B.

According to Towle and Breur (2004) reference point, if the extra digit is on the medial side of the limb, the condition is called paraxial polydactyly, and if on the lateral side of the limb, the condition is called postaxial polydactyly and the extra digit often does not contain a full complement of bones. In this study, an extra digit located on the axial side of digit IV was found. In human studies, this condition is referred to as the central polydactyly. Central polydactyly is an extra digit within the hand and not along its borders (Kozin, 2003). This hypoplastic digit also contain 3 phalanges.

Cleft-hand results from a longitudinal deficiency of the central rays of the hand in humans (Kozin, 2003). The incidence of this anomaly in humans is 1 per 90000 live births with no sex predilection (Pinette et al., 2006).

Canine ectrodactyly (cleft-hand) is a very heterogeneous disorder, to the extent that none of the cases described in the literature is identical (Barrand, 2004). Possible non-hereditary basis for canine ectrodactyly is suggested because there is low incidence of bilaterally affected cases; there is lack of clear breed predisposition (Carrig et al., 1981; Barrand, 2004).

Ectrodactyly is classified into two forms; a typical form (mostly bilateral and frequently hereditary) and an atypical form (mostly unilateral and sporadic, rarely hereditary) (Busch et al., 2002). The heterogeneity seen in canine ectrodactyly makes classification of the anomalies difficult (Barrand, 2004).

In a case series reported by Carrig et al.

(1981) metacarpal bone hypoplasia adjacent to the plane of separation was noted in 13 limbs. It was also found in this study with separation between Digits II and III.

Barrand (2004) stated that the absence of compartments in the distal end of the forelimb occurs due to concurrent abnormality of the ulnar and radial rays. In the case described here, the hypoplastic metacarpus and the digit adjacent to digit IV fused with metacarpus II and III, this suggests Central and Ulnar ray abnormality.

In the split-hand anomaly in humans, the thumb is often absent (Kelikian, 1974). In Barrand's (2004) study, this absence of digit I was also described. No abnormality was found in digit I.

On the basis of chick, mice, and human studies, mutations are suspected to play a role in canine and feline dysostoses, although none has been identified. Environmental factors have also been implicated in the development of dysostoses. Such environmental factors may include drugs, maternal disease, faulty maternal diet, modified-live vaccines, radiation, and trauma to the mother, embryo, or placenta. Therefore, most canine and feline dysostoses may be mutations (Towle et al., 2004).

In conclusion, Polydactyly is an autosomal dominant trait. The cause of the condition in the present case could not be ascertained. The defect is present at birth and prognosis is considered excellent, it is necessary that breeding of these animals should be discouraged.

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## چند انگشتی و انگشت به هم چسبیده در سگ نژاد مخلوط

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### چکیده

پلی داکتلی، وجود یک یا چند انگشت اضافه، مادرزادی است. انگشت‌های اضافی اغلب فاقد استخوان‌های کامل‌اند. این گزارش مربوط به پلی داکتلی یک طرفه در سگ نژاد مخلوط است. این عارضه در پنجه جلویی سمت چپ سگ ماده نژاد مخلوط سه ماهه غیر واکسینه با وزن ۸ Kg مشاهده شد. طی معاینه بالینی درجه لنگش اندام مبتلا ۰ از ۵ تعیین گردید. شمارش کامل گلبول‌ها و آزمایش‌های بیوشیمیایی سرم هیچ گونه حالت غیرطبیعی نشان نداد. رادیوگرافی از انتهای دیستال هر دو اندام حرکتی پیشین تهیه شد. در این رادیوگراف‌ها جوش خوردن متاکارپ ۲ و ۳ و بقایای متاکارپ و انگشت تحلیل رفته در سطح محوری انتهای دیستال اندام پیشین سمت چپ مشاهده گردید. ارزیابی: با توجه به پایین بودن میزان لنگش و عدم پیگیری صاحب حیوان تصمیم‌گیری در رابطه با درمان و جراحی به بررسی شرایط بیمار در آینده و بالارفتن سن آن موکول شد.

واژه‌های کلیدی: چند انگشتی، سین داکتلی، سگ

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