The Padovan® Method as an adjuvant therapy for tendon elongation surgery in children with cerebral paralysis: two case reports

O Método Padovan® como coadjuvante à cirurgia de alongamento dos tendões em crianças com paralisia cerebral: dois relatos de caso

El Método Padovan® como coadyuvante de la cirugía de estiramiento de tendón en niños con parálisis cerebral: dos informes de casos

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ABSTRACT

Objective: To report two cases of children rehabilitated with the Padovan® Method before the tendon stretching surgery. **Case reports:** Observational, descriptive, quantitative and retrospective study of two cases of children who had cerebral palsy, spasticity, shortening of the tendons and lack of gait, due to hypoxia in the neonatal period, seen in a private clinic by the Padovan® method of neurofunctional reorganization, through review of medical records. For motor evaluation, the Gross Motor Function Classification System (GMFCS) was used. The reports were approved by the Research Ethics Committee. Patients received conventional motor physiotherapy from the first months of life to 7 years old (case 1) and 5 years old (case 2), when they started rehabilitation with the Padovan® Method, 3 times a week and, after improving their tone and muscle strength, patients were referred for orthopedic surgery and moved from level IV (mobility with limitations) to level II (walking with limitations) on the GMFCS scale. **Final considerations:** Even after the sequela installed, patients managed to acquire gait, contributing to the results of orthopedic surgery due to the reprogramming of movements proposed by the Padovan® Method, which can contribute to reducing failures in this type of surgery.

Keywords: Cerebral palsy, Orthopedic surgery, Neuroplasticity.

RESUMO

Objetivo: Relatar dois casos de crianças reabilitadas com o Método Padovan® antes da cirurgia de alongamento do tendão. **Relato dos casos:** Estudo observacional, descritivo, quantitativo e retrospectivo de dois casos de crianças que apresentaram paralisia cerebral, espasticidade, encurtamento dos tendões e ausência de marcha, devido à hipóxia no período neonatal, atendidas em uma clínica particular pelo Método Padovan® de reorganização neurofuncional, através de revisão de prontuários. Para avaliação motora, foi utilizado o Sistema de Classificação da Função Motora Grossa (GMFCS). Os relatos foram aprovados pelo Comitê de Ética em pesquisa. Os pacientes receberam fisioterapia motora convencional desde os primeiros meses de vida até os 7 anos (caso 1) e 5 anos (caso 2), quando iniciaram a reabilitação com o Método Padovan®, 3 vezes por semana e, após melhora do tônus e força muscular, os pacientes foram encaminhados para cirurgia ortopédica e passaram do nível IV (mobilidade com limitações) para o nível II (anda com limitações) da escala GMFCS. **Considerações finais:** Mesmo após a sequela instalada, os pacientes conseguiram adquirir a marcha, contribuindo para os resultados da cirurgia ortopédica devido à reprogramação dos movimentos propostos pelo Método Padovan®, o que pode contribuir para reduzir falhas neste tipo de cirurgia.

Palavras-Chave: Paralisia cerebral, Cirurgia ortopédica, Neuroplasticidade.

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RESUMEN

Objetivo: Informar dos casos de niños rehabilitados con el Método Padovan® antes de la cirugía de estiramiento del tendón. **Reportes del caso:** Estudio observacional, descriptivo, cuantitativo y retrospectivo de dos casos de niños con parálisis cerebral, espasticidad, acortamiento de los tendones y falta de marcha, debido a hipoxia en el período neonatal, visto en una clínica privada por el Método Padovan®, por la revisión de registros médicos. Para la evaluación motora, se utilizó el Sistema de clasificación de la función motora gruesa (GMFCS). Los informes fueron aprobados por el Comité de Ética en Investigación. Los pacientes recibieron fisioterapia motora convencional desde los primeros meses de vida hasta los 7 años (caso 1) y los 5 años (caso 2), cuando comenzaron la rehabilitación con el Método Padovan®, 3 veces por semana y, después de mejorar su tono y la fuerza muscular, los pacientes fueron remitidos para cirugía ortopédica y pasaron del nivel IV (movilidad con limitaciones) al nivel II (caminar con limitaciones) en la escala GMFCS. **Consideraciones finales:** Incluso después de que se instaló la secuela, los pacientes lograron adquirir la marcha, lo que contribuyó a los resultados de la cirugía ortopédica debido a la reprogramación de movimientos propuesta por el Método Padovan®, que puede contribuir a reducir las fallas en este tipo de cirugía.

Palabras-claves: Paralisis cerebral, Cirurgia ortopédica, Neuroplasticidad.

INTRODUCTION

Cerebral Palsy (CP) is the most common cause of physical disability in childhood (LOWES LP, et al., 2014). The incidence of this condition in developed countries ranges from 1.5 to 5.9 / 1,000 live births and about 17,000 new cases appear annually in Brazil (ROTTA NT, 2002). The CP is resulting from a non-progressive Central Nervous System (CNS) injury that may lead to motor dysfunction, movement disorders and mental impairment in addition to functional changes (SPOSITO MMDM e RILBERTO M, 2010).

Equine foot is one of the most common deformity in CP patients (ASSUMPÇÃO RMCD, et al., 2008). This deformity requires treatment because it directly affects both balance and postural stability because the base of support is diminished. In addition, it interferes with the knee joint, gait dynamics and proprioception (MEDEIROS DLD, et al., 2013).

It has been estimated that 20% to 25% of all patients need some surgical procedure for this type of deformity (ASSUMPÇÃO RMCD, et al., 2008). However, despite the kinematic improvement of the ankle, significant recurrences of contracture and excessive stretching in some patients are significant problems. This is due to age at time of surgery, distribution and extension of CP and development of contractures at other levels (WREN TAL, et al., 2010).

The Padovan® Method of neurofunctional reorganization was created by the Brazilian speech therapist Beatriz Padovan in the 1970s. This method has been shown to be effective in the treatment of various neurological conditions, such as cerebral palsy (BOUDREAULT CG, et al., 2016). In these cases, the method is helpful in reducing spasticity, improving gait and overall functionality of the patient, since it works with neuroplasticity, creating new ways for the brain to perform the motor command. This method is based on the doctrines of Rudolf Steiner (1861-1915) on the nature of human development and the theory of neurological reorganization created in the 1950s by the neurologist Temple Fay (1895-1963). (PADOVAN BAE, 1994; BOUDREAULT CG et al., 2016; BENDER NA, 2017)

Body exercises that recapitulate all the stages of ontogenetic motor development can reduce the failures of the motor development, promoting overall neurological maturation. In addition, the oral exercises stimulate reeducation of the Reflex-Vegetative Functions (respiration, suction, chewing and deglutition (PEREIRA LM, et al., 2015). Finally, the Padovan® method is validated by the principles of cerebral plasticity, because it states that the practice of motor tasks induces plastic and dynamic changes in the CNS (BORELLA MP e SACCHELLI T, 2009).

This study aims to report two cases of children with cerebral palsy and shortening of tendons submitted to the Padovan® Method and to explain an adjuvant therapy to the surgical procedure.

CASE REPORTS

This is an observational, descriptive, quantitative, and retrospective study. The data collection started when the project was approved by the Research Ethics Committee (CEP) of the University of Medicine of Estácio de Juazeiro do Norte in April 2018, under the number 2.579.109, selected by Plataforma Brasil with a Certificate of Presentation for Ethical Appreciation (CAAE) number 86154418.2.0000.8074.

Case 1

Male student, born premature, cesarean delivery, with 36 weeks of gestational age, low weight (1,865g), classified as small for gestational age and Apgar 7 / 8. The genitor reported pregnancy-specific hypertensive disease. The newborn had several apneias in the neonatal period, used Continuous Positive Airway Pressure (CPAP) and evolved with hypoxic-ischemic encephalopathy, presenting delayed motor development with spastic tetraplegia and without intellect impairment.

He held his head and sat unsupported at age 2 and crawled at 2 years and 5 months. He began motor physical therapy before 1 year of age and started the Neurofunctional reorganization therapy using the Padovan® Method at 7 years of age, when he had spasticity of the 4 limbs, spasticity of the hands, decreased strength of the arms (he could not raise them above the shoulders and neither sustained for long extended forward), motor deficit in the ocular musculature (difficulty in fixing and accompanying objects) and in the speech (dragged), no walking and creeping locomotion categorized as level IV in the Gross Motor Function Classification System (GMFCS) scale.

The therapy was made with body and respiratory exercises and oral sucking, chewing and swallowing functions. After 2 years of therapy, he had improved strength and balance and was referred for orthopedic surgery for correction of the Achilles tendon shortening. After the surgery, it evolved with progressive improvement reaching independent gait. He remained in treatment with the Padovan Method and, at 12 years of age, presented better performance in the school environment.

This may be related to an improvement in the motor coordination that facilitated the use of pencils and improvement in the movements of the eyes and vision (through visual exercises). This gave him the capacity of learning through reading. In addition, the speech became articulate and rhythmic and the walking homolateral, without support, giving him more independence in his daily life reaching GMFCS level II. The patient remains in therapy currently and continues to show progress.

Case 2

Male student, born extremaly premature, normal delivery, with 29 weeks of gestational age, exceptionally low weight (1.220g), classified as suitable for gestational age. He remained on mechanical ventilation for 2 days, CPAP for 5 days and oxi-hood for 1 day. He presented early sepsis and jaundice and thus, received phototherapy. In the first year of life, he developed delayed neuropsychomotor development, with the following milestones: nodded at 5 months, sat unsupported at 1 year and 2 months and crawled at 2,5 and years (kneeling and dragging both legs forward), kept in physical therapy from hospital discharge.

He initiated the Neurofunctional Reorganization therapy using the Padovan® Method, with body and respiratory exercises, in addition to exercises oral functions of suction, chewing and swallowing at 4 years and 8 months. A neurological examination in the beginning of the therapy showed that he did not stand up, presenting spastic paraplegia with hypertonia of the musculature of the lower limbs, equine foot, shortening of the Achilles tendon and the hip muscle and posterior musculature of the thigh, with internal rotation of the knees, posture in semiflexion of the trunk, scaled gait - with support.

He also presented decreased muscular strength of the lower limbs and upper limbs, mainly of the shoulder girdle, being unable to raise the shoulders or flex the arms in the back. The balance and motor coordination were altered, and the movements of the hands promised by spasticity, mainly on the left side, which was categorized as level IV on the GMFCS scale.

After 4 months of therapy, the patient presented improvement in the hypertonia of the hands, as well as in posture, showing capacity of giving few loose steps. After 1 year of therapy he walked loose, despite the

shortening of the tendons and the equino feet. Additionally, he became more attentive in the school because he copies of the slate. At 2 years and 3 months of therapy, the child walked unsupported, even with bad posture of the lower limbs reaching level II in GMFCS. After corrective surgery, he could walk independently and followed in conventional physiotherapy.

DISCUSSION

The most frequent musculo-skeletal complication in these children is deformity of the feet including the equine foot, as the most common (SEES e MILLER, 2013; DREHER T, et al., 2013). Spasticity is present in 75% to 88% of the cases and is responsible for muscle weakness, decreased body control skills, spasms, and possible fractures in these patients (SPOSITO MMdM e RILBERTO M, 2010).

The disproportionate force that the muscle causes in the bone generates deformities cause a succession of losses, such as tiptoe walking, instability in the posture phase, pressure on the forefoot and absence of the balance phase (DREHER T, et al., 2012; KALKMAN BM, et al., 2017).

Conservative treatment is the first choice for deformities not yet installed and ankle-foot orthotics are the most indicated, because, in addition to stabilizing the extremities, they provide improvements in the biomechanical alignment (MEDEIROS DLd, et al., 2013). However, around 6 to 8 years of age, children begin to develop important contractures in the gastrocnemius and hemiplegia in the soleus, which makes infeasible the exclusively conservative treatment (SEES JP e MILLER F, 2013).

Surgical treatment is the first choice when there are well-established deformities present and zetaplasty for the elongation of the calcaneus tendon is the most indicated in this case, as it promotes maintenance of muscle strength and restores the static and dynamic function of the ankle (MEDEIROS DLd, et al., 2013).

Despite regaining the amplitude of dorsiflexion, surgery does not improve the normal architecture of the muscle-tendon (WREN TAL, et al., 2010). In addition, tendons have low vascularization and disorganization of the collagen fibers and, therefore present a high rupture ratio (VIEIRA CP, et al., 2014). Equine foot recurrence after gastrocnemius recession or stretching of the Achilles tendon reaches 41% of patients (WREN TAL, et al., 2010).

It has been shown that age of the patient at the time of surgery is an important for the results. Thus, children younger than 8 years who had hemiplegia or diplegia had higher recurrence rates in relation to older patients (SEES JP e MILLER F, 2013). In addition, recurrence can also occur because the brain (responsible for movement control) is under injury and if it is not reprogrammed will maintain abnormal movement causing further deformities (GRAHAM HK e SELBER P, 2003).

It has been shown that prevention and rehabilitation measures are required in the equine foot treatment (MEDEIROS DLd, et al., 2013). During rehabilitation, neuroplasticity can be stimulated by specific therapy with repetitive and sensory training associated with mental practice (BORELLA MP e SACCHELLI T, 2009).

The principles of neuroplasticity state that the CNS can undergo maturation, as it changes structurally and functionally to adapt to injuries (ISMAIL FY, 2016). Grounded on these principles, Beatriz created the Padovan® Neurofunctional Reorganization Method, which is based on the repetition of typical developmental movements, such as rolling, crawling, motor movements of arms and legs, hands, eyes, gait, which stimulates new neural pathways and improves the organization of the nervous system, (PADOVAN BAE, 1994; BOUDREAULT CG et al., 2016; GURFINKEL V; GROTTI AZ, 2016).

The method consists of body exercises that resemble the phases of the development (rolling, crawling, crawling and walking) and promote the re-education of reflex-vegetative-oral functions (breathing, sucking, chewing and swallowing) (PADOVAN BAE, 1997; PEREIRA LM, et al., 2015).

In the Padovan method, the vestibular system is stimulated by the body movements; the ocular system is stimulated by the training of the ocular movements with lantern and the diaphragm and the larynx are stimulated through breathing exercises as well as exercises with whistles and vibrations in the face and intraoral.

Elastic exercises in the tongue are also carried out to stimulate the cranial nerves (PEREIRA LM, et al., 2018). Thus, the patient is treated in a comprehensive manner since the individual functions cooperate for health as a whole.

Previous studies confirmed that motor training contributes to the formation of neural circuits, angiogenesis, and pre/post-synaptic modulation. Therefore, even if an undamaged member is introduced into the therapy, there may be synaptogenesis expression (BORELLA MP e SACCHELLI T, 2009).

In this context, the Padovan® Method reorganizes the patient's cerebral connections by recapitulating the neuroevolutionary stages, providing new assimilation of information that was not previously acquired during development. The circuits formed through the passive training create different routes for the gait learning contributing to the improvement of balance, strength, and muscle tone.

This improve the limb stability and contributes to the post-surgical success, as evidenced by the presente case reports, which showed that patients moved from level IV (self-mobility with limitations, using motor support technology) to level II (with limitations) on the GMFCS scale.

Because of the reprogramming of the movements by the therapy, patients maintained independent gait and no recurrence of shortening after 5 years of surgery was seen in both cases, demonstrating the possibility of neuroplasticity.

The GMFCS is used to determine the level that best represents current skills and limitations in overall motor function. It is based on self-initiated movement with emphasis on sitting, transfers and mobility. The criteria are based on functional limitations, the need to use locomotion devices (wanderers, walking sticks) or wheelchairs, and to a lesser extent on the quality of the movement (ANTUNES PP, 2015). In the present study, it was used to evaluate patients at the start of therapy and at the time they started walking, to establish a quantitative assessment of patients' responses to the intervention.

The Padovan® Method can be used both as a preventive and curative in several early childhood pathologies, such as hypoxic-ischemic encephalopathy, head trauma and various syndromes (PEREIRA LM, et al., 2018; BENDER NA, 2017). The best results are obtained in patients younger than 2 years. This age range (0 -2 years) is known as the critical period because there is greater axon or ontogenetic plasticity (ANDRADE ALM e JÚNIOR ALA, 2005).

In fact, in response to stimuli, the young brain is more susceptible to changes than the adult and the CNS reorganization capacity is greater soon after birth (ISMAIL FY, et al., 2016; FERRARI EAM, et al., 2001). Therefore, in this method, the therapy should start as soon as possible. It is also known that plasticity occurs in all stages of ontogeny (FERRARI EAM, et al., 2001).

Thus, as motor development takes the individual from the horizontal position to gait, language development; and cognitive functions and all these steps are recapitulated during Padovan® therapy, this method stimulates the individual to develop his or her genetic potential.

Because the brain is plastic throughout our life, rehabilitation is possible even after the sequela is installed, as seen in the two cases described in this study. Even after the functional alteration of the musculoskeletal system of the patients, it was possible to recover the gait.

This is especially relevant because the gait is a motor function especially important for the human independence and therefore, it is one of the main goals to be achieved in a rehabilitation. The dissemination of knowledge about the Padovan® Method may contribute to the early indication of therapy and thus, achieving better motor outcomes with fewer disabling sequelae.

Surgery is the definitive treatment in cases of tendon shortening because it re-establishes the anatomy and function of the limb. However, this method has a high rate of relapse due to neurological damage. The pre- and post-surgical Padovan® method acts in a complementary way by improving the range of motion, improving motor skills, and decreasing the failure rate of orthopedic correction. This method creates alternative cerebral pathways for command and controlling movement and can reduce musculoskeletal deformities, especially when applied in the first year of life.

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