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Anatomical study of the 3rd metacarpal bone of some mammals

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Abstract

The current study included the anatomical structure of the metatarsal bone in sheep in terms of the traditional structural description of the bone, as it was found that the metatarsal bone in the fore and hind limbs of adult sheep had no visible differences between it and animals, especially ruminants. The metacarpal \tarsal bone No. 3 was cylindrical in shape, with the presence of the metacarpal \tarsal bones 2 and 4 declines, articulated from the proximal end with the metacarpal and metatarsal bones whereas from the distal part with the fetlock joint and the first phalanx bone. The aim of the study is to determine whether the environment and its changes in Iraq have affected the animals and their bones in terms of length, thickness, and hardness.

Keywords: 3rd metacarpals; Bone; Anatomically; Measurements; Iraq

1. Introduction

The embryonic bone formation depends in its mechanical concept on the characteristics of the bone in the treatment of fatigue and resistance, and thus the arrangement of the bony scales differs from one bone to another.(1)

The digit in mammals is a constraint, while reptiles, may lose the limbs completely, but in mammals, the finger is reduced in a simplified way, it may be reduced from the locomotor system, but remains in archaeological from previous studies have suggested that the metatarsal bone develops through the fusion of the 3rd and 4th metatarsal bones. This is one of the basics of bone development during embryonic development (2). In equids, the third and fourth digits are fused to the third metacarpal component, while the second and fifth digits protrude to the sides of the third digits, and the first toe is completely reduced(3). For example, in some species, there are metatarsal splints and external hooves, but the toes on the sides are without phalanges, differently from the Swedish species, the toes on both sides of the digits are complete and small(4). The horse shows the front end differently over the ages, it may vary according to the circumstances that those ages went through. In the early ice ages, horses appeared with three fingers, and with the development of horses, it seemed to be reduced to the third metacarpal bone (5). It was observed in camels that the metatarsal bone of the foot is formed by the fusion of the 3rd and 4th metacarpal extending along the metacarpal bone and eventually diverging to form the joint (6). It turns out that the metatarsal bone in the forelimbs has more pressure, is exposed to shocks, and bears more body weight than the hind limbs(7). The 3 metacarpal bone is one of the most comprehensive and extended bones in equines and cattle. It is located on the inner surface of the second, fourth, and fifth metacarpals running along the third metacarpal bone(8). The Metacarpal bone articulates laterally with its small face from the second metacarpal and articulates proximally to the trapezium (one large facet) and the magnum (one small facet). The third metatarsal articulates laterally with the fourth metacarpal, and near the magnum (one large facet) and irregular (one small facet). The fourth metatarsal articulates laterally with the V metatarsal (one small facet) and proximal with the irregular (one large facet). The V-comb closely articulates with the irregular facet (one large facet) (9). Developmental differences occur in mammals. During embryonic development, precursors are reduced and digits are removed by programmed death and degeneration of metatarsal cells(10). This happens during the embryonic

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mutation during the phenotypic stage and this requires development and reduction for a long period that passes by many years and according to the breeds as in horses (11).

2. Material and methods

Sample collection: The current study was conducted on the third metatarsal bone by taking it from the fore and hind limbs of adult sheep (males) 1 year of age. I got the samples from the Baghdad slaughterhouse after slaughtering the animal and taking the bone. It is disassembled from the joints connected with it and transported to the laboratories of the Iraq Natural History Research Center and the Museum for an anatomical examination and taking measurements with imaging to understand the changes after the slaughter process.

The bones were prepared by removing the skin, tendons, and ligaments surrounding the bone, then left in boiling water to get rid of the soft tissues attached to the bone. Then it was cleaned with small scrapers and washed under tap water, for the purpose of cleaning and bleaching. It was placed in an aqueous solution for 2-4 hours, then dried under the sun for a whole day. (12,13).

3. Results

The current study showed 3rd metacarpal bone fused and developed a well and long bone articulated from the proximal end with the carpal bones in the forelimb and with the tarsus bones in the hind limb while it articulated with the phalanx joint from the distal side, which separated and diverged to articulate on the bones of the fingers. The fusion increases the strength of the bone so that the newborn can stand after birth and move freely and with greater balance. The depression in the groove through which the tendon passes in the forelimb was more pronounced and extended to the middle of the bone, while in the hind limb the groove was confined to the proximal end of the lateral bone(Fig3 A&B).

The metatarsal bone in the third and fourth sheep has merged, called the lateral or small metatarsal bone(Fig3 A&B), and is articulated by fiber united medium. 3rd metacarpal bone was longer than the forelimb, as the measurements of the 3rd metacarpal of the hind limb were 12.2 ± 12.4 cm and a diameter of 9.2 ± 9 mm. In contrast, the metatarsal in the forelimb was 11.2 ±11.1 cm and had a 9.4 ±9.2 mm diameter (Fig 1&2). The shaped surface of articulation with respect to the 3dr metacarpal bone was different from the articulation in the hind limb of sheep, due to the number and shape of the carpal\tarsal bones (Fig 4). The palmar articular surface was rough and somewhat weak. The palmar ligaments stabilized it and articulated it with the proximal sesamoid bones(Fig.5).

With regard to the differences in sexes for males and females, there are no differences, in addition to the environment, it did not affect any change in shape and length for sheep. Food may have a negative effect on some individual cases, genetic modifications, or congenital deformities.

Figure 1 3^RD metacarpals (B) & metatarsals (A) bone showed longitudinal Anterior section the difference between length and diameters

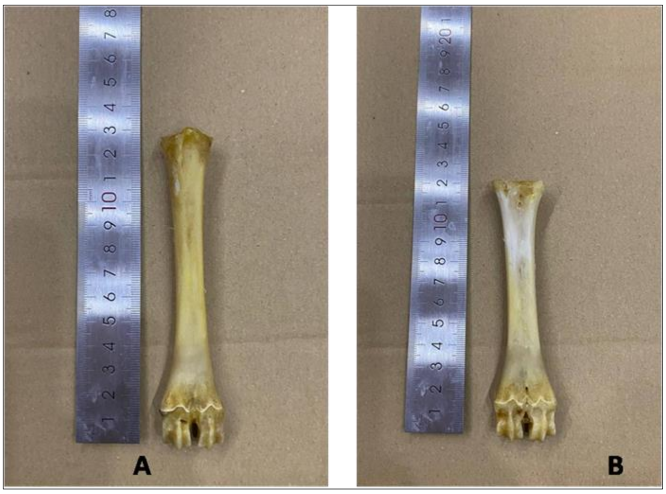

Figure 2 3RD metatarsal (A) metacarpal (B) bone showed longitudinal posterior section the difference between length and diameters

Figure 3 3RD metacarpal (A) & metatarsal (B) bone showed longitudinal posterior section the location of small metatarsal (red arrow) ,and the groove (blaach arrow)

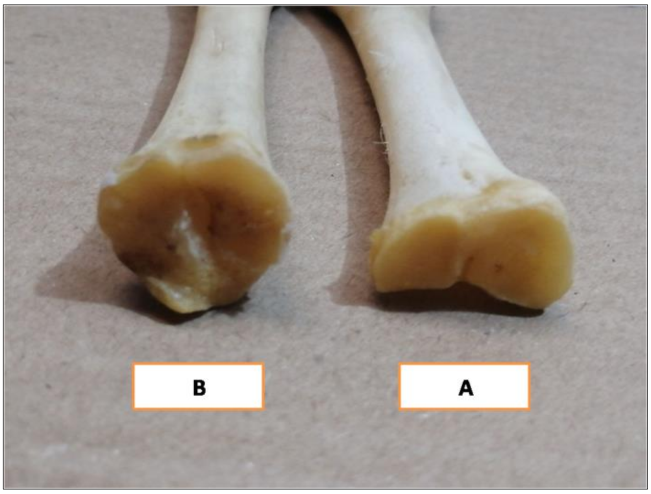

Figure 4 3RD metacarpal (A) & metatarsal (B) showed the articulation surface MC \ MS bone difference between its

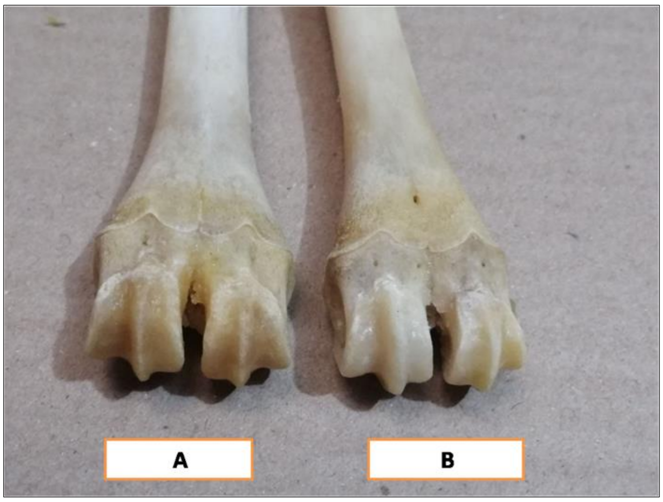

Figure 5 showed the palmer groove articulated A 3RD Metacarpal B Metatarsal

4. Discussion

In the current study, no differences were observed between ewes and rams in relation to the difference in sex. It did not affect the length or thickness, while (14) was recorded after comparing some long bones. It was found that the metatarsal bone in bulls is longer and thicker than in cows. The current study differs from (15) in terms of bone shape, thickness, and joint. The horse was more developed, although it always had fractures.

In camels (6) it is evident that the 3rd metatarsal bone merged with the fourth, as in the current study, while it differed with horses by reducing the second and fourth bones with the third metatarsal bone (16) In bovine (17), in which the third and fourth bones have been reduced, the fusion extends along the third metatarsal bone.

The proximal end articulates with the carpal bones of the distal row, which appears slightly concave in most ruminants. It is consistent with most studies (18,19). The dorsal Metacarpal tuberosity did not present, various studies that showed its presence in other ruminants, while in horses, the dorsal tuberosity was found on the medial side of the dorsal surface of the Metacarpal bone (5,16,17,19). The articular surface of the metatarsal bone in sheep from the distal end was articulated with the digits. The separated surface was not as large as in camels (6) and was also articulated with the proximal sesamoid bones. On the other hand, the horses were characterized by the fact that the distal end of the metacarpal consists of two condyles articulated by a sagittal edge with the proximal sesamoid bones (22). The palmar articular surfaces had a flat and weaker groove in which the ligaments settled. The result was consistent with cows and different with camels (20,21), While it appeared in horses, the surface was smooth and convex, taking a straight shape (22).

5. Conclusion

Researching previous studies with the current study, the differences were simple, most of which depended on the mechanical effort that the animal performs in proportion to the size of the body, so it is necessary to conduct histological and embryonic studies of the third metatarsal bone, whether in the fore and hind limb, to know the development and differences in histological formation.

Compliance with ethical standards

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Statement of ethical approval

All research and conclusions were conducted under the supervision and knowledge Laboratories of the Iraq Natural History Research Center and Museum/Baghdad University.

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