The domestic carnivores have five digits in front limbs and generally, four in the pelvic limbs, the first digit being absent. Scarcely ever in cats and more frequently in dogs, the first digit can be present in pelvic limbs, as a rudiment, more or less developed, being known as “dewclaw”. This term is used also for the first digit of the thoracic limb, being more reduced than the rest of the digits, but is more proper for the pelvic limb. Genetically, the presence of the dewclaw in pelvic limb, simple or double, and double in thoracic limb is known as hind-limb-specific preaxial polydactyly – PPD. Taking into account these aspects, we set out to analyse the morphological and structural variability of the hind limb dewclaw in dogs, in relation with the development degree of the first metatarsal bone, using clinical and imagistic exam. The most of the animals were patients of two veterinary clinics having various pathologies of the legs. Clinically were identified two animals having dewclaw in pelvic limb, one being simple and not joined and the other one, double and joined. The X-ray exam, even the number of the animals with dewclaw wasn’t high, revealed many more-pathologies of the legs. Clinically were identified two animals having dewclaw in pelvic limb, one being simple and not joined and the other one, double and joined. The X-ray exam, even the number of the animals with dewclaw wasn’t high, revealed many more morphologic types of the dewclaw: simple and not joined dewclaw, without phalanges (one case); simple and not joined dewclaw, in his structure having one or two phalanges (three cases); simple and joined dewclaw, the osseous structure including two phalanges, simultaneously being present the first metatarsal bone represented by the proximal and distal extremity (two cases); simple dewclaw, well developed, with two phalanges and joined with the first metatarsal bone completely developed (two cases). In most of the cases (seven) was noted the lack of the dewclaw, but the presence of the proximal extremity of the first metatarsal bone and, in other two cases the first metatarsal bone was completely absent. Can be noted firstly an obvious polymorphism of the dewclaw in dogs, this aspect being important especially when the surgical removal is necessary.

**Keywords**: dewclaw, dog, structure, x-ray exam

**ABSTRACT**

Carnivorele domestice au cinci degete la membrele anterioare și de obicei patru la membrele posterioare, lipsind degetul I. Foarte rar la pisică, dar mai frecvent la câine, degetul I poate fi prezent și la membrele posterioare sub formă rudimentară, cu un grad mai mare sau mai redus de dezvoltare, fiind cunoscut sub denumirea de pînten. Acest termen este folosit și pentru degetul I al membrului toracic, fiind mai redus decât celelalte, dar este mai propriu membrului pelvin. Din punct de vedere genetic, prezența pîntenului la membrele posterioare, simplu sau chiar dedublat și a pîntenului dedublat la membrele anterioare este descrisă sub denumirea de hind-limb-specific preaxial polydactyly – PPD.

Date fiind aceste aspecte, ne-am propus o analiză a variabilității morfologice și structurale a pîntenului la membrul posterior, în corelație cu dezvoltarea metatarsului I, prin examene clinice și imagistice.

Cele mai multe animale luate în studiu au fost pacienții care au fost aduși la două clinici veterinare pentru diverse afecțiuni ale membrelor posterioare. Clinica a fost înregistrată prezența pîntenului la două animale, din rasă comună, la unul fiind simplu și nearchitetic, iar la celălalt bifid și articulat.

Imagistic, deși pîntenul nu a fost observat la un număr mare de animale, s-au constatat și identificat mai multe variante morfologice: pîten simplu, nearticulat, fără structură osoasă (1 caz); pîten simplu, nearticulat, având în structura sa una, respectiv două falange (3 cazuri); pîten simplu, dar articulat, cu un schelet format din două falange (2 cazuri), concomitent cu prezența metatarsului rudimentar I, reprezentat prin extremitatea proximală și distală; pîten simplu, bine dezvoltat, cu două falange și articulat cu metatarsul I sub articulat (2 cazuri). La cele mai multe animale (șapte), pîtenul a fost absent, dar s-a observat prezența numai a extremității proximale a metatarsului I, iar la alte două animale și metatarsul I a fost total absent. Se poate remarca în primul rând un polimorfism accentuat al pîntenului la câine, aspect important mai ales atunci când se ridică problema îndepărțării chirurgicale a acestuia.

**Cuvinte cheie**: pîten, câine, structură, examen radiografic
The autopodium is that segment of the locomotor apparatus which presents the largest morphological variability from a species to another. This variability is present inside to a vertebrate class but also from a class to another, being in a close relationship with the locomotion type (3).

Both thoracic and pelvic autopodium include three segments namely: basipodium, consisting of carpal bones for thoracic limb and tarsal bones for the pelvic one; metapodium, which includes the metacarpal bones in case of the thoracic limb and metatarsal bones in case of the pelvic one and the acropodium, which is represented by the skeleton of the digits that includes the phalangeal and the sesamoid bones (2, 12, 17, 18).

The most important inter-species peculiarities target the acropodium, between mammal domestic species existing a large variability of the digits number. Generally, the number of digits is directly correlated with the number of metacarpal or metatarsal bones. When exist rudimentary metacarpal or metatarsal bones, there is no corresponding digit, as in the case of the 2nd and 4th metacarpal/metatarsal bones in horses or the 5th metacarpal bone in ruminants (2, 3).

In domestic carnivores the thoracic acropodium is complete, including 5 digits (I-V) corresponding to the metacarpal bones (I-V). The first digit is more reduced, his skeleton has two phalanges (proximal and distal) and generally has no function to support (3, 10). At the pelvic limb dogs in general have four digits (II-V), presumably due to an evolutionary adaptation (7, 14), corresponding to the metatarsal bones II-V. The first digit (I), usually misses. In dogs occasionally, and exceptionally in cats, the first digit can exist also for the pelvic limb (19), as a rudiment and it is named dewclaw (also for the thoracic limb). When the dewclaw exists in cats, the I st digit has no phalanges, only the horny sheath.

A dewclaw is a vestigial digit in some animals, on the foot of many mammals, birds and reptiles (including some extinct orders, like certain theropods). It commonly grows higher on the leg than the rest of the foot, such that in digitigrade or unguligrade species it does not make contact with the ground when the animal is standing. The name refers to the dewclaw’s alleged tendency to brush dew away from the grass (4). On dogs and cats, the dewclaws are on the inside of the front legs, positioned analogously to a human thumb (22). Although many animals have dewclaws, other similar species do not, such as horses, giraffes and the African wild dog (8, 23, 27).

Although both fore limb and hind limb first digits are commonly referred to as “dewclaws”, only the vestigial digits inside the hind limbs are dewclaws proper (5).

The morphology and the structure of the dewclaw can vary greatly in relation with the degree of development. In forelimb commonly it presents two phalanges, proximal and distal one, and makes joint with the I st metacarpal bones. There are breeds, as the Norwegian Lundehund, which have a double dewclaw. In the pelvic limb the dewclaw is more vestigial, commonly has no phalanges or sometimes a rudimentary distal phalanx. Generally, it is attached by the metapodium only through the skin (9, 26). In some cases, the pelvic dewclaw presents a complete skeleton and is joined with the first metatarsal bone.

The presence of the dewclaw in hind limb can conduct to some pathologies, especially when it is poorly connected with the leg. Hind limb dewclaws tend to be removed more frequently because they are loosely attached by skin and pose more of a risk of getting caught on something or ripped (24).

Our observations were focused to analyse the variability on the conformation and the structure of the hind limb dewclaw in dogs using the clinical and imagistic methods.

**MATERIAL AND METHODS**

The investigations were made on 19 canine specimens, both males (11) and females (8). The most of the animals were half breed. Other breeds were: Pekingese (1 animal), Rottweiler (1 animal), Bichon (4 animals). The age varied between 9 months and 13 years. Except two dogs, the animals were patients of two veterinary clinics from Iasi (Romania) and were brought to clinics for various pathologies of the legs. The dogs were clinically examined and then subjected to imagistic examination, more exactly x-ray exam in two instances: mediolateral (ML) and dorsoplantar (DPL). The x-rays images obtained for the pathologies were used also to study and analyse the morphology and the structure of the dewclaw. Totally, there were analysed x-rays images of 3420 dogs to find the animals which had dewclaws. Two canine specimens were not patients but were included into the study having dewclaws, and there was no possibility to complete the clinical observations with imagistic exam.

The obtained images were examined in a comparative way to analyse as complete is possible the morphological details. To describe these aspects, we used the terms in accordance with the NAV, Sixth Edition, 2017 (11).

**RESULTS AND DISCUSSIONS**

From the beginning it was observed the structural polymorphism of the dewclaw in examined animals, clinically but also radiological. Firstly, in the two dogs which were only clinically analysed, the morphology of the dewclaw was different. In the first case (Fig. 1) it was observed a forked or double dewclaw.
Through palpation it was concluded that there exists a joint with the metatarsus, being a joined digit because the mobility was reduced. In the second case it was noticed a simple dewclaw (Fig. 2) which presented a high degree of mobility. We supposed that there was no joint with metatarsus, and the connection was provided by the soft tissue (skin). Unfortunately, for these two animals was no possibility of radiologic exam for structural details.

Fig. 1. Double and joined dewclaw (A)

Fig. 2. Simple and not joined dewclaw (A)

Through the X-ray exam, it was observed a different osseous structure of the dewclaw and a various development of the first metatarsal bone. In a dog was registered a simple and not joined dewclaw, no phalanx being present. Only the horny sheath can be observed (Fig. 3). In other three cases it was noticed that the dewclaw is also simple, not joined, but the skeleton included two phalanges in two dogs (Fig. 4 and Fig. 5) and a single phalanx - distal one (Phalanx distalis) in the third one (Fig. 6). These three animals had or not the vestige (proximal extremity) of the I\textsuperscript{th} metatarsal bone (Os metatarsale I). In other two animals, it was noticed a joined dewclaw, having also a complete skeleton including the proximal (Phalanx proximalis) and the distal phalanx (Phalanx distalis). In a case (Fig. 7), on x-ray image can be observed only the proximal phalanx, but most probably it had also the distal one. In these dogs the first metatarsal bone was present, being rudimentary. There were developed only the proximal (Basis) and distal extremity (Caput), the last one being joined with the proximal phalanx of the dewclaw (Fig. 7, Fig. 8).

Also, for the I\textsuperscript{th} metatarsal bone (Os metatarsale I) there were remarked different degrees of development from a dog to another. In the most of the animals the x-ray exam revealed the lack of the first metatarsal bone (2 cases) (Fig. 9) or the presence of the proximal extremity (Basis), being joined with the first tarsal bone (Os tarsale I) (7 cases) (Fig. 10.). In other two animals, as previously was described, both extremities were present (Fig. 7, Fig. 8). Finally, in two animals it was noticed a complete and well developed I\textsuperscript{th} metatarsal bone, short (Fig. 11) or even long, almost similar to the other metatarsal bones (Fig. 12). Also, in first case, it could be observed a complete and joined dewclaw, well developed, in the second one the x-ray image did not include the view of the dewclaw.

Fig. 3. Simple and not joined dewclaw without osseous structure (A)

Fig. 4 & 5. Simple and not joined dewclaw with two phalanges (A)
According to the dates, a joined first digit of the fore limb consists of a proximal phalanx and a distal phalanx. The distal phalanx has a claw attached. The digit articulates with the first metacarpal bone via the metacarpophalangeal joint. Also, for the hind limb, a fully developed digit consists of a proximal phalanx and a distal phalanx. The distal phalanx has a claw attached. The digit articulates with the first metatarsal bone via a metatarsophalangeal joint (15, 26). A non-articulated first digit (dewclaw) is a vestigial structure composed of a terminal phalanx with a claw attached and connected to the limb only by skin tissue. It is variably present on the hind limb of dogs, and on occasion may also be seen on a fore limb (26).

In some breeds, there are two dewclaws. When a dog has extra dewclaws in addition to the usual one on each front leg, the dog is said to be double dewclawed (4, 26).

Unlike front dewclaws, rear dewclaws tend to have little bone or muscle structure in most breeds. It is normal, although not biologically necessary, that certain breeds will have more than one dewclaw on the same paw. At least one of these dewclaws will be poorly connected to the leg, and in this case, it is often surgically removed (1).

The hind dewclaws do not have associated tendons and are considered non-functional (though they may be required for some breed standards) (24).

The dewclaw articulates with metatarsal bone I, which is often small and may be fused to tarsal bone I. If two dewclaws are present, there may be, on occasion, complete duplication of the phalanges and metatarsal bone I. Metatarsal bone I may also exist as two segments united by fibrous tissue or present with a distinct joint between the segments (24).
In a few breeds, five or six digits have been intentionally maintained through breeding. Examples of breeds that must have the dewclaw present in order to be recognized as the breed standard include Great Pyrenees, Beauceron, St. Bernard, Briard, Icelandic Sheepdog, Anatolian Shepherd (24, 22).

In addition, most breeds often display this extra digit as a genetic variation, although the number of digits (five) in the forelimb is essentially unchanged. This type of dominant genetic alteration has been commonly called "dewclaw". A more technical term for these additional digits on the rear legs is hind-limb-specific preaxial polydactyly. Several genetic mechanisms can cause rear dewclaws; they involve the LMBR1 gene and related parts of the genome (16). Rarely, polydactyl mutations involving both the fore and hind limbs occur, as reported in breeds like the Norwegian Lundehund (6), although their genetic bases are poorly understood. Except for its exclusive appearance in the hind limb, hind-limb-specific canine PPD resembles human PPD type I, which increases one or more biphalangeal thumbs (6, 16).

According to the literature, if in the forelimb the dewclaw can be even useful, in case of the hind limb can cause damages and raises the issue of surgical removal. The dewclaws are not dead appendages. They can be used to lightly grip bones and other items that dogs hold with the paws. In some dogs these claws may not appear to be connected to the leg at all except by a flap of skin; in such dogs the claws do not have a use for gripping as the claw can easily fold or turn (10).

Four of the toes (equivalent to our fingers), are in contact with the ground when the dog is standing. When a dog runs, however, the entire foot from the carpus to the toes contacts the ground. If the dog then turns, it can dig the dewclaw (the equivalent of our thumb) into the ground to stabilize the leg and reduce torque on the rest of the leg. There is a great deal of misconception about front dewclaws. The fact that they are not in contact with the ground when the dog is standing still has led people to mistakenly believe that they have no function in movement. As a result, the dewclaws are removed from many purebred puppies soon after birth. Many breeders feel this gives a cleaner, straighter look to the dog’s front legs. Others believe that the dewclaws should be removed so that they will not get injured. But stop-action photographs clearly demonstrate that they are in contact with the ground whenever the dog canters or gallops.

Further proof of the front dewclaws’ functionality comes from anatomical studies demonstrating that there are several tendons that connect muscles of the lower limb to the dewclaw. Some veterinarians report a higher incidence of foot and carpus injuries and arthritis in dogs that lack dewclaws, likely because of additional torque on the leg.

Thus, for working dogs it is best for the dewclaws not to be amputated. If the dewclaw does suffer a traumatic injury, the problem can be dealt with at that time, including amputation if needed (22).

There is some debate as to whether dewclaws should be surgically removed. The argument for removal states that dewclaws are a weak digit, barely attached to the leg, and thus they can rip partway off or easily catch on something and break, which can be painful and prone to infection.

Dewclaw removal is most easily performed when the dog is young, around 2–5 days of age. It can also be performed on older dogs if necessary though the surgery may be more difficult then. The surgery is fairly straightforward and may be done with local anaesthetics if the digit is not well connected to the leg (4, 13, 21).

In some breeds of dogs, front limb dewclaws are routinely removed to improve the dog’s front-end appearance in the show ring. In some cases, a dog’s front dewclaw is removed if it has been severely injured or has developed a disease (e.g., cancerous tumour). In these cases, it is certainly in the dog’s best interest to remove it. In speaking with numerous veterinarians, it has been found that dewclaws are the least injured digit of the canine carpus.

Hindlimb dewclaws tend to be removed more frequently because they are loosely attached by skin and pose more of a risk of getting caught on something or ripped (24).

For certain dog breeds a dewclaw is considered a necessity, e.g. a Beauceron for sheep herding and for navigating snowy terrain (4). As such, there is some debate about whether a dewclaw helps dogs to gain traction when they run because in some dogs, the dewclaw makes contact when they are running and the nail on the dewclaw often wears down in the same way that the nails on their other toes do, from contact with the ground. In many dogs the dewclaws never contact the ground. In this case, the dewclaw’s nail never wears away, and it is often trimmed to maintain it at a safe length (23).

CONCLUSIONS

The investigation revealed an evident polymorphism of the dewclaw in dogs, in correlation with the development degree of the first metatarsal bone.

In addition to clinical investigations, the x-ray exam can be successfully used to observe the peculiarities of the dewclaw structure, the data being important especially for surgical removal.

The study did not reveal an obvious specificity of the presence/structure of the dewclaw and first metatarsal bone for some animals depending on breed, age, sex, etc.
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