ウシの尺骨性二肢症

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Ulnar Dimelia in a Calf

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Abstract. Ulnar dimelia was found in a calf with true polymelia and intraindividual ipsilateral dimelia. It had not been reported in cattle as far as the authors knew. This calf was born in Shimane Prefecture. The duplicated ulnae of the left limb located cranially and caudally, respectively, were mirror-images of each other with the anconeus processes facing each other. The radius with hemimelia associated with symmelia was divided into two parts, proximal and distal. The proximal part was recognized as a small osseous piece situated between both ulnae. The distal part fused with both ulnar distal portions. In the part corresponding to the shaft, no osseous substance was found, but there was only a tendinous connection between the proximal and distal parts. In the duplicated carpal bones, morphological changes were induced by the abnormal acute refraction of the wrist joint and the absence of the radial and accessory carpal bones in the proximal row in both carpal bones. The metacarpal bones showed a duplication facing the medial side. The digits were polydactylious. In the muscular system, abnormality was observed in the origin, insertion and relationship of duplicated muscles in association with the abnormality of the skeletal system.

A distinction was made between polymelia and the duplication of limbs proximal to basipodium. True polymelia was due to the presence of a second supernumerary rudiment or splitting of a single rudiment. Parasitic polymelia was an unequal duplication with the supernumerary limb attached to the body in the region of the back, particularly the thoracic vertebrae, or even to the occiput [7].

In human beings, the characteristic morphological appearance of dimelia was found in three sets of circumstance, (1) interindividual ambilateral dimelia (limb duplication associated with body axis duplication), (2) intraindividual ambilateral dimelia (symmelia), and (3) intraindividual ipsilateral dimelia (limb duplication without body duplication, e.g., dibrachia, diantebrachia, dicheiria and polydactylia) [8].

Polydactylia has been described in domestic animals by many authors, but a deformity of this kind has rarely been reported in cattle [6]. Although statistical data have been reported on deformities of domestic animals, including cattle, no previous reports are available on diantebrachia [3, 5, 6, 9]. To the authors' knowledge, there have been no reports on this deformity in domestic animals.

This paper deals with a calf with ulnar dimelia corresponding to true polymelia in the classification of Nieberle and Cohrs [7] and to diantebrachia (ulnar dimelia) as defined by O'Rahilly [8].

Materials and Methods

The case observed here was a female Japanese Black calf which was born in Shimane Prefecture. Her parents were normal in appearance. The calf weighed 28 kg when sacrificed.

A 10% formalin solution was perfused through the left common carotid artery. Radiograph was

made of the left forelimb. As it was difficult to examine the vascular and peripheral nervous systems in the left limb, anatomical observation was limited to the skeletal and muscular systems.

Results

No abnormality was found in the outside appearance, except the left forelimb. Gross findings of the left forelimb were as follows. The arm and forearm were turned caudalward. Especially, the forearm was parallel to the body axis. The manus turned cranialward at the wrist joint at an acute angle. As a result, it was twisted on the base of the hoofs facing upward. Thus the hoofs did not contact the ground. The forearm and metacarpal regions were thicker than those on the right side. The duplicated digits were separated from one another, thereby giving a polydactylious appearance. These abnormalities in posture were fixed and immovable to make standing impossible without assistance.

Anatomically, no abnormality was found in the other body regions, except the left forelimb. Radiographically, the extremely abnormal pictures of the forearm and manus were shown. The bones of the forearm were composed of two ulnae which faced each other cranially and caudally and one radius lying between the two ulnae. The radius did not develop into a complete bone. It was composed of two bony parts, a small proximal and a distal. The latter part was not divided from the distal parts of the two ulnae. The carpal bones were observed only as a mass of several small bones. It was impossible to identify any bone of this mass by morphological characteristics. The metacarpals and phalanges were clearly recognized in two sets.

After dissection, the skeletal system was examined in detail by cleaning each bone. The scapula was almost normal. Its spine was 2 cm shorter and the longer and shorter diameters of the glenoid fossa were smaller than those of the right one. The humerus (Fig. 1) was thin and its head narrow. The bone axis was rotated medially at an angle of 60°. As a result, the olecranon fossa was situated on the midsagittal plane of this bone. The coronoid fossa was deep. Both condyles failed to extend cranially over the plane of the anterior surface of the shaft of the bone.

The two ulnae (Fig. 1) were situated cranially and caudally. The cranial one was the extra ulna. The ulnae were mirror-images of each other with the anconeus processes facing each other. They were extremely short. The caudal one was 14.7 cm long the extra one 15.3 cm (the normal right one was 19.3 cm long). The ulnae were almost equal to the normal right radius in length. The olecranons of both ulnae were smaller than that of the ulna on the normal side. The anconeus process of the caudal ulna was projected into the olecranon fossa situated on the midsagittal plane of the humerus by inward twisting of the shaft of the bone.

On the other hand, the same process of the extra ulna on the cranial side projected into the coronoid fossa. Consequently the mobility of the elbow joint was lost. The distal extremities of both ulnae were broad and fused with each other, enveloping the distal part of the radius. The boundary of both ulnae was indicated only by a shallow groove on the medial surface.

The radius (Fig. 1) was not duplicated as the ulna, but was separated into proximal and distal parts. The proximal part was found between the coronoid processes of both ulnae as a small bone piece. The distal part was an outward protuberance with ill-defined boundaries due to osseous fusion with both ulnae. The proximal and distal parts were connected by a tendinous

band.

Due to an acute refraction at the wrist joint, the carpal bones appeared as a flattened pyramidal mass. The abnormal form of the carpal bones made it impossible to identify each bone morphologically. The proximal and distal rows were composed of four bones. The bone corresponding to the accessory carpal bone was not found.

The metacarpals (Fig. 2) consisted of two sets which were almost normal in length (12.4 cm). The shafts of the bones of the two sets were narrower (1.7 cm and 1.4 cm, respectively) than the normal one on the right side 2.0 cm in diameter. The proximal articular surfaces were extremely narrow. The general morphological features, however, were similar to those of the normal bones. These sets fused with each other, except at the distal end.

Although the phalanges consisted of two sets (Fig. 2), the shafts were shorter in length and smaller in diameter. The general morphological features were normal. All the proximal sesamoids were present with the two sets of phalanges, though they were less developed. The distal sesamoids, however, could not be found. This may be due to the undeveloped condition.

No abnormalities were observed in the dorsal division of the muscles of the shoulder girdle of the left limb. In the ventral division, the origins and insertions of the pectoral muscles were normal, but the relative positions of their attachments to the chest-wall were more caudal than in the normal right limb. The less-developed cleidobrachialis was partially fascial.

In the shoulder, the deltoideus was also less-developed. In the left arm, two sets of the triceps brachii were recognized. This muscle that inserted in the caudally situated ulna were almost normal. In the muscle that inserted in the cranially situated ulna, its long, lateral and medial heads extended in the cranio-ventral, ventral and caudo-ventral directions, respectively. Both origins of the biceps brachii which was composed of two muscles were abnormal. The origin of this muscle on the extra-ulnar side was the lateral tuberosity and that on the other side the medial tuberosity.

The less-developed brachialis extended straightly due to the rotation of the humerus. The anconeus, the extensor digitorum communis, the extensor digitorum lateralis and the interosseus medius were less-developed. The abductor digiti I longus, the pronator teres or the interossei laterales could not be found. In the forearm, every muscle, except those that could no be recognized, consisted of pairs of muscles. The extensor digitorum communis, which was situated caudally, was divided into three tendons at the proximal level of the metacarpus. One of the tendons extended to the fourth digit, running parallel to the tendon of the extensor digitorum lateralis. Another tendon situated cranially was not separated from the humeral or ulnar head, but the extensor digiti III was separated at the proximal level.

On the side of the caudal ulna, the extensor digitorum lateralis, lying caudal to the extensor digitorum communis, was slender and less-developed. It was interposed by the osseous protuberance corresponding to the distal part of the radius between this muscle and the extensor digitorum communis on the same side. The other tendon on the side of the cranial extra ulna lay cranial to the extensor digitorum communis of the same side.

The flexor carpi radialis and the extensor carpi ulnaris on the cranial ulnar side fused into one muscle. At the distal level they had two bellies. The flexor carpi ulnaris was separated indistinctly into two parts,

the humeral and ulnar heads. The flexor digitorum superficialis on one side fused with that on the other into one belly at the distal level of the metacarpal. At the level of the first phalanges of both digits, the two muscles were again divided into two tendons.

The tendons of the flexor digitorum profundus on both sides were united at the central level of the metacarpals and again divided into two tendons at the distal level of the metacarpals. The tendon on the side of the caudal ulna was divided into two tendons, which were portions 1 cm distal to this ulna and ran to the third and fourth digits, respectively. The tendon on the side of the cranial ulna branched 1 cm distal and fused with that on the other side at a point 3.5 cm distal to this ulna. The fused tendon again bifurcated 2 cm distally to insert into the third and fourth digits. The muscles other than those described above were almost normal in origin and insertion. Abnormalities in the relationship between muscles were remarkable. Therefore, the muscles of the arm and forearm consisting of pairs of muscles were not completely symmetrical.

Discussion

O'Rahilly [8] classified dimelia into three types. The third type consisted of dibrachia, diantebrachia, dicheiria and polydactylia. In this type, duplicated parts generally appear to be mirror-images of each other. Ulnar dimelia shows radial symmelia associated with double radial hemimelia. In the forelimb of the mouse [2], the blastemal condensation of the ulna occurs earlier than that of the radius. In agreement with this observation, it was reported that radial dimelia with ulnar deficiency was difficult to find [8]. It may be that the case reported here to show mirror-image ulnar dimelia and radial hemimelia is comparable with the third type of O'Rahilly [8].

The abnormality of the forearm and the immobility of the elbow joint, as well as the abnormal morphological changes of the humerus, were due to the projection of the anconeus process of the extra ulna into the coronoid fossa. The morphological features of each of the carpal bones were not shown due to changes in the form of these bones as a whole in association with an acute refraction of the wrist joint.

According to O'Rahilly [8], the duplicated carpal bones in ulnar dimelia show a mirror-image arrangement and a deficiency of bone on the medial side. In this case, it may also be that the proximal row of four carpal bones is composed of pairs of intermediate and ulnar carpal bones. No bones are present on the medial side. On the other hand, the distal row consists of four bones showing a complete duplication. The metacarpal bones and the phalanges are mirror-images as well. Free digits forming a pair are similar in size to each other and polydactylious in appearance.

In the cat, Danforth [1] described that the peripheral alteration that occurred in polydactyly affected the organogenesis of most types of tissue in the distal part of the limb. In this case, abnormalities in the origins and insertions of some muscles and mutual relationships between duplicated muscles were presented in association with the anomalies of the skeletal system.

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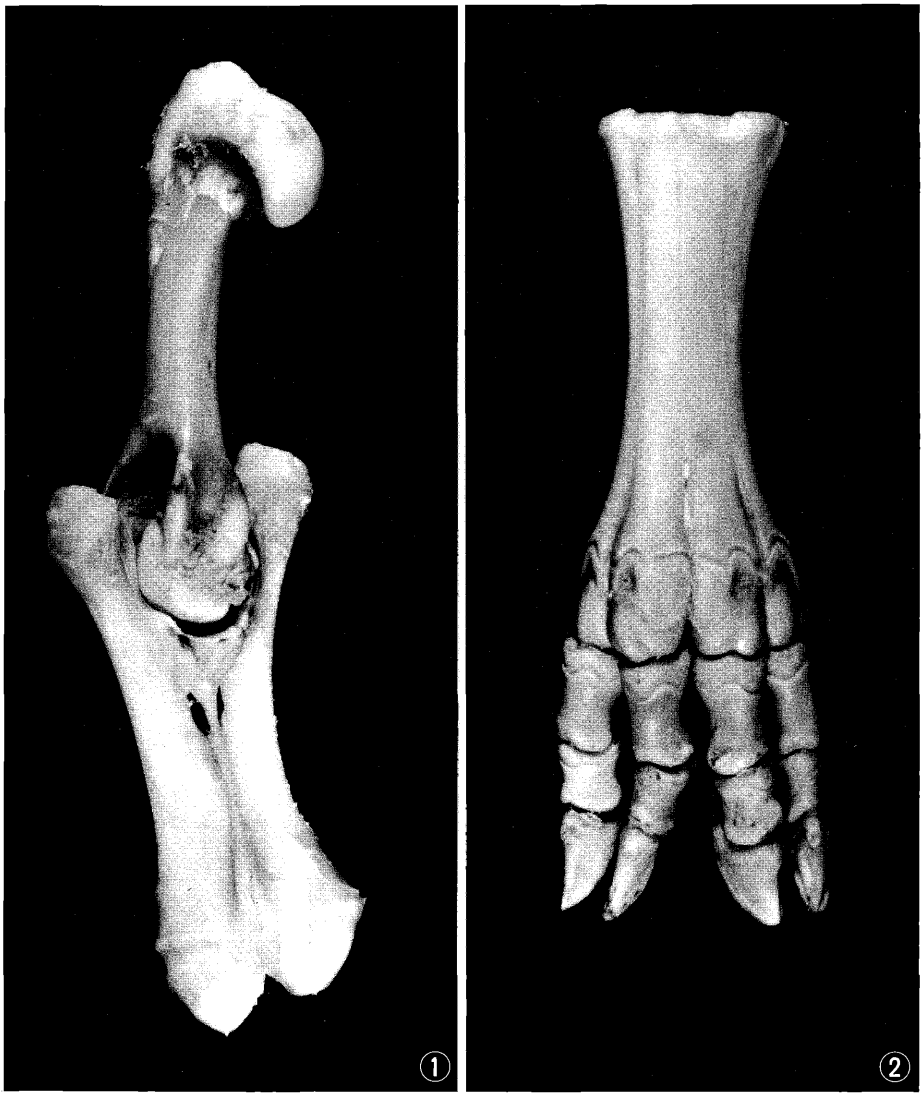
要　約

ウシの尺骨性二肢症: 上嶋俊彦・上原正人（鳥取大学農学部獣医学科家畜解剖学教室）——島根県産の子牛に，これまで報告されていない true polymelia および intraindividual ipsilateral dimelia に分類される，極めて稀な尺骨性二肢症が発見された．二肢症を示す左側前肢の尺骨は，肘突起を向き合わせた前後位の鏡像的位置をとっていた．橈骨は symmelia および hemimelia を示して近位部と遠位部に分かれる．近位部は小骨片として両尺骨の間に存し，遠位部は両尺骨と癒合し，骨体相当部を欠き，近位部と遠位部は腱様構造により結合していた．重複した手根骨では，肘関節の重度の屈曲に伴う形態異常と，それぞれの近位列の橈側手根骨および副手根骨の欠除が見られた．中手骨は内側に向き合わせる重複を示し，指骨は多指症様であった．筋系には，骨格の異常に伴う二次的な起始，終止および重複せる筋相互間の配列に異常が見られた．

Explanation of Figures

Fig. 1. Lateral view of the bones of arm and forearm in the left limb. The duplicated ulnae located cranially and caudally, respectively, are mirror-images of each other. The radius with hemimelia associated with symmelia is divided into proximal and distal parts. ×0.5.

Fig. 2. Dorsal view of metacarpal bones and phalanges in the left limb. The metacarpal bones show duplication facing the medial side. The digits are polydactylious. ×0.5.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