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AGE CHANGES IN THE LINEAR SIZES OF THE BONES OF THE PELVIC LIMB SHEEP OF THE KARAKUL BREED

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ABSTRACT

In order to determine the influence of habitat conditions on the morphofunctional features of the bones of Karakul sheep and mechanisms of adaptation to them, the postnatal ontogenesis of the pelvic limb bones was studied in Karakul sheep bred in the foothill pastures of Uzbekistan in different periods of postnatal ontogenesis. Over the entire study period, that is, from 2-5 days to 4 years of age, the intensity of linear growth of the pelvic limb bones decreases. The highest growth rate is observed at birth up to 30 days of age. From 3 to 6 months, the growth rates decrease and remain unchanged up to 12 months. From 12 to 18 months, another decrease in growth rates is observed and remains so until the end of the research. The bones of the tarsus have the lowest intensity of growth in length, then the intensity of growth increases in the proximal and distal directions. In the pelvic bone, the transverse grows more vigorously, and in the bones of the free limb, their longitudinal dimensions. Age-related changes in relative linear sizes directly correlate with changes in the intensity of their growth. The ratio of the width, thickness of the diaphysis and epiphyses of bones to their length, as well as changes in the constituent elements (tubercles, processes) are due to the load on the skeleton, general biological laws, and apparently functional changes in other elements of the musculoskeletal system acting on them, under the influence of conditions of detention and breed patterns of development.

Keywords. Karakul sheep, habitat conditions, foothill pastures, postnatal ontogenesis, morphofunctional features of bones, pelvic limb, growth rate, length, width, thickness, relative sizes, diaphysis and epiphysis of bones, functional changes, breed patterns of development.

INTRODUCTION. In Uzbekistan, Karakul sheep are bred in a variety of conditions - from foothill pastures to arid and poor in forage natural areas. Climatic and nutritional differences in breeding conditions affect the offspring, constitution, quantity and quality of the products obtained from them, and in accordance with the above conditions contribute to the formation of the musculoskeletal system of the Karakul sheep. In this regard, the study of the dynamics of the development of the skeleton and muscles in general and in the relationship of individual parts is an important factor in the development of methods for managing the processes of ontogenesis [5, 6, 3, 1].

The musculoskeletal system is one of the most important vital organs of the body and, like other systems, undergoes certain stages of development in response to environmental conditions.

The study of the skeleton and muscles is necessary not only to determine the exterior of animals and conduct selection in breeding work, but also because of their wide biological significance. Bones form the basis of the musculoskeletal system and are a depot of mineral salts,

which are important for maintaining the body's homeostasis. Therefore, it is one of the main components that ensure the continuity of metabolic processes in the body.

In conclusion, it should be noted that the study of limb bones of Karakul sheep is not only of theoretical interest, but also has a special practical value for determining changes in the musculoskeletal system and meat qualities of animals [2].

MATERIAL AND METHODS. The material for the study was Karakul lambs and sheep from the farms of the Kushrabat district of the Samarkand region, which were kept in the same conditions of keeping and feeding. The Kushrabat region is located in the northern part of the Zerafshan valley in the southern foothills of the Nurata ridge. These hilly foothills are known in Central Asia as loess hills of the Zerafshan and Turkestan mountain ranges (400-900 m above sea level).

Samarkand region is included in the zone of continental arid climate. Winters are relatively mild (January temperature in the north of the region is -2 ° C, in Samarkand –1.9 ° C, in the mountains –4.8 ° C. In Samarkand, the average July temperature is + 26.7 ° C. In the south, to the west of region + 32-38 ° C. The amount of precipitation in Samarkand falls up to 355 mm, in the Zerafshan ridge - up to 800 mm.

The natural vegetation of the rest of the region is to some extent degraded as a result of overgrazing, agriculture in the hills, mining and other economic activities [7, 4].

A distinctive feature of the Adyrs' climate is a sharp instability over the years. Spring in the foothills is mostly warm and rainy, but there are often snowfalls and cold weather; sometimes there is little or no precipitation. Summers are hot and dry.

The pastures of the adyrs of the Zerafshan basin are most suitable for grazing only in spring and partly in summer. In autumn, they are often unsuitable, because, unlike desert pastures, annual saltwort and wormwood grow poorly there.

The studied animals were divided into 9 age groups: 2-5, 30 days, 3, 6, 12 and 18 months, 2, 3, and 4 years. Age and breed were determined from records in the breeding and inventory books of farms. Age was additionally controlled by the teeth. All studied animals were female, of average body condition and strong constitution.

Newborn lambs were acquired during the mass lambing of sheep - in March-April. At the same time, 30-day, 12-month old sheep and 2, 3, 4-year-old sheep were purchased. 3-month-old lice were purchased in June, and 6- and 18-month old ones - in August and September.

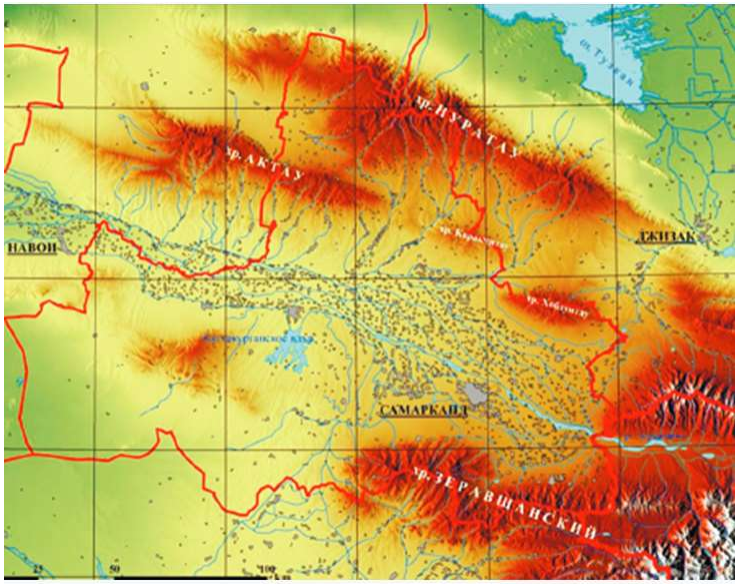

Figure 1. **Zerafshan valley** [4]

Before slaughter, the animals were weighed. The slaughter was carried out at the Department of Normal Anatomy of Farm Animals of the Samarkand Agricultural Institute, by cutting the prepared carotid artery. After slaughter, the skin was removed from the animals, the organs of the abdominal and pelvic cavities were removed, and the weight of the carcass was determined.

Age-related changes in the linear growth of bones (pelvic, femur, shin bones, tarsus, metatarsus and fingers) of the pelvic limb were studied.

The linear dimensions of the bones were determined using a measuring compass, a ruler and a measuring tape with divisions [3]. In order to follow the age-related changes in the bones, the processes, tubercles and other components of the ured.

To determine the age-related dynamics of bone growth, the growth rates were calculated by dividing the length, width, thickness and circumference of the bones of older animals by the corresponding indicators in younger animals, as well as in general for the entire studied postnatal ontogenesis according to the formula K = Vt / Vo, where TV - absolute bone indicators at the age ...; Vo is the initial absolute bone count.

When studying the pelvic girdle, the following were measured:

- the greatest length of the pelvis - from the crotch to the caudal protrusion of the ischial tuberosity;
- the width of the entrance to the pelvis (largest) - between the maclokovy hillocks;
- the average width of the pelvis (average diameter of the entrance) - between the ischial spines;
- the lower width of the pelvis (ventral diameter of the entrance) - between the ilio-pubic eminences;
- the width of the exit from the pelvis (diameter of the exit) - between the cranio-medial protrusions of the ischial tubercles;
- the height of the entrance to the pelvis - from the promontory of the sacrum to the pubic fusion;

- The height of the exit from the pelvis is vertical from the fourth caudal vertebra to the caudal edge of the pelvic suture.

When studying the skeleton of the pelvic limb, the following ratios were calculated:

- the length of the individual bones of the pelvic limb to their total mass and length;
- the width of the entrance to the pelvis, the average width of the pelvis, the width of the exit from the pelvis to its greatest length;
- width (latero-medal diameter) and thickness (dorso-volar diameter) of the middle of the diaphysis and epiphyses to the length of the corresponding limb bones.

The absolute bone data obtained as a result of the research were processed by the variational-statistical method. At the same time, the following were determined: the arithmetic mean (m), the standard deviation of the arithmetic mean (δ), the error of the arithmetic mean (± m), the coefficient of variability (C%), the reliability criterion (t). The degree of confidence (P) was found from the Student's table.

RESULTS AND DISCUSSION. Over the entire study period, that is, from 2-5 days to 4 years of age, the length of the free pelvic limb increases from 38.84 to 66.88 cm ($P < 0.05$) or 1.72 times. With age, the intensity of bone growth decreases. The greatest intensity of growth in length is noted at birth up to 30 days of age (K = 1.24). From 3 to 6 months, the growth rate decreases (K = 1.08) and remains unchanged until 18 months (K = 1.05). At the age of 2, there is another decrease in the growth rate (K = 0.95), which rises again by the end of the research (4 years, K = 1.04).

Bones of the pelvic girdle (cingulum membri pelvini). The pelvic girdle of Karakul sheep consists of two pelvic bones (os coxae) connected by a pelvic suture. The pelvic bone (pelvis) in the longitudinal direction for the period of development from 2-5 days to 4 years increases from 10.17 to 20.10 cm ($P < 0.05$) or 1.98 times. Moreover, the most intensively in the length of the pelvis grows from birth to 6 months (K = 1.31). Then the growth rate decreases by 18 months (K = 1.02) and does not change significantly in the future. The smallest growth rate is observed from 3 to 4 years (K = 0.96) (Figure 2).

The width of the entrance to the pelvis and the height of the exit from the pelvis increase intensively from birth to 6 months (up to 12.80 cm, K = 1.34; up to 4.23 cm, K = 1.22, respectively).

Of the transverse dimensions, the greatest slowdown in growth rates is observed at the width of the entrance to the pelvis from 6 to 12 months (K = 1.0), at the ventral diameter of the entrance to the pelvis from 3 to 4 years (K = 0.99), at the height of the exit from the pelvis from 30 days to 3 months (K = 0.97), at the height of the entrance to the pelvis from 30 days to 3 months (K = 0.97) and from 3 to 4 years (K = 0.94).

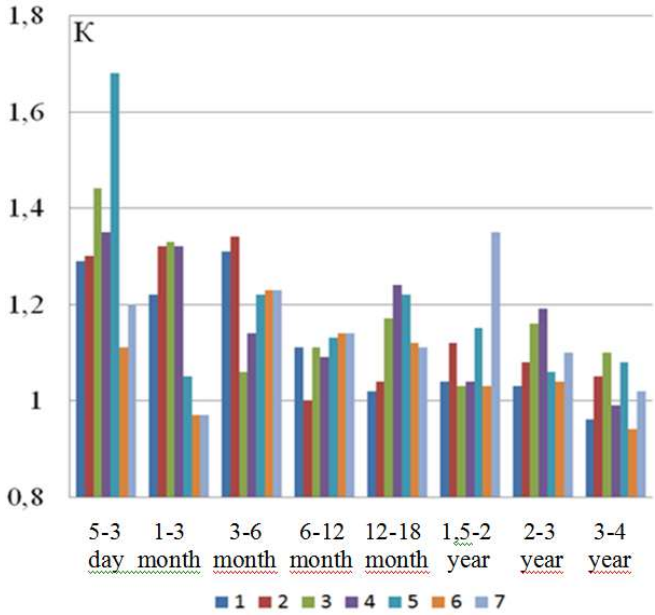

Figure 2. **Coefficients of linear growth of the pelvic bone**
1-greatest length of the pelvis, 2-greatest length of the pelvis, 3-average width of the entrance of the pelvis, 4-ventral width of the entrance of the pelvis, 5-pelvic outlet width, 6-height of the entrance of the pelvis, 7- pelvic outlet height.

The growth rate of the average entrance diameter is the highest from birth to 1 month (K = 1.44). Then it decreases to 6 months (K = 1.06) and, rising by 3 years (K = 1.16), decreases again. In the period from 3 to 6 months (K = 1.06) and 18 months to 2 years (K = 1.03), its growth rate is the smallest. The diameter of the exit is actively growing in the first month of life, bright (K = 1.68) and has the greatest increase than other indicators of the size of the pelvis. The growth rate then declines to 1.08 at 4 years of age. The growth rate of the largest width of the entrance to the pelvis increases up to 6 months (K = 1.34). Then there is a decline in the growth rate from 6 to 12 months (K = 1.0) and again an increase by 2 years (K = 1.12). This is followed by a sequential decrease in the growth rate to K = 1.05 at the age of 4 (Figure 2).

In general, during the period under study, of the transverse dimensions, the ventral diameter of the entrance to the pelvis (K = 4.18) grows most vigorously, then the diameter of the exit (K = 3.90) and the average diameter of the entrance to the pelvis (K = 3.49), the smallest the growth rate is characteristic of the height of the entrance to the pelvis (K = 2.03) (Figure 3).

In postnatal ontogenesis, the rate of growth of the pelvic bone in length (K = 1.98) is less than in diameter (Figure 2, 3).

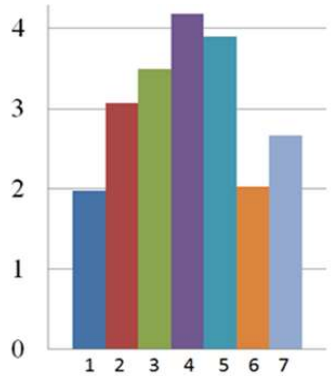

Figure 3. **Coefficients of linear growth of the pelvic bone from 2-5 days to 4 years**
1-greatest length of the pelvis, 2-greatest length of the pelvis, 3-average width of the entrance of the pelvis, 4-ventral width of the entrance of the pelvis, 5-pelvic outlet width, 6-height of the entrance of the pelvis, 7- pelvic outlet height.

The relative transverse dimensions of the pelvis to its length increase with age, except for the height of the entrance to the pelvis, which almost does not change with age (49.46% -50.75%) (Figure 4).

Femur (os femoris). From 2-5 days to 4 years, the femur increases from 9.80 to 18.00 cm (P <0.05), or 1.84 times (Figure 5). The highest intensity of longitudinal growth is observed from birth to 30 days of age (K = 1.27). Then it gradually decreases. The smallest growth rate in length of the femur is in 2-year-old sheep (K = 0.98). Despite the subsequent decrease in the growth rate of the femur, with age, its relative length to the length of the free limb increases (25.23% -26.91% (Figure 6). In thickness, the femur grows more intensively (K = 2.03) than in width (K = 1.92) and length (K = 1.84). Its relative transverse dimensions hardly change with age. The ratio of the circumference of the femur body to its length increases up to 3 months (from 31.63 to 33.5%), then, decreasing in 6-month-old lambs (27.34%), it increases again in adult animals, reaching 32.64%.

The length, width and depth of the acetabulum almost double with age (from 1.53 to 2.80 cm, from 0.73 to 1.63 cm, from 0.83 to 1.70 cm, respectively, P <0, 05). The distal epiphysis of the femur in width grows less intensively than the proximal (K = 1.44 and 1.69, respectively). In width, the intensity of growth of the proximal and distal epiphyses decreases from birth to 18 months (K = from 1.27 to 1.04 and from 1.23 to 0.98, respectively) and later remains relatively unchanged. The growth rate of the distal pineal gland is higher in thickness than in width (K = 1.6). With age, except for some periods of increase, it decreases.

Knee cap (patella). The length of the knee cap during the study period increases from 2.17 to 3.33 cm, or 1.53 times (P <0.05). The intensity of growth in length by 2 years gradually decreases (K = 1.24-0.94), and further by 4 years it slightly increases (K = 1.04). The width at the base increases by 1.80 times over the entire study period, and the thickness by 2 times. Consequently, the knee cap grows more vigorously in thickness than in width and length. Its relative length to the length of the femur decreases with age (from 22.14% to 18.50%), and its relative transverse dimensions, on the contrary, increase (width from 61.30% to 72.00% and thickness from 41.47 up to 54.05%).

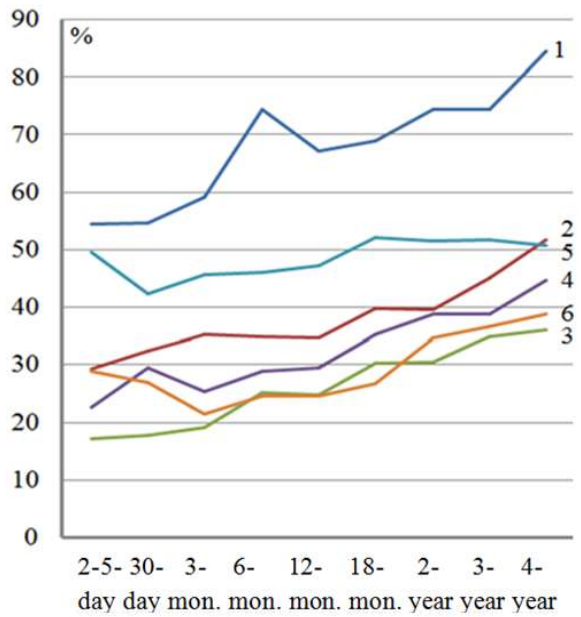

Figure 4. **Relative transverse dimensions of the pelvis to its length**
1-greatest width of the entrance of the pelvis, 2-average width of the entrance of the pelvis, 3-ventral pelvic entrance width, 4-pelvic outlet width, 5-height of the entrance of the pelvis, 6-height of exit from the pelvis

Shin bones (ossea cruris). The shin bones consist of the tibia and fibula, preserved as a rudiment.

Tibia (tibia). In the longitudinal direction, the tibia over the entire studied period of the animal's life increases from 11.37 to 20.57 cm (P <0.05), or 1.81 times (Figure 5). The greatest intensity of growth in length is observed from birth to 30 days (K = 1.25). Then, up to 2 years of age, the growth rate decreases (K = 0.91). From 2 to 4 years, the growth rate increases again (K = 1.06), but no longer reaches the value that was observed in the period up to 12 months (K = 1.11).

The relative length of the tibia to the length of the free limb slightly increases with age, in 18-month-olds (31.55%) it is greater than in animals of adjacent groups (Figure 6).

The proximal pineal gland in width (K = 1.35) grows weaker than in thickness (K = 1.83). The growth rate of the transverse dimensions of the proximal pineal gland decreases with the age of the animal. On average, the growth rate is the same in width and thickness. The greatest peak of growth is observed from 2-5 to 30 days (K = 1.13) and in 6-month-old lambs (K = 1.11).

The diaphysis of the tibia from 2-5 days to 4 years old increases in width by 1.60 times, and in thickness by 1.71 times (Figure 5), that is, it grows in thickness more vigorously than in width. With age, the intensity of growth of these indicators decreases and the greatest decline is observed from 18 months to 2 years (K = 0.95). The width of the distal pineal gland for the entire study period increases by 1.25 times. With age, the intensity of growth decreases, especially noticeably from 3 to 6 months (K = 0.99) and from 12 months to 2 years (K = 0.98).

The relative length of the fibula (fibula) to the length of the tibia is greatest in newborns (8.80%) and 12 month old lambs (8.03%), the smallest in 18-month-old (6.98%) and 4-year-old sheep (6.95%).

The bones are tarsus (ossa tarsi). The tarsus consists of three rows of bones: the proximal, including the talus and calcaneus, the middle, consisting of the tarsal central + fourth and fifth, and the distal, which includes the first tarsal and fused second and third bones.

The length of the tarsus along the medial edge for postnatal ontogenesis increases from 3.40 to 4.63 cm (P <0.05), or 1.36 times (Figure 5), and along the lateral edge - from 4.83 to 6, 10 cm, or 1.43 times. With age, the intensity of growth of the metatarsal bones both along the lateral (K = 1.17-1.03) and medial (K = 1.13-1.03) edges decreases. The growth intensity along the medial edge is the smallest from 3 to 6 months (K = 0.95) and from 18 months to 2 years (K = 0.97). The intensity of the growth of the tarsus bones in width decreases from birth to 18 months (K = 1.00) and then slightly increases (K = 1.06). In general, over the period under study, the growth rate of the transverse dimensions of the tarsus is almost the same: the width and thickness increase by 1.30 times. Consequently, the bones of the tarsus in width and thickness grow less intensively than in length.

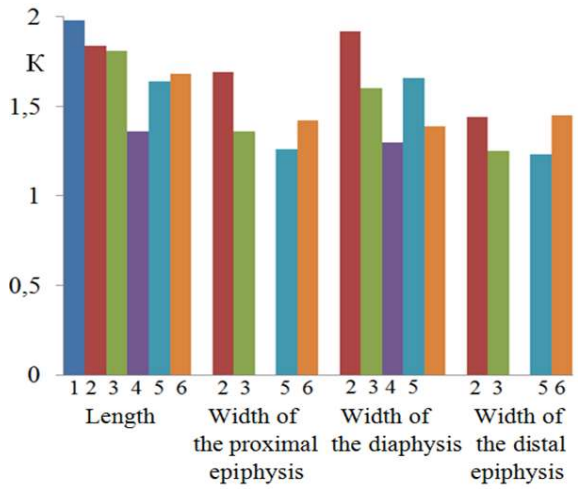

Figure 5. **Coefficients of linear dimensions of individual bones of growth of the pelvic limb from 2-5 days to 4 years**
1-pelvis, 2-femoris, 3-tibia, 4-tarsal bones, 5-metatarsal bone, 6-finger bones

The relative length of the bones of the tarsus to the length of the limb, both along the lateral and medial margins, decreases with age, and their lowest relative size is noted at 6 (6.87%), 18 months (6.89%), and at 4 years of age (6,92%; Figure 6).

Metatarsal bones (metatarsi). The third and fourth metatarsal bones are fused into one tubular (metatarsal) bone. During postnatal ontogenesis, the metatarsal bone increases in length from 8.80 to 14.47 cm (P <0.05), or 1.64 times (Figure 5). The highest growth rate is observed from birth to 30 days of age (K = 1.23), then decreases by 3 months (K = 1.07) and does not change significantly until 18 months, and from 18 months to 2 years, its growth rate again decreases markedly (K = 0.88). The relative length of the metatarsal bone and the length of the free pelvic limb decreases from birth to 6 months (from 22.66% to 21.30%; Figure 6) and further is relatively the same in all age groups.

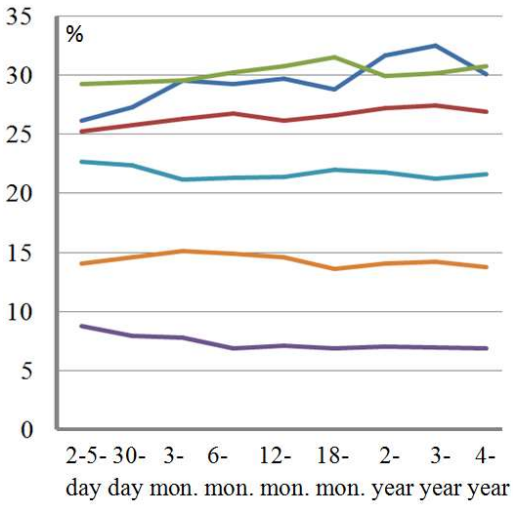

Figure 6. **The relative length of bones to the length of the limb**
1-pelvis, 2-femoris, 3-tibia, 4-tarsal bones, 5-metatarsal bone, 6-finger bones

The width of the proximal pineal gland over the entire study period increases by 1.26 times (Figure 5).The growth rate of the proximal pineal gland in width decreases from 3 to 6 months (K = 1.06) and increases by 12 months (K = 1.12). The smallest growth rate was observed from 18 months to 2 years (K = 0.81). In general, the growth rate throughout the life of the animal is relatively the same.

From 2-5 days to 4 years, the width in the middle of the diaphysis increases by 1.66 times, and the thickness by 1.5 times. In general, the metatarsal bone grows longitudinally as well as across (Figure 5). From 3 to 6 months (K = 1.04), from 2 to 3 years, the width of the diaphysis increases more intensively (K = 0.95), and from 3 to 4 years - its thickness (K = 1.17).

The width of the distal pineal gland for the entire study period increases by 1.23 times, which is slightly lower than the growth rate of the proximal pineal gland. However, the intensity of growth of the distal pineal gland in width at the age of up to 6 months (K = 1.13) and from 18 months to 2 years (K = 1.08), on the contrary, is higher.

Finger bones (ossa digitorum). The toe consists of the proximal (fetal), medial (coronary), and distal (claw) bones. Over the entire studied period of development, the length of the toe increases from 5.47 to 9.21 cm ($P < 0.05$), or 1.68 times (Figure 5), that is, its growth rate is higher than that of the metatarsal and metatarsal bones.

The intensity of the longitudinal growth of the entire finger is greatest from birth to 30 days (K = 1.29), then it decreases to 18 months (K = 1.00), later rising again, but no longer reaching the growth rate of the finger bones of young animals. The smallest relative length of the fingers is noted at 3-4 years (6.80% -6.82%), the greatest - from 30 days (8.03%) to 3 months (7.94%; Figure 6).

CONCLUSIONS

1. Over the entire study period, that is, from 2-5 days to 4 years of age, the intensity of linear growth of the pelvic limb bones decreases. The highest growth rate is observed at birth up to 30 days of age. From 3 to 6 months, the growth rates decrease and remain unchanged up to 12 months. From 12 to 18 months, another decrease in growth rates is observed and remains so until the end of the research.

2. The slowdown in growth in length of the entire pelvic limb begins earlier - from 12 to 18 months and stops in 4-year-old sheep. The transverse dimensions of the pelvis grow more intensively than the longitudinal dimensions. The length of the free pelvic limb increases more intensively than the transverse dimensions of the diaphysis and epiphyses.

3. Over the entire studied period and in the first month of the animal's life, the bones of the tarsus have the lowest growth rate in length, then the rate of bone growth increases in the proximal and distal directions. In other age groups, this pattern of growth of certain bones is violated.

4. The greatest relative length to the length of the free pelvic limb is possessed by the pelvic, tibia, femur, metatarsal, finger bones and metatarsal bones. The relative length of the pelvic, femoral, femur and metatarsal bones to the length of the free pelvic limb increases with age, and decreases in the metatarsal and finger bones.

5. Age-related changes in the relative linear dimensions of bones directly correlate with changes in the intensity of their growth. Changes in the ratio of the width, thickness of the diaphysis and epiphyses of bones to their length, as well as changes in the constituent elements (tubercles, processes) are apparently due to functional changes in the muscles acting on them.

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