METHODS OF DIAGNOSIS AND OPTIMAL KNEE JOINT RECURREXION CORRECTION IN CHILDREN WITH CEREBRAL PALSY

Knee joint recurvation is among motor disorders in patient with infantile cerebral paralysis (ICP). The work was initiated to define methods for diagnosis and correction of knee joint recurvation in 23 patients with ICP. Knee joint recurvation in the infantile cerebral paralysis can arise either from weakness of tendo-ligamentous component of the segment or due to pathological contractures in the adjacent lower extremity’s joints. The suggested method to diagnose knee joint recurvation is expedient in determination of mechanisms of deformity development and its differentiation primacy. Analysis of orthopedic and surgical methods of management demonstrated their efficacy and necessity of their timely performance with recurvation variants and the deformity severity taken into account.

Keywords: Equinovarus, infantile cerebral paralysis, knee joint recurvation.

UDC: 616.8+616-053.2+616-036.82/.85

Background

Muscular hypertonicity caused by muscular tonicity dysregulation of the central genesis underlies orthopedic pathologies in infantile cerebral paralysis (ICP) (Bosykh, 2003; Yavorskiy et al., 2003; Gage, 2004). With all this muscular spasticity of the extremities joint deformities with typically reduced tonicity of a muscle or a group of muscles belonging to one segment occur. Knee joint recurvation is among motor disorders in ICP patient (Kutuzov, 1996).

Both medical and surgical methods of orthopedic treatment are used upon rehabilitation of ICP patients with the knee joint recurvation (Belova, 2000; Bosykh, 2003; Doderlain and Wolf, 2004, Gage, 2004). Any method for knee joint recurvation used, it should be pathogenetically analyzed and biomechanically substantiated, being reproducible and complex (Belova, 2000).

There are only few publications on factors of knee joint recurvation in ICP patients as well as on methods of its diagnosis and correction, no information about common management tactics available (Bosykh, 2003; Kutuzov, 1996).

Occurring in healthy children, physiological knee joint recurvation up to 10° is known to be compensated in walking due to full range of motion in other joints (Vitenzon, 1998; Yavorskiy et al., 2003). Questions why joint recurvation cannot be self-eliminating in ICP patients and what hinders the process remain unanswered.

Unfortunately, isolated literature data does not allow determining course of medical and rehabilitative measures upon knee joint recurvation in ICP patients. The work was initiated to define methods for diagnosis and correction of knee joint recurvation in ICP patients.

Materials and methods

We examined 23 patients, 14 boys and 9 girls among them, (mean age 6.4±1.1 years) with infantile cerebral paralysis rehabilitated at U. Kurbanoq Republican Pediatric Psychoneurological Hospital (Uzbekistan). Among the examinees there were 19 and 6 children with spastic diplegia and spastic hemiparesis, respectively. By severity knee joint
recurrvation was defined as mild (up to 15°) in 11 patients, moderate (from 15° to 30°) in 3 children and severe (more than 30°) in 9.

In patients with mild knee joint lesions the recurvation (1st group) could be observed at some phases of backward jolt upon walking only. The children managed to compensate the deformity, mostly succeeding. Habitual standing posture retained, the lower extremity’s axis remaining unchanged.

Patients with moderate knee joint recurvation (2nd group) walked with the knee joint recurved which was evident prior to each subsequent step. In these patients pathological knee joint recurvation was not apparent in the sitting position only.

Children with severe knee joint recurvation, persisting both in the standing position and upon any movement, were included into the 3rd group. This motor knee joint abnormality significantly limited capabilities of the ICP patients.

Achilloplasty in 9 ICP patients with equinovarus and distal tendotomy of musculus rectus femoris in 3 ICP patients with flexion contracture of hip joint were the surgeries to correct knee joint recurvation due to deformity of adjacent lower extremity’s joints. Joint contractures were corrected by typical surgical methods.

Knee joint recurvation due to non-fixed pathologies in the adjacent joints or secondary changes in musculotendinous and ligamentous structure of the joint were corrected by orthopedic and rehabilitative orthoses in addition to physiotherapeutic procedures. The method was used for treatment of 11 patients.

Results and discussion

Late-term outcomes of orthopedic and surgical treatment of the knee joint recurvation were followed-up for 1-8 years. Their efficacy was assessed as “good” when physiological volume of crural extension was achieved, the result was observed in 14 patients (following 7 cases of achilloplasty, 2 tendotomies of musculus rectus femoris and 5 cases of medical rehabilitation). Improvement in a patient’s vertical position due to deformity reduction with insignificant residual recurvation, not hindering an infant’s movement, was defined as a “satisfactory” outcome: it was registered in 7 patients, two of whom had undergone surgery on hip flexors and musculus gastrocnemius. “Unsatisfactory” outcomes were observed in 2 patients under medical correction with the short-term recurrence of knee joint recurvation. The children were subsequently operated on, and they are under follow-up monitoring.

Case: Patient A., born in 1995, medical anamnesis No.115. Date of hospitalization: 05.03.08. Diagnosis: ICP, moderate spastic diplegia, recurvation of both knee joints - Ist degree on the right and IIIrd degree on the left. The patient can stand and walk by his own, but both standing and walking are unsteadily. In the vertically positioned patient the knee joint recurvation can be seen, mostly on the left. Diagnostic and biomechanical findings confirmed primary equinovarus and secondary compensatory knee joint recurvation. Left achilloplasty according to Bayer was performed on April 2, 2008. Physiotherapeutic procedures to strengthen crural flexors and to relax triceps of the calf were prescribed for the right lower extremity with subsequent orthosis bearing. Eight weeks later the patient can stand with complete foot loading. Calves are upright. Upon walking mild residual right knee joint recurvation could be compensated by a knee-cap or removable joint immobilizer. The outcome is categorized “good”. 

True common center of mass projection in the sagittal plane intersects rotating part of hip joint anterior to the knee joint rotation center terminating anterior to the malleolar level. Due to central dysregulation of posture in the ICP patients the complementary mechanisms of compensation are necessary to preserve balance in vertical position. In particular, to differentiate knee joint recurvation caused by the equinovarus the crural extension is needed as the common center of mass projection will pass anterior to rotation center in the knee joint. If there is a hip joint flexion contracture in the patient, the motor
Pathology can exacerbate, forming a vicious circle contributing to progression of knee joint recurvation.

To differentiate primary pathological knee joint recurvation due to its anatomical alterations from the one caused by the equinovarus an infant stands on toe, the degree selected in accordance with severity of the equinovarus. Upon full foot loading the crus should be upright. If the recurvation disappears the equinovarus is considered primary, the former being secondary to the latter. The knee joint recurvation like this is considered static and corrected surgically by achilloplasty.

Presence of dynamic recurvation is defined by comparative analysis of gait of patients using orthoses and without them. The recurvation reduced or disappeared upon use of orthoses is considered secondary to the equinovarus. In some cases when following the equinovarus compensation recurvation persists, the rectus-test to diagnose fixed or tonic hip joint flexion contracture as an instigator of knee joint recurvation is performed. In this case of knee joint recurvation the hip joint flexion deformity should be corrected.

It should be noted that the knee joint recurvation can form due to anatomical alterations in the joint per se, including weakness of ligamentous apparatus or physiological posterior slanting of the tibial articular surface. Medical correction with physiotherapeutic procedures and ortoses contributes to positive motor dynamics in an ICP patient.

Method of motor abnormality correction is chosen following elucidation of the knee joint recurvation causes in children with ICP.

**Conclusion**

Knee joint recurvation in the infantile cerebral paralysis can arise either from weakness of tendo-ligamentous component of the segment or due to pathological contractures in the adjacent lower extremity’s joints. The method to diagnose knee joint recurvation we suggest is expedient in determination of mechanisms of deformity development and its differentiation primacy. Analysis of orthopedic and surgical methods of management demonstrated their efficacy and necessity of their timely performance with recurvation variants and the deformity severity taken into account.

**References**


Vitenzon, A., 1998. “Mechanisms of normal and pathological man’s walking” [Zakonomernosti normalnoy i patologicheskykh khodby cheloveka], in Russian, Moscow: Zercalo-M.