Features of the Macroscopic Picture of the Femoral Head in Dysplastic Coxarthrosis

Akhmedov Shamshod Shavkatovich, Hamraev Behzod Uktamovich
Bukhara State Medical Institute

ANNOTATION

dysplastic coxarthrosis is a degenerative-dystrophic disease due to congenital underdevelopment of the hip joint. The study of the etiopathogenesis of this disease allowed us to establish that the main factors contributing to its development are congenital progressive biomechanical imbalance. For an orthopedic practitioner, the determination of the X-ray anatomical features of a dysplastic hip joint and possible biomechanical disorders are necessary to choose the tactics of surgical treatment of coxarthrosis, because the choice of the acetabulum and femoral components of the endoprosthesis depends on the degree of dysplastic disorders.

KEYWORDS: *Dysplastic coxarthrosis, hyaline cartilage, morphology of the femoral head.*

Relevance: dysplastic coxarthrosis is a degenerative—dystrophic disease due to congenital underdevelopment of the hip joint, in which the deformation of the articular ends of the bones manifests itself in a change in the shape and depth of the acetabulum, a change in the cervical-diaphyseal angle and the proximal femur [1]. Residual defects in the development of the hip joint after conservative and surgical treatment are the main cause of dysplastic coxarthrosis in 10-60% of cases. The study of the etiopathogenesis of this disease allowed us to establish that the main factors contributing to its development are congenital progressive biomechanical imbalance and local overload of chondral and subchondral structures of the joint. The higher the degree of mechanical overload associated with the underdevelopment of the mutually supporting zones of the femoral head and the roof of the acetabulum, the faster the breakdown of the resistant capabilities of the joint occurs. Kamosko (2005) considers dysplastic coxarthrosis as a response of tissue structures to an imbalance between load and resistance to it, first of articular cartilage, and then of all joint structures as a result of anatomical and functional inconsistencies. Moreover, the severity of the degenerative-dystrophic process is due to the localization of areas of hyperpression, changes in the size of the bearing surface of the joint, the duration of chronic overload.

The trigger mechanism for the development of any type of coxarthrosis, as well as dysplastic, is changes in the parameters and morphology of hyaline cartilage. As a result of numerous studies, it has been found that cartilage degeneration increases with the progression of the stage of the disease, and degeneration of the cartilage of the cavity contributes to the development of a similar process in the femoral head [2.4]. In dysplastic coxarthrosis, pronounced deformation of the acetabulum and proximal femur leads to discongruence and biomechanical inferiority of the joint [3,5]. It is the anatomical and biomechanical failure of articular surfaces that leads to the development of secondary arthrosis mainly in people over 30 years old [6,7]. Crowe et al. proposed a classification (1979), which is based on an assessment of the level of cranial displacement of the femoral head and includes four types. The authors assumed that on the radiograph of normal hip joints, the lower border of the tear figure and the place of transition of the femoral head to the neck are at the same level, and the height of the head is 20% of the pelvic height. With Crowe type I, the proximal displacement of the head is up to 50% of the head height or up to 10% of the pelvis height, with type

II — 50-75% of the head height or 10-15% of the pelvis height, with type III — 75-100% or 15-20%, respectively. Type IV according to Crowe is characterized by a proximal displacement of the head of more than 100% or more than 20% of the pelvic height. Due to the digital parameters, the Crowe classification is clear and unambiguous, but it does not fully take into account changes in the acetabulum depending on the degree of dysplasia, which is important for planning the installation of the acetabulum component of the prosthesis. The objective interpretation of the degree of dysplastic coxarthrosis is quite complex and requires good knowledge of possible dysplastic changes in the hip joint, which are caused by some pathogenetic features of the disease. Anatomical and pathogenological features of the hip joint in dysplastic coxarthrosis of varying severity are described. In dysplastic coxarthrosis of type I–II, taking into account the Crowe classification, the following were noted: a decrease in the index of the acetabulum by 16% and the angle of the Viberg by 28%; narrowing of the cerebral cavity and a decrease in the length of the femoral shoulder by 6 %; an increase in the Sharpe angle by 12% and the cervical-diaphyseal angle by 6%. Dysplastic coxarthrosis type III is characterized by the progression of dysplastic manifestations; there is a defect in the roof of the acetabulum; the head of the femur articulates with the true and false acetabulum. Dysplastic coxarthrosis of type IV is characterized by maximum damage to the bone structures of the hip joint; the acetabulum is flattened; but the deficit of the roof of the acetabulum is insignificant; neoarthrosis is formed, isolated from the true cavity [8,9]. Abnormal redistribution of stress forces in the hip joint in dysplasia leads to overload of the ilio-femoral ligament and excessive pressure in the cartilaginous lip ("acetabular stress"), which causes degenerative changes in the ligamentous apparatus, the appearance of foci of calcification in microtrauma. The prolonged course of the process of dysplastic coxarthrosis can lead to dystrophic changes in innervating nerve trunks and fibers. Abnormal structure of collagen in dysplastic coxarthrosis causes structural changes in the vascular bed in the hip joint: weakness, tortuosity and overgrowth of the walls of arteries and veins, a decrease in the number of anastomosing branches. All these structural changes lead to a decrease in the level of blood supply to the hip joint, to reversible capillary stasis at the microvascular level, and an increase in local tissue hypoxia [10]. In dysplastic coxarthrosis, all muscle groups of the hip joint are characterized by weakness, reduced ability to contract, and degenerative changes in the fibers. In addition, anatomical and biomechanical features of dysplastic coxarthrosis contribute to the convergence of attachment points of muscle fibers in the abductor muscle group, which causes their positional weakness. In dysplastic coxarthrosis, the fundamental point is the violation of biomechanics in the joint and the redistribution of forces that ensure the centralization of the head and stability in the hip joint. For an orthopedic practitioner, the determination of the X-ray anatomical features of a dysplastic hip joint and possible biomechanical disorders are necessary to choose the tactics of surgical treatment of coxarthrosis, because the degree of dysplastic disorders determines the choice of the acetabulum and femoral components of the endoprosthesis, as well as the conduct of total endoprosthesis, which is the "gold standard" of treatment, in combination with the necessary additional techniques, such as plastic roof of the acetabulum to fill its deficit, shortening osteotomy of the femur in order to minimize traction damage to paraarticular tissues and restore the length of the limb.

Material and methods. Femoral heads were examined after total hip replacement (TETS) from 42 patients diagnosed with dysplastic coxarthritis. (women – 29, average age – 61.3 years; men – 123, average age – 52.4 years). In the process of cutting out the material for histological examination, attention was paid to the macroscopic picture of the femoral head. The fixation of the material was carried out in 10% formalin. After decalcification, paraffin sections were stained with hematoxylin and eosin, hematoxylin and picrofuxin.

The results of the study. The studied material made it possible to identify a number of morphological conditions in the main areas studied, namely: articular cartilage, subchondral bone, marginal zone of the cartilaginous plate, cortical plate of the neck, spongy bone. The morphology of tissues divided into three groups has been determined in the articular cartilage. Articular cartilage is characterized by uneven thickness in different parts, the absence of a cell-free zone. The stratification of groups of chondrocytes, their orientation, multidirection, together with the fibrillar component – collagen fibers, with respect to the thickness and extent of the cartilaginous plate is disrupted. Fragmentation of cartilage tissue on the surface with the separation of tissue complexes in the form of gaps in deep sections. Discomplexation of structural components in the thickness of articular cartilage.

The boundary line disappears.

In the subchondral bone, it is necessary to isolate the zone of enchondral osteogenesis, since it largely determines the morphology of the progression of coxarthrosis. In this zone, areas of completed and incomplete ostegenesis are identified. Completed osteogenesis is determined by the presence of a plate of bone tissue separating cartilage tissue from bone marrow structures with vessels, endostomes. Incomplete osteogenesis is revealed in the form of two variants of structures: a – vascular penetration. from bone marrow to articular cartilage with areas of bone resorption, altered cartilage tissue and areas of enchondral osteogenesis; b – preservation of cartilage tissue in adjacent bone beams of the zone of enchondral osteogenesis, the presence of newly formed cartilage tissue in these areas. In the spongy bone of the femoral head, osteoporosis is determined; fatty and hematopoietic bone marrow; newly formed connective tissue; chronic osteomyelitis; foci of necrosis, myxomatosis, psevodocysts. The revealed morphological changes in the tissue complex during the formation of dysplastic coxarthrosis allow us to consider the morphogenesis of osteoarthritis as an interaction of cartilage, bone tissue, tissues of the marginal zone of the femoral head, bone marrow structures of the zone of enchondral ossification, vessels and connective tissue. The morphological basis of this interaction is determined by the essential role of vessels performing not only trophic (service), but also morphogenetic function. It is characterized by the germination of blood vessels, pericytes, connective tissue cells from the bone marrow into the articular cartilage. This is accompanied by resorption of cartilage tissue, enchondral osteogenesis or lack of osteogenesis; the tissue complex reaches the surface of the cartilage plate. Connective tissue with vessels – fibroblasts, collagen fibers on the surface of the cartilage plate on the one hand provide resorption of cartilage tissue, and on the other hand, up to a certain time, form the articular surface. The progression of incomplete osteogenesis – the growth of vessels and pericytes into the cartilaginous plate with the resorption of cartilage tissue from the bone marrow and the resorption of cartilage tissue from the panus – leads to the separation of articular cartilage into separate fragments, the replacement of hyaline cartilage with connective tissue. In the marginal zone of the articular surface of the femoral head, the restructuring of the tissue complex leads to the proliferation of connective tissue, displacement of the synovial lining and obliteration of the joint cavity. Fractures are detected in the area of interaction of the hyaline cartilage of the joint with the subchondral bone. This leads to a displacement of tissues relative to their initial positions. Subsequently, during the healing processes – the fusion of morphogenetically closely related tissues – a kind of histotectonics and anatomical deformation of the femoral head is carried out. Obliteration of the joint cavity leads to the formation of contractures, restructuring of tissues in the hip joint.

Conclusion: The above makes it possible to evaluate morphological changes in the femoral head in dysplastic coxarthrosis based on the understanding that this complex of tissues carrying a supporting function is associated with gravity. As a result, in the morphogenesis of dysplastic coxarthrosis, along with vessels, a significant place belongs to mechanomorphosis, which determines the behavior of tissues. Based on this, it is possible to choose the optimal method of endoprosthetics for dysplastic coxarthrosis.

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