

Minimal Brain Dysfunction (MBD) – the influence on the Locomotor System. Symptoms. Physiotherapy

Tomasz Karski¹, Jacek Karski², Jan Oleszczuk³, Henryka Oleszczuk³, Marian Domagała⁴, Honorata Menet⁵

¹Vincent Pol University in Lublin, Poland

²Paediatric Orthopaedics and Rehabilitation Department, Medical University of Lublin, Poland

³Department of Gynaecology, Medical University of Lublin, Poland

⁴Medical Center in Laszczów, district Tomaszów Lubelski, Poland

⁵Student, University in Caen, France

Abstract

The observations from the years 1995 – 2019 were presented. The study population included 1055 children and adolescents aged 2 – 18 years. The clinical symptoms of Minimal Brain Dysfunction [MBD] were described, including valgus deformity of the feet, hyperextension of the knees, anterior tilt of the pelvis, hyperlordosis of the lumbar spine, psychological disorders like ADHD and inclination to hyperactivity (frequent jumping leading to Perthes disease). Moreover, physiotherapeutic measures in MBD were discussed.

Key words: minimal brain dysfunction, anterior tilt of the pelvis, hyperlordosis of the lumbar spine, hyperextension of the knees, valgus of the feet.

Introduction

In Poland, almost 12 % of children and adolescents born in the last 30 years have various CNS changes caused by the complications during pregnancy and delivery.

According to obstetricians and gynaecologists, the causes of MBD in children include (1) chronic placental inefficiency, (2) intrauterine limitations of the foetus growth, (3) oligohydramnios, (4) spotting, (5) uterus contractions during pregnancy, (6) excessively intense action of the uterus during delivery as well as uterine tetanus, (7) maternal hypertension, (8) maternal hypotension, (9) maternal anaemia, (10) infection of the urinary tract, (11) mellitus, (12) stress and noise during pregnancy, (13) overdoses or improper medications during delivery, (14) twin-to-twin transfusion syndrome (TTTS).

The conditions presented above can lead to

CNS asphyxia during pregnancy and delivery and are defined as Minimal Brain Dysfunction (MBD).

MBD results in secondary changes in the locomotor system [1-5, 11]. There are three significant symptoms observed even in babies: 1/ straight position of the spine, 2/ anterior tilt of the pelvis and hyperlordosis of the lumbar spine, 3/ laxity of the joints (Fig. 1, 2, 3).

The authors present the opinions of many Polish rehabilitation doctors about “low tension of the muscles” and the necessity to strengthen the muscles and to form “ a special master of activity of the brain to influence the muscle function”. Our point of view, totally different from those of other authors, is presented in the chapter “Discussion”.

Material

The study population included 1055 children and young individuals, aged 2 – 18 years; the

observations covered the period between 1995 and 2019. The patients were treated in the Paediatric Orthopaedics and Rehabilitation Department, Medical University of Lublin (1995 – 2009) and in the Praxis orthopaedic offices (1995 – 2019).

Pes valgus or planovalgus

The causes of pes valgus deformities (Fig. 4a, 4b) presented in the literature are as follows:

- a. spastic shortening of pronator muscles – m. peroneus brevis and m. peroneus longus,
- b. bone anomalies
- c. joint laxity.

According to our observations, the main cause of valgus foot deformities is the shortening (contracture) of the Achilles tendon, m. triceps surae and other foot flexors because of spastic or semi-spastic contracture, mainly of m. triceps surae [7-16].

In children with Minimal Brain Dysfunction (MBD), the deformities are mostly observed in both legs. In cases of shortening of the Achilles tendon and m. triceps surae alone, the child walks using both feet (or one foot) in the equine position. When joint laxity is also present, the pes valgus deformity develops. In Poland, such a foot deformity affects 8% - 12% of the population.

Development of valgus foot deformities

1. Dorsal flexion of the feet by 15 to 20 degrees is needed for walking.
2. In the case of shortening of the Achilles tendon and m. triceps surae, accompanied by the laxity of joints, the necessary dorsal flexion is possible only in the prone position of the feet,
3. After some years, repeated dorsal flexion in the prone position, results in the full fixed valgus or planovalgus deformity of the feet.

Such a deformity requires early physiotherapy. The treatment involves stretching exercises to lengthen m. triceps surae and Achilles tendons. Left untreated in childhood, valgus foot deformities

cause significant problems in adulthood – pain, limping, difficulties in walking (Fig. 5a, 5b).

The development of recurvation and valgus deformities of the knees

Hyperextension of the knees (Fig. 6) occurs very commonly as an accompanying symptom of a foot valgus deformity. This knee deformity also results from the Achilles tendon and m. triceps surae shortening. Knee recurvation is a compensatory deformation that can be explained in the following way:

1. Limitation of the foot dorsal flexion is caused by shortened m. triceps surae and Achilles tendon,
2. During walking, when the foot is in full contact with the floor, hyperextension of the knees develops as a compensatory movement. After some years, the knee is defined as a recurvation deformity.

The causes of knee valgus deformities

In children with MBD, such deformities are caused by spastic shortening of tractus iliotibialis or permanent improper sitting with the legs directed sideward and backward [6]. Such an incorrect sitting position is very common among children with “general laxity”. The laxity of joints is caused by the changed properties of collagen. It is worth stressing again that the laxity of joints is also one of the symptoms of MBD.

Hip dysplasia

Hip dysplasia occurs in the following situations:

1. in the case of general joint laxity, which affects 10% of all dysplasia cases in Poland,
2. in the Syndrome of Contractures and Deformities” (SofCD - H. Mau, T. Karski & J. Karski) - 90% of all hip dysplasia cases in Poland. In the latter group, dysplasia develops slowly, not because of the primarily undeveloped roof of the acetabulum, but because of incorrect positioning of the femoral head in the acetabulum,

which results from insufficient abduction of one or both hips. According to Professor Klisic from Beograd, dysplasia connected with SofCD is the Developmental Dysplasia of the Hip (DDH). In both groups of dysplasia, children require permanent abduction and flexion positions of the hips from birth to the age of one or two years. For prophylaxis, the proper way of carrying the child and the proper sitting position are crucial [9, 10]. The “butterfly position” is the best sitting position (the term taken from karate).

Anterior tilt of the pelvis and hyperlordosis of the lumbar spine

Irrespectively of the valgus deformity of the feet and recurvation of the knees, an anterior tilt of the pelvis with hyperlordosis of the lumbar spine are observed in children with MBD. (Fig. 7). In cases of MBD, m. rectus often appears to be too short and can trigger “flexion contracture of the hips”. As a result, hyperlordosis of the lumbar spine develops [9, 10, 12]. This deformity appears in 12% of individuals in Poland. Thus, all the symptoms of MBD – deformities in the feet and knees, abnormalities in the position of the pelvis and in the spine – require long-lasting therapy in the early stage of childhood. Such an early treatment is defined as “prophylaxis for adults”.

Psychological problems in children with MBD

The behavior of children with MBD is utterly distinct. Children affected by MBD are usually nervous, they shout, cry without any reason and at the same time they very affectionate and seek close contact with their loved ones.

They like to jump off various high objects such as chairs, sofas, window-sills or tree branches. Repeated jumping, e.g. 20 – 30 times per day, can cause the Legg – Calve – Perthes – Waldenström disease, i.e. necrosis of the femoral head. During repeated jumping the cartilage is resistant but the

bones can be fractured and the process of necrosis of the femoral head begins [7, 8, 9, 10, 12].

The knowledge about the causes enables us to inform about possible prophylaxis. Children at the age of 4 to 11 should not regularly jump onto a hard surface.

Physiotherapy in the treatment and prophylaxis

In the treatment of deformed feet, knees as well as pelvic and hip positions, stretching exercises are crucial, which lead to provision of anatomical symmetry, proper length of tendons, fascias, muscles, capsules, symmetry of joint movements and symmetrical functioning during any form of activity.

Stretching exercises of the Achilles tendons and of m. triceps surae are essential for correction of foot valgus deformities (Fig. 8). Likewise, stretching exercises in children can cure the pathological anterior tilt of the pelvis and hyperlordosis of the lumbar spine (Fig. 9). Such exercises are the only ones found proper and effective. Strengthening exercises of the opposite group of muscles, for instance of extensors of the knees, i.e. of m. quadriceps in flexion contracture of the knee, never give positive results. Likewise, exercises of the foot extensor in the equines deformity, never lead to good outcomes. Only stretching exercises of shortened / contracted muscles, tendons and capsules give good results in children and can “soften” the pathology even in adults (Fig 10a, 10b). In our opinion, strengthening exercises are a mistake. Such incorrect therapy never gives positive results.

The proper therapy of dysplastic hips is essential, especially in cases with simultaneous spasticity or sub-spasticity of the hip adductor muscles. Small children need to be carried in a proper way, face to face, with maximal abduction and flexion of the child’s legs.

Only abduction of hips during the first 12 months of life can prevent hip dysplasia and enable good functioning of the hips for the entire life.

During therapy, love shown to MBD children always has positive effects.. Permanent contact with the mother or father, also at night, is vital. Moreover, music therapy is important. Good treatment outcomes are also observed when occupational therapy is applied. A complete psychological and physiotherapy program should be carried out not only at home but also in kindergartens and schools.

Discussion

Before introducing a physiotherapy program, it is essential for the physiotherapist to discuss with parents the period of gravidity and delivery as well as the child`s behavior. Parents are invited to tell about the pathological symptoms during walking, sitting and other activities of their child. Their answers are crucial for planning the therapy. The diagnosis of MBD should be proper and include all pathologies; the program of therapy ought to be considered. The treatment should combine physiotherapy in rehabilitation centres and at home. The program of prophylaxis or treatment should be planed for many years and cover the period of child`s growth. Stretching exercises are essential to provide full and symmetrical movement of all joints. It should be stressed that strengthening exercises of muscles are incorrect. Laxity of joints is not caused by weak muscles but by changes in biology of collagen.

The treatment of laxity of joints is difficult, but active exercises in geothermal water (mineral natural warm water) are very beneficial.

Conclusions

1. In Poland 8 % to 12 % of children and youths have symptoms of Minimal Brain Dysfunction (MBD).
2. Clinically, MBD is characterized by shortening of muscles and tendons, (called contractures), as well as laxity of joints because of changes in collagen properties.

3. In cases of double pathology – shortening of muscles, tendons and laxity - valgus or plano - valgus deformities of feet, recurvation of knees, anterior tilt of the pelvis with hyperlordosis of the lumbar spine are likely to develop..
4. If the valgus deformity of feet, hyperextension (recurvation) of knees, and anterior tilt of pelvis with hyperlordosis of the lumbar spine are not treated in childhood, they can result in the pain syndrome in adulthood.
5. Early treatment in childhood is the best prophylaxis of pain syndromes and arthrosis in adults.
6. In the treatment of all deformities caused by the MBD, stretching exercises are optimal, as they allow to obtain full and symmetrical range of joint movements.
7. Exercises in geothermal water and physiotherapy programs are beneficial. Only 5 % of patients require surgery.

Figures



Fig. 1. A 1.5-year-old child. Typical symptoms of Minimal Brain Dysfunction (MBD). An extension contracture of the spine (Photo T. Karski)



Fig. 2. A 7-year-old child. Typical symptoms of Minimal Brain Dysfunction (MBD). Anterior tilt of the pelvis as a result of flexion contracture of hips (Photo T. Karski)



Fig. 3. A 9-year-old child. Typical symptoms of Minimal Brain Dysfunction (MBD). General laxity of joints as a result of changed properties of collagen. One of the ten (10) symptoms according to Wynne-Davies (Photo T. Karski)



Fig. 4a, 4b. An 8-year-old child. Complicated gravidity and delivery. Typical symptoms of Minimal Brain Dysfunction (MBD). Plano – valgus deformity of feet because of shortening of m. triceps surae and Achilles tendon on both sides (Photo T. Karski)



Fig. 5a, 5b. A 61-year-old female patient. Symptoms of Minimal Brain Dysfunction (MBD). The patient never treated in childhood. Shortening of m. triceps surae and Achilles tendon on both sides. Laxity of joints. Extended valgus and planes deformity of feet. Hypertrophy of soft tissues in the tarsus. Pain. Difficulties during walking (Photo T. Karski)



Fig. 6. A 4-year-old child. Problems during pregnancy and delivery. Changes typical of Minimal Brain Dysfunction (MBD). Recurvatum deformity of knees. The deformity caused by shortening of the Achilles tendons and m. triceps surae on both sides and function „gait” and „standing”. Explanations in the text (Photo T. Karski)



Fig. 7. A 7-year-old child. Typical symptoms of Minimal Brain Dysfunction (MBD). Diagnosis:
1/ shortening of Achilles on both sides and plane – valgus deformity of feet. 2/ Anterior tilt of the pelvis because of flexion contracture of both hips. 3/ Result - hyperlordosis of the lumbar spine. The child requires stretching exercises to obtain proper pelvis position (Photo T. Karski)



Fig. 8. 13-year-old patients. Symptoms of Minimal Brain Dysfunction. Shortening of m. triceps surae and Achilles tendon on both sides. Laxity of joints. Extended valgus and planes deformity of feet. Stretching exercises for the Achilles tendon and flexors of knees on both sides (Photo T. Karski).



Fig. 9. 8-year-old patients. Symptoms of Minimal Brain Dysfunction. Shortening of m. flexors of hips. Anterior tilt of pelvis. Stretching exercises for hip flexors to obtain proper pelvis position and normal axis of the lumbar spine. Exercises typical of karate (Photo T. Karski)



Fig. 10a, 10b. 60-year-old patients. Symptoms of Minimal Brain Dysfunction. Anterior tilt of the pelvis. Stretching exercises of hip flexors to improve the pelvis position. In the second phase, flexion of the spine. The exercises beneficial not only for „the movement apparatus” but also for blood circulation (Photo T. Karski).

References

1. Chang HW, Lin CJ, Kuo LC, Tsai MJ, Chieh HF, Su FC.: Three-dimensional measurement of foot arch in preschool children. *Biomed Eng Online*. 2012 Sep 25;11(1):76
2. Czochońska J.: *Badanie i ocena neurorozwojowa niemowląt i noworodków*. Wydawnictwo Folium , 1995
3. De Pellegrin M. - Subtalar screw - arthroereisis for correction of flat foot in children. *Orthopade*. 2005 Sep; 34(9): 941-53
4. Kałakucki J.: *Wybrane parametry rozwoju psycho - ruchowego u dzieci z chorobą Perthesa. (Some parameters of psychological behavior and movement apparatus changes in children with Perthes disease)*. *Doctor dissertation*. 2010, 125. Uniwersytet Medyczny w Lublinie

5. Karski J, Karski T, Kałakucki J, Długosz M.: Cerebral palsy - problems of diagnosis and treatment. Lublin RAO method in treatment. *Pohyb. Ustr.* 2010 R. 17 č. 3/4 suppl., s. 374-377.
6. Karski J, Karski T, Kałakucki J.: Contracture of tractus ilio-tibialis as an important factor in etiology of „genua valga idiopathica”, habitual dislocation of patella. New operative therapy as advising procedure for „Decade of Bone and Joint 2000-2010”. W: 60th Annual International Congress of the Egyptian Orthopaedic Association. Cairo, 17-20 November 2008. Abstr, s. 129-130.
7. Karski J., Karski T., Pyrc J., Kulka M. Deformations of the feet, knees, hips, pelvis in children and adults with minimal brain dysfunction. causes. treatment. Prophylaxis. *Locomotor System* vol. 23, 2016, no. 2 / *Pohybové Ustrojí*, ročník 23, 2016, č. 2
8. Karski Jacek, Tomasz Karski: Deformacje neuromięśniowe stóp, kolan, bioder, miednicy u dzieci. Wtórne zespoły bólowe u dorosłych. Przyczyny, zapobieganie i leczenie. Deformations of the feet, knees, hips, pelvis in children with minimal brain dysfunction. Causes, prophylaxis and treatment in children and adults. *Neurologia Praktyczna* 1/2016
9. Karski T., Karski J., Karska K., Karska K. and Menet H.: Pediatric Prophylaxis Program of Motor System Deformations and Illnesses in Children. *Problems of Spine, Hips, Knees and Feet, EC PAEDIATRICS, UK*, Review Article, Pages 11
10. Karski J. Karski T. Pathological changes in locomotors system in children with Minimal Brain Dysfunction (MBD). Causes. Symptoms. *Physiotherapy Arch Physiother Glob Res* 2017; 21 (2): 35-43
11. Karski T.: Wpływ osi kończyn na kształt i czynność stóp oraz sposób zużywania obuwia. *Przegląd Skórzany*, 1986, 3/472, 53-55
12. Karski T.: Wrodzone i nabyte wady stóp u dzieci; *Ortopedia, traumatologia i rehabilitacja narządów ruchu*, pod redakcją Prof. St. Piątkowskiego, PZWL, Warszawa 1990, 217–220
13. Karski T, Konera W, Malicki M.: Statische und jatrogene Knieckplattfussdeformitäten bei Kinder. Erklärung der Erscheinungen und Möglichkeiten der Therapie. *Szekersefahvar*, 1990, October, 4–6, Dni Ortopedyczne Węgierskiego Towarzystwa Ortopedycznego
14. Karski T, Karski J, Snela S, Ostrowski J.: Knickfussdeformitäten bei Kindern mit spastischer Verkürzung der Achillessehne. Internationaler Gemeinschaftskongress, 1995, 15–17 Juni, Berlin, Kurzfassungen – Block 6
15. Łuba R.: Działalność badawczo wdrożeniowa Instytutu Przemysłu Skórzanego w zakresie ochrony stóp ludności Polski - wydrukowana w *Przeglądzie Skórzanym*, 5/1994
16. www.ortopedia.karski.lublin.pl

Acknowledgments: Many thanks to David Poynton and Honorata Menet for proofreading of the English manuscript.

Corresponding Author:

Prof. Tomasz Karski MD PhD,
Vincent Pol University, 20-816 Lublin, Choiny
Street 2, Poland
t.karski@neostrada.pl