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BILATERAL POLYDACTYLY IN A DOMESTIC PIG (*SUS SCROFA DOMESTICUS* L.) – A CASE REPORT

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ABSTRACT

Congenital limb malformations are relatively rare in domestic swine (*Sus scrofa domesticus* L., Family: *Suidae*, Order: *Artiodactyla*). The incidence increases with improper breeding, especially in cases of mating of individuals that are closely related genetically (inbreeding). The present case presents bilateral, asymmetrical, postaxial polydactyly of the thoracic limbs in a pig, breed "Big White", about 9 months old. The signs of improper development of the fingers were noticed at an early age and an unsuccessful attempt treatment was made. Due to the lack of clinical manifestation of a disease, no repeated therapeutic approach was performed and the full development of the malformation was detected after slaughter, during the post-mortem examination. The limbs were provided for morphological analysis, in the departments of "Special Pathological Anatomy" and "Anatomy of Domestic Animals", at the Faculty of Veterinary Medicine, at the Forestry University.

Key words: polydactyly, digit anomalies, pig, morphological analysis.

Introduction

Polydactyly is a pathological condition with an increased number of fingers, which can affect the entire finger or only an anatomical part of it. The malformation is recognized as a type of monstrosity that affects an organism in the limb area (Manov, 2022). It is possible to affect one, several or all limbs. In humans, it has been found that polydactyly of the hands is more common than that of the feet, with the incidence of affecting the right hand and left foot being higher than the opposite analogues (Malik *et al.*, 2014). There are many varieties of the anomaly, based on the anatomical position, the involvement of normal fingers, the way in which the additional fingers develop, etc. Depending on the location relative to the axial axis of the limb, preaxial, postaxial and central polydactyly are distinguished (Nikitin *et al.*, 2021), with different subcategories known in human medicine. The precise morphological classification of the type and subtypes of malformations determines the approach of a specific surgical technique in the specific case for treating this deformity.

The polydactyly is observed in all species of domestic animals, but is most commonly found in cats, dogs, horses and cattle (Maxie, 2015). It is rare in domestic pigs (*Sus scrofa domesticus* L., Family: *Suidae*, Order: *Artiodactyla*) (5) and is characterized by high genetic heterogeneity in different populations (Ma *et al.*, 2020).

Case presentation

In the current case is presented a pig, backyard breeding, about 9 months old, a "Big White" breed, in the purpose of meat production for personal consumption by the owners. The increased number of fingers on the right forelimb was noticed at an early age. An unsuccessful attempt was

made to treat the pathology, by amputation of the extra fingers based on hemostasis. For this purpose, an elastic rope was tightened over the fingers, near the wrist joint. The bandage was left for an excessively long time, and it formed a pathological channel in the soft tissues and through the base of the abaxial additional second and fifth metacarpal bones of the right forelimb (Fig. 1, A, B, C). During life, the animal did not show signs of lameness or discomfort in walking. After slaughter, carried out in accordance with the requirements for meat production in extra-slaughterhouse conditions under the supervision of a veterinarian, an obvious polydactyly was found on both forelimbs.

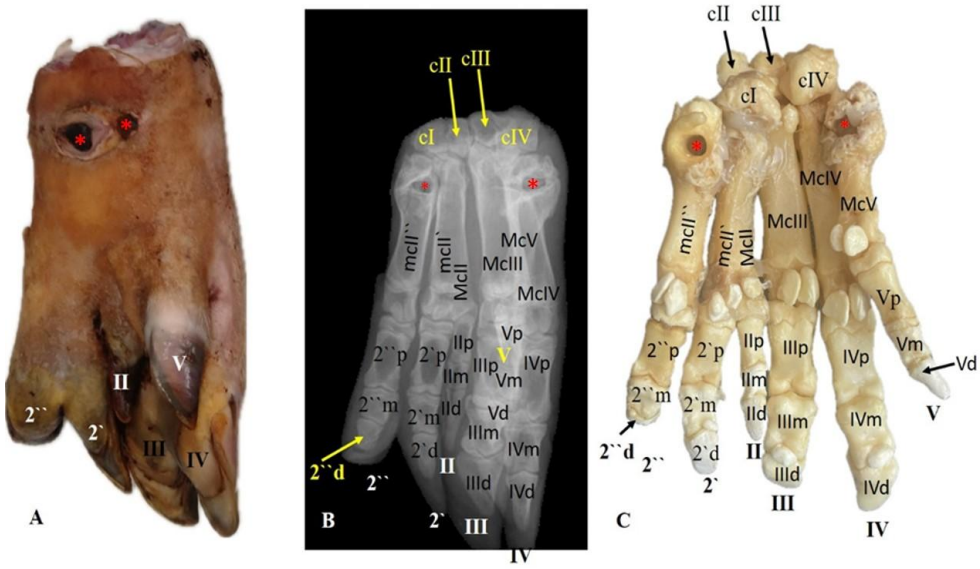

Figure 1: Right thoracic limb of a pig with polydactyly, native photograph (A), radiograph (B), skeleton of the hand (C), palmarolateral views. The red asterisk indicates the pathological channel formed by the elastic rope.; II – normal second digit; 2`- „second" axial, duplicated digit; 2``- „second" abaxial, duplicated digit; cI – overdeveloped *os carpale I*; cII – *os carpale II*; cIII – *os carpale III*; cIV – *os carpale IV*; McII – normal *os metacarpale II* fussed with the duplicated first or axial; mcII` – „first", axial, duplicated *os metacarpale II*, synostosis with the normal second; mcII`` – „second", abaxial, duplicated *os metacarpale II*; McIII – *os metacarpale III*; Mc IV – *os metacarpale IV*; Mc V – *os metacarpale V*; IIp – *phalanx proxmalis* of normal second digit; IIm – *phalanx media* of normal second digit; IId – of *phalanx distalis* of normal second digit; 2`p – *phalanx proximalis* of the axial duplicated digit; 2`m – *phalanx media* of the axial duplicated digit; 2`d – *phalanx distalis* of the axial duplicated digit; 2``p – *phalanx proximalis* of the abaxial duplicated digit; 2``m – *phalanx media* of the abaxial duplicated digit; 2``d – *phalanx distalis* of the abaxial duplicated digit; IIIp – *phalanx proximalis* of the third digit; IIIm – *phalanx media* of the third digit; IIId – *phalanx distalis* of the third digit; IVp – *phalanx proximalis* of the fourth digit; IVm – *phalanx media* of the fourth digit; IVd – *phalanx distalis* of the fourth digit; Vp – *phalanx proximalis* of the fifth digit; Vm – *phalanx media* of the fifth digit; Vd – *phalanx distalis* of the fifth digit.

The comparison of the macroscopic appearance, the radiographic examination and the structure of the skeleton allows to perform a complete morphological analysis and to determine the type and subtype of polydactyly, according to the classifications described in the literature in humans. The macroscopic examination revealed that two additional digits were present in addition to the four-digit thoracic limb of the pig. The main third and fourth digits, as well as the duplicated ones, bore the weight of the body, which is evident from the abrasion of the solear surfaces (Fig. 1A; Fig.

2A). The hanging second and fifth digits were also burdened by excessive loading of the limb during the support phase of movement.

X-ray images and skeletal reconstruction (Fig. 1B, 1C; Fig. 2B, 2C) were showed that all four bones of the distal carpal row are present, with the first carpal bone, *os carpale I*, being enlarged in both limbs. All four metacarpal bones, phalanges, and the adjacent proximal and distal sesamoid bones of the four developed fingers of both limbs are observed. Of interest were the duplicated digits of the right limb, where the axial second metacarpal bone was in synostosis with the regular second metacarpal, while the abaxial duplicate is fully developed and separated. The phalanges of the duplicated two second digits were fully developed. Although the skeleton of the second digit appeared smaller, this was a triple (triplication of) the second digit of the right limb (Fig. 1, A, B, C).

In the left limb, the axial second metacarpal bone was duplicated and independent, being completely separated from the regular second metacarpal bone. The abaxial duplicated metacarpal bone was also independent, with its epiphysis, metaphysis and partially diaphysis clearly visible, the latter being attached to the body of the axially located supernumerary bone. Here also, all phalanges and sesamoid bones were found on the duplicated two second digits, also specifying a triple second digit or triplicity in the left thoracic limb (Fig. 2, A, B, C).

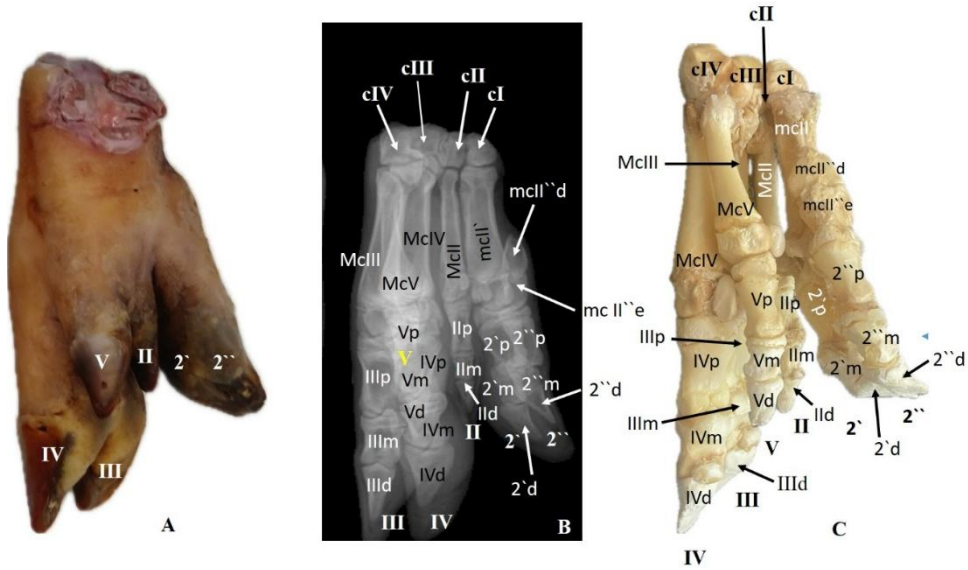

Figure 2: Left forelimb of a pig with polydactyly, native photograph (A), radiograph (B), skeleton of the palmar (C), palmarolateral views. II – normal second digit; 2`- „second“ axial, duplicated digit; 2``- „second“ abaxial, duplicated digit; cI – overdeveloped *os carpale I*; cII – *os carpale II*; cIII – *os carpale III*; cIV – *os carpale IV*; McII – normal *os metacarpale II*; mcII` – „first“, axial duplicated *os metacarpale II*; mcII``e – epiphysis of „second“, abaxial duplicated *os metacarpale II*; mcII``d – diaphysis of „second“, abaxial duplicated *os metacarpale II*; McIII – *os metacarpale III*; Mc IV – *os metacarpale IV*; Mc V – *os metacarpale V*; IIp – *phalanx proxmalis* of the normal second digit; IIm – *phalanx media* of the normal second digit; IId – *phalanx distalis* of the normal second digit; 2`p – *phalanx proximalis* of the axial duplicated digit; 2`m – *phalanx media* of the axial duplicated digit; 2`d – *phalanx distalis* of the axial duplicated digit; 2``p – *phalanx proximalis* of the abaxial duplicated digit; 2``m – *phalanx media* of the abaxial duplicated digit; 2``d – *phalanx distalis* of the abaxial duplicated digit; IIIp – *phalanx proximalis* of the third digit; IIIm – *phalanx media* the third digit; IIId – *phalanx distalis* the third digit; IVp – *phalanx proximalis* of the fourth digit; IVm – *phalanx media* of the fourth digit; IVd – *phalanx distalis* of the fourth digit; Vp – *phalanx proximalis* of the fifth digit; Vm – *phalanx media* of the fifth digit; Vd – *phalanx distalis* of the fifth digit.

The latest terminological (Gasse *et al.*, 2017) and illustrated anatomical nomenclature (Budras *et al.*, 2018) was used to describe the bone structures of the native, radiographic, and post-reconstruction images.

Discussion

Polydactyly in animals rarely is manifested with signs of lameness, for example in Maine Coon cats in which the incidence of this anomaly is relatively high, such a clinical presentation is not observed (Hamelin *et al.*, 2016). In the presented case also, there was lack of pain manifestation or discomfort while walking. The affected animal was stepped with all its toes, including the extra ones, while walking, as indicated by abrasions on the lower foot surfaces of the hooves. A similar type of anomaly, in which the second toe is divided into two or three, is common in wild pigs in Cuba and neighboring islands (Nikitin *et al.*, 2021). Clinically, the pigs exhibited the so-called "bear paw", since they did not stand on two (as is normal), but rather on four toes (Ivanchuk, 2011).

The polydactyly observed in the present case was classified as bilateral and asymmetric, based on the presence of an increased number of digits on both forelimbs and the lack of complete (symmetrical) correspondence between the two malformations, respectively. During a macroscopic assessment, it may be mistaken for a duplicated first digit. However, by examination of the skeleton, this possibility was denied, since the first digit is composed of only two phalanges (Budras *et al.*, 2018; Kovachev *et al.*, 2024). The duplicated digit was precisely the second, since both supernumerary digits were composed of three phalanges each, and were located medial to the axial plane. All carpal bones in pigs are well developed, and in the distal row their size gradually increases from the medial to the lateral (Budras *et al.*, 2018; Kovachev *et al.*, 2024). In the present case, it was found that the first carpal bone was excessively developed in order for the duplicated second digit to have support and reach for the ground surface.

The location of the extra digits can be subdivided into radial, preaxial and medial, or ulnar, postaxial or lateral. In the present case, the polydactyly was defined as preaxial, since it was located inward from the axial plane and was a duplicated second digit, rather than the fifth, which was observed in the postaxial variety (Umair *et al.*, 2018). A similar type of malformation involving the metacarpal bones is known in horses, with the supernumerary digit developing medially on the forelimb in 80% of cases (Jackson & Auer, 2019). The same authors argue that these digits, etiologically, may have an atavistic or teratogenic form of splitting of the metacarpal and phalangeal bones.

The type of the present malformation resembles polydactyly of the second fingers or index digits (preaxial polydactyly type 3) described in humans by Umair *et al.* (2018). The authors report the anomaly as rare, transmitted in an autosomal dominant manner. In it, the index finger is usually duplicated, and one or two triphalangeal fingers replace the thumb. The additional finger is usually in a radial position, and the normal finger can be localized to the lateral or ulnar side to varying degrees (Perez-Lopez *et al.*, 2018). The additional metacarpal bones in the present case were two, with the axial bone synostosizing through its epiphysis with the regular metacarpal, while in the left limb the abaxial supernumerary bone was completely separated.

In our previous study, it was noted that the bilateral polydactyly in the current pig was due to a duplicated second and fifth toe (Georgiev, 2024), but without carefully reading the coincidence of the articular surfaces of the first carpal bone with the radiographic images in two projections,

and here we can definitively state that it was a duplicated second digit, which is added to the regular one, and we can define the case as a triplication or triple second digit.

Conclusion

By the above-described comparative morphological analysis, we can summarize that the presented clinical case concerned asymmetric bilateral preaxial polydactyly in the pig, which was probably an autosomal dominant inherited condition. Despite the lack of clinically pronounced lameness, animals with such type of deformity should be excluded from breeding in order to eliminate the risk of transmission to the offspring.

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