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Morphofunctional Prerequisites for the Development of Hip Joint Pathologies

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Abstract The hip joint is one of the important organ-specific systems of the pelvic limb, whose participation in the locomotor act of the animal plays a leading role. The discovery of the basic patterns of biomechanics of the hip joint is one of the fundamental tasks of clinical morphology, since the number of diseases of this joint of post-traumatic and hereditary origin is steadily increasing. Studies devoted to clarifying the species-specific features of this joint remain particularly relevant, in particular, and the lack of generally accepted definitions in deciphering the morphobiomechanical prerequisites for the development of joint pathologies is a consequence of insufficient knowledge of the structural and functional status of the joint under normal and pathological conditions.

Keywords Hip joint, Joint pathologies, Functional status of the joint, Norms and pathologies

1. Introduction

Currently, there are known methods of surgical treatment of hip dysplasia, such as resection arthroplasty, triple pelvic osteotomy, total arthroplasty, scallop muscle myotomy and myectomy, joint capsule denervation, etc. Despite the well-known effectiveness of these operations, some of them involve high traumatization of the structures of the joint and adjacent organs, which is inevitably associated with a long rehabilitation period and a high risk of postoperative complications. Minimally invasive interventions such as scallop muscle myotomy or myectomy and joint capsule denervation are not effective enough, as they are symptomatic and have temporary success, since they are primarily aimed at relieving pain. At the same time, due to the fact that hip dysplasia is diagnosed only in the presence of pronounced destructive changes in the joint components based on an X-ray examination of the joint, prognostic criteria for the development of this disease have not been developed. There is no doubt that information about the structural and biomechanical characteristics of the hip joint, based on the analysis of the functional anatomy of individual muscle groups that ensure the biomechanical perfection of the locomotor act and are the first to be involved in arthropathies of hereditary determination and post-traumatic genesis, is fundamental in the development of new methods of surgical correction of dysplasia of this joint [2,4,6,8,10].

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2. Results and Analyzes

The patterns of functional morphology of the hip joint have been established. On this basis, the morphofunctional prerequisites for the development of its dysplasia have been scientifically substantiated. A new rational method of surgical correction of hip dysplasia has been developed, based on an analysis of the patterns of functional morphology, topographic features of articulation and biomechanics of the locomotor joint, which is minimally invasive and highly effective in the treatment of this pathology. Based on the fact that the spiral deformity of the femur in hip dysplasia has a hallux valgus component, an increase in the cervical-diaphyseal angle leads to a shift in the level of the large trochanter below the main axis of rotation of the joint. Thus, the gluteus medius and biceps, acting in opposite directions, are fixed on a kind of lever of the 2nd kind on one side of the fulcrum of the hip joint. In this biomechanical design, the femoral neck acts as a similar lever, where the opposing forces are the gluteus medius muscle and the external lock with twin muscles. Protecting the joint from destruction, the amplitude of hip movement, however, having a large mass of the limb and a large amount of muscular strength, it gradually begins to injure the group of latchers with the action of the middle gluteus muscle, and then the middle gluteus itself with the action of the biceps femoris muscle. Acetabulum dysplasia is one of the causes of congenital hip dislocation. Underdevelopment of the acetabulum in dislocation and subluxation. It indicated the presence of undulation of the contours of the upper edge of the acetabulum in normal one-year-old children. With congenital dislocation of the hip, a similar phenomenon is detected at 3-4 years of age, and later ossification is noted. The acetabulum loses its

ability to develop further in conditions of dysplasia. Along with acetabulum dysplasia, there is a violation of its spatial orientation - frontal inclination. With hip dysplasia and congenital hip dislocation, there are disorders of the proximal femur. I found that the rotation of the entire proximal femur, called torsion, exacerbates the pathology. The cause of pathological torsion of the proximal femur is considered to be a change in the function of m. llio-psoas [1,3,5,7,9,11].

Most orthopaedists believe that in 2/3 of cases with congenital hip dislocation there is increased antetorsion, leading to decentration of the femoral head, which leads to impaired development of the acetabulum and roof, joint instability, and subsequent development of dysplastic coxarthrosis. Their material has shown that if by the time treatment for congenital hip dislocation is completed, antetorsion of more than 45° persists. in 90% of cases, anterior subluxation occurs. An increase in the cervical-diaphyseal angle in dysplasia and congenital hip dislocation has been noted. It is believed that walking is an important factor in the normal development of the cervical-diaphyseal angle. Studying the X-rays of children treated in a diverting splint, we noticed that most of them had an increase in LSD on both the sick and healthy sides. He explained the mechanism of the increase in the cervical-diaphyseal angle by the weakness of the middle and small gluteal muscles, as well as the horizontal location of the epiphyseal growth zone of the femoral head. When the growth zone of the large trochanter is irritated, elongation and valgus deformation of the femoral neck are formed, and when the ossification point of the head is destroyed, the neck thickens and assumes a varus position. Normally, in all people of different ages, until the head growth zone is completely closed, its growth plate in the frontal plane is perpendicular to the mechanical axis of the trunk load, despite the difference in the size of the pelvic and hip bones. Corrective operations at the proximal end of the thigh must achieve its perpendicular position to the axis. It is believed that a flat depression leads to an increase in the cervical-diaphyseal angle. I noticed that the value of the cervical-diaphyseal angle gradually decreases starting from the age of one year. After ossification of the epiphyseal cartilage, valgization ends, and varicose veins last a lifetime [7,9,11]. Deformity of the femoral head and its underdevelopment were noted. In cases of high dislocations, the size of the ossification core significantly lags behind the norm, the shape of the femoral head may change, over the years it takes the form of a "drop" of the cap on one side, shortening and widening of the femoral neck are noted. Hip head hypoplasia in hip dysplasia increases its sensitivity to various types of injuries, including reduction, with the subsequent development of the dystrophic process. Most researchers associate the development of the dystrophic process with impaired blood supply to the femoral head as a result of vascular injury during reduction and reduced stability of the dysplastic joint. A number of authors point to the onset of compression of the femoral head as a result of prolonged, non-physiological hip position due to decentration, subluxation of the head, immobility due to prolonged immobilization, as well as significant repositional trauma, especially with simultaneous forcible reduction. Most authors note the phasicity of the course of the dystrophic process, distinguishing from three to eight phases. The dystrophic process can develop both during the treatment of dysplasia, hip dislocation, and in the long term, which confirms the need for medical examination of children with hip dysplasia. Histological examination revealed foci of destruction, fragmentation of the ossification core. Hip joint tissues under the influence of adverse factors, such as simultaneous reduction, prolonged immobilization in a forced position. Micro- and macroscopic examination revealed that the dystrophic process of the femoral head proceeds without the phenomena of aseptic necrosis [2,4,6,8,10]. A number of stability indices have been proposed to assess the spatial relationship between the proximal femur and the acetabulum. The most important are: the orientation of the mechanical axis of the femoral neck, which makes it possible to differentiate dislocation, subluxation, and decentration of the femoral head in the cavity; the angle of vertical alignment determines the stability of the hip joint in the vertical plane; the degree of bone coverage of the head by the roof characterizes the stability of the hip joint in the frontal plane. The degree of coverage of less than 2/3 indicates instability of the joint in the frontal plane due to lateroposition of the head, or insufficient development of the roof of the acetabulum. The magnitude of the pathological torsion of the proximal femur determines the stability of the joint in the horizontal plane.

Contrast arthrography of the hip joints has become widespread in clinical practice, which makes it possible to assess not only the condition of the bone components of the joint, but also the cartilaginous and soft tissue ones. The arthrogram shows the cartilaginous head, the arch of the acetabulum with a limbus, the bottom of the acetabulum, the capsule of the joint, its turns, and the attachment points of the capsule to the acetabulum and femoral neck. The relationship between the cartilaginous head of the femur and the acetabulum is determined. It is possible to determine the condition of the soft tissue and cartilaginous elements of the hip joint. According to the literature, the best treatment results for congenital hip dislocation, up to complete cure, can be obtained with early functional treatment from the newborn period. However, it is known that 10-20% of cases, even with early functional treatment, end in failure. The majority of clinicians attribute the failures of this treatment method to the age of initiation of treatment and the anatomical and topographic conditions of the subsequent development of the hip joint. With treatment initiated in the first half of life, the roof of the acetabulum develops in 96% of cases, from one to two years - in 55%, and over two years - in 20%. In the last twenty years, in our country and abroad, the treatment of children with congenital dislocation with "overhead" traction, which was proposed.

As a result, the increasing pronation of the femur induces the destruction of the pelvic articular cavity. The data we obtained were used to develop an operative method for the

treatment of hip dysplasia through extraarticular myoplasty of the gluteus medius muscle and its transposition above the level of the main axis of rotation. It is associated with low injury to paraarticular tissues, which leads to a significant reduction in the rehabilitation period, duration of surgery and a reduction in the risk of postoperative complications.

3. Conclusions

Due to the fact that hip dysplasia is diagnosed only in the presence of pronounced destructive changes in the components of the joint based on an X-ray examination of the joint, prognostic criteria for the development of this disease have not been developed. We tend to believe that topical changes in the level of the large trochanter are a kind of prognostic test that must be taken into account when developing tactics for the treatment and prevention of this pathology.

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