# MORPHOMETRIC PARAMETERS OF THE ELEMENTS OF THE KNEE JOINT UNDER THE INFLUENCE OF EXPERIMENTAL HYPOTHYROIDISM

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***Abstract.*** *Today, the number of patients with hypothyroidism among thyroid gland diseases is increasing. Decreased activity of the thyroid gland, more precisely, low concentration of thyroid hormone in the blood, leads to the derailment of metabolism in the body, and as a result, to some extent, the development of pathological changes. Its hypofunction originates and occurs due to several factors: gland injuries, tumor and cystic diseases, pituitary-hypothalamic system disorders, gland development defects, surgical intervention errors, long-term use of thyrostatic drugs, etc. Hypothyroidism is widespread among the population, iodine deficiency is one of the regional problems for our country.*

*This article describes the morphometric changes of the elements of the knee joint during early ontogeny in offspring born to mothers with experimental hypothyroidism during pregnancy. Experimental hypothyroidism model and research results allow early detection of morphofunctional changes of knee joint elements in offspring born from this disease and prediction of complications.*

***Keywords:*** *experimental, hypothyroidism, elements of the knee joint, morphometry, bone-muscle, tendon, uncle, dysplasia, thyroid hormones.*

**Relevance**

As a result of many years of research in the world, scientists have achieved a number of important practical results. Among the diseases of the thyroid gland worldwide, hypofunction of the thyroid gland occupies the first place. According to the World Health Organization, thyroid diseases occur in many patients. Hypothyroidism affects all organs and systems. The lack of a fundamental system of knowledge about the morphofunctional characteristics of the bone-joint system of the free part of the foot leads to serious shortcomings and errors in the prevention and treatment of injuries and deformations in this area. Thus, solving these problems is not only scientific, but also practical.

Despite the radical changes in this direction, many aspects of this problem are still not fully revealed. Thus, information on the functional anatomy of the tendon system and tendon apparatus is scarce and contradictory, and there is no information on the micromorphology of tendons and their attachment to bone, structural and biomechanical mechanisms. At the same time, it is important to determine the morphological features of the muscle-joint system of the large joints, to determine its least stable areas, age periods of injury risk, and biomechanics of injuries.

All of the above allows us to draw a conclusion about the small knowledge, the problem we are developing and the prevalence of deformities and limb injuries and their lack of morphofunctional justification.

The results can complement the information in the field of functional morphology of the musculoskeletal system. At the same time, they will expand their views on the etiology and pathogenesis of tendovaginitis and enthesopathy and will be important in developing measures to correct their prevention and treatment methods; it is also important in deciphering X-ray data about the structural and functional state of a certain area.

Based on the above, there is a need to organize systematic information about the structural and functional characteristics of the knee joint.

**The purpose of the study.** Study of morphometric indicators of knee joint elements under the influence of experimental hypothyroidism

**Materials and styles.** The experiments were carried out on 114 white laboratory rats with a body weight of 120-200 g in accordance with the ethical standards and recommendations for the humane treatment of laboratory animals, reflected in the European Convention for the Protection of Vertebrate Animals Used for Experimental and Other Scientific Purposes. The animals were kept in standard vivarium conditions in natural light, on a standard diet of laboratory animals.

It is carried out to determine the general patterns and topical features of the microorganism of the bone-ligament joints of the knee joints.

Samples of 4-5 mm size were separated from tendons, and 5-8 mm pieces were separated from bone-tendon joints. The material was recorded in a 5% solution of neutral formalin. Bone-joint specimens decalcified in 5% nitric acid solution for 36 hours, then treated with 5% kvast (carnois) solution. During the day, the bone-joint samples were washed in running water, dehydrated in high-concentration alcohols: 50, 70, 96, 100% and embedded in wax paraffin. Sections with a thickness of 8-10 microns were prepared from paraffin blocks on a universal microtome. Sections were counterstained in xylene and stained with hematoxylin and eosin and Van Gieson. Morphometry of the structures was performed under an MBI-15 microscope.

Conducting experiments, using experiments on animals, without going beyond the framework of legal regulations and the global convention (on the protection of vertebrate animals, 1997) was fully followed. Rats were placed in vivarium conditions in special metal cages, no more than 5 animals in each. Experiments were conducted during the spring and autumn seasons. Each animal was fed a fixed standard diet. Sexually mature rats were kept in separate cages from the 16th to the 18th day of pregnancy. For morphological studies, animals are decapitated using ether anesthesia with chloroform.

The knee joint elements of the animals were isolated for histological examination. Bone tissue samples were fixed in 10% formalin solution and then embedded in paraffin. A 10-μm-thick histological section was prepared and stained with hematoxylin-eosin, Van Gison, Masson, and picrofuchsin with histochemical SHIK reaction.

**Research results.** Experimental materials obtained from the elements of the knee joint of control group rats with experimental hypothyroidism were subjected to morphometric examination.

The results of the determination of thyrotropin, T3 and thyroxine in the blood serum of the experimental group of animals indicate the development of hypofunction of the thyroid gland. After taking mercazolil, a decrease in T3 and thyroxine secretion was observed against the background of increased thyrotropin levels.

***Table 1.***

***Thyroid hormones in serum of experimentally hypothyroid rats***

| Hormones | Control group, n = 10 | Experimental group, n = 18 | P |
|---|---|---|---|
| Thyrotropin, μME/l | 1.12±0.098 | 1.89±0.092 | < 0.005 |
| Total thyroxine, nmol/l | 77.2±3.26 | 59.8±2.38 | < 0.05 |
| Total triiodothyronine, nmol/l | 2.94±0.16 | 1.67±0.095 | < 0.005 |

Determination of the content of markers of bone tissue metabolism in the blood serum of the experimental group of rats shows clear changes (Table 2). The level of β-CTX, a marker of bone resorption, and the marker of bone formation, bone alkaline phosphatase, are statistically significantly reduced, reflecting the slowing of remodeling processes, which ultimately leads to a decrease in bone mass [3, 5].

***Table 2.***

***Indicators of mineral metabolism and composition of markers of bone tissue metabolism in experimental hypothyroidism in rats.***

| Indicators | control group,n=10 | Experimental group, n = 18 | P |
|---|---|---|---|
| Total Ca, mmol/l | 2.25±0.090 | 2.02±0.085 | < 0.1 |
| P, mmol/l | 1.84±0.044 | 1.68±0.054 | < 0.1 |
| Mg, mmol/l | 0.92±0.058 | 0.81±0.041 | < 0.1 |
| Bone alkaline phosphatase, Me/l | 6.4±0.54 | 4.8±0.32 | < 0.05 |
| β-CTX, ng/l | 0.90±0.05 | 0.76±0.029 | < 0.05 |

A sign of bone formation, osteocalA statistically significant correlation was found between zinc and free thyroxine, which confirms the direct effect of thyroid hormones on the functions of osteoblasts. Thyroid hormones act on osteoblasts through the nuclear receptor signaling system, which induces the expression of receptor activator of nuclear factor κB ligand (RANKL), which then binds and activates RANKL receptors on osteoclast precursors, leading to the stimulation of osteoclastogenesis.

There were no statistically significant changes in the content of calcium, phosphorus and magnesium in the blood serum of animals suffering from hypothyroidism, but a tendency to decrease their levels was revealed.

This fact correlates well with modern concepts, according to which the accumulation of total GAGs is closely related to the increase in the strength properties of connective tissues. When we studied the structural organization of the transverse annular folds that fix the apophyses of the bones, we found that their tissue is fibrocartilaginous. Studying the distal parts of the joint reveals the presence of Sharpei fibers flowing into the periosteum, their fibrous skeleton is weakly eosinophilic, and the collagen fibers are mainly straight-oriented, cytoplasm-rich, oval-shaped cells with a rounded nucleus and are grouped together.

However, the results of studies show that with the development of hypothyroidism, bone remodeling and mineral metabolism disorders are not only the result of the direct effect of thyroid hormones on osteoblasts and osteoclasts. They may also be associated with other movement mechanisms.

The assessment of the body condition, which is carried out according to this table, ends with the collection of points and the release of the total value. The obtained value is compared on the scale of threshold values and the severity of morphometric changes is determined, as well as the further development of para-articular structures is predicted.

**Conclusion.** The interpretation of morphometric, histochemical, laboratory data obtained during the study made it possible to establish the concept of hypothyroidism as a risk factor for knee joint deformities.

Histological and histochemical changes detected in the elements of the knee joint may indicate serious disorders in the formation of these joint components and cause the development of dysplasia. Therefore, changes in the components of the knee joint are more clearly expressed negatively than hypothyroidism, these changes lead to incomplete development of the joint.

The knee joint has been morphologically studied by few researchers. At the same time, the condition of the knee joint tissue is important in terms of its transformation and regeneration possibilities after knee joint correction.

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