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A reprogramação dinâmica muscular na reabilitação pós traumatismo cranioencefálico: um estudo de caso

Dynamic muscle reprogramming in rehabilitation after traumatic brain injury: a case study

Reprogramación muscular dinámica en la rehabilitación tras una lesión cerebral traumática: estudio de um caso clínico

Laís Barbosa de Castro Delgado[1], Francisco Miguel Pinto[2], Estélio Henrique Martin Dantas[3], Carmen Silvia da Silva Martinid[1]

RESUMO

Objetivo: avaliar os efeitos do método de Reprogramação da dinâmica muscular em paciente pós traumatismo cranioencefálico. **Método:** trata-se de um estudo de caso, com paciente do sexo feminino, de 21 anos, atendida 2 vezes por semana, sessão de 45min, de 2018 a 2020, pelo Programa Núcleo Multiprofissional de Reabilitação Neurofuncional. As avaliações contaram com: anamnese, avaliação postural estática e dinâmica, avaliação sensitiva padrão ASIA e Medida de Independência Funcional. **Resultados:** foi observado ganho de controle motor geral e diminuição da dor, quanto a ASIA, no que refere a sensibilidade com a agulha (Δ% = 51,8%) e, da sensibilidade ao toque leve (Δ% = 58,6%); e, na MIF, foram observadas evoluções no autocuidado, mobilidade e locomoção (Δ% = 64,82%). **Conclusão:** a estratégia do método na paciente, possibilitou uma nova percepção do seu próprio corpo, bem como favoreceu a reaquisição das percepções sensório motoras, melhorando as atividades e independência funcional da paciente.

Descritores: Equilíbrio postural; Modalidades de fisioterapia; Lesões encefálicas; Propriocepção; Reabilitação.

ABSTRACT

Objective: this longitudinal case study evaluates the effects of the Muscle Dynamics Reprogramming method in patients with traumatic brain injury. **Method:** this is a case report, with a 21-year-old female patient, with etiological diagnosis of sequelae of traumatic brain injury, attended twice a week, from 2018 to 2020. The evaluations were made by anamnesis form, static and dynamic postural evaluation, standard sensory evaluation ASIA and the Measure of Functional Independence. **Results:** there was a gain in general motor control and a decrease in pain, in terms of ASIA, about the sensitivity with the needle (Δ% = 51.8%) and sensitivity to light touch (Δ% = 58.6%); and, in the MIF, evolutions in self-care, mobility and locomotion were observed (Δ% = 64.82%). **Conclusion:** the strategy with the patient, allowed a new perception of her own body, requiring a work of great attention and concentration, as well as favored the reacquisition of sensory-motor perceptions, improving the individual and the functional independence of the patient.

[1] Universidade Federal do Amazonas, Manaus-AM. *E-mail: laisdelgado98@gmail.com
[2] Escola de Postura Brasil – EPB, Rio de Janeiro-RJ.
[3] Universidade Federal do Estado do Rio de Janeiro, Rio de Janeiro-RJ

Descriptors: Postural balance; Physical therapy modalities; Brain injuries; Propoception; Rehabilitation.

RESUMEN

Objetivo: este estudio longitudinal de casos evalúa los efectos del método de Reprogramación Dinámica Muscular en pacientes con lesión cerebral traumática. **Método:** se trata de un reporte de caso, con una paciente femenina de 21 años de edad, con diagnóstico etiológico de secuelas de lesión cerebral traumática, atendida dos veces por semana, desde 2018 hasta 2020. Las evaluaciones se realizaron mediante formulario de anamnesis, evaluación postural estática y dinámica, evaluación sensorial estándar ASIA y la Medida de Independencia Funcional. **Resultados:** hubo una ganancia en el control motor general y una disminución del dolor, en términos de ASIA, sobre la sensibilidad con la aguja (Δ% = 51,8%) y la sensibilidad al tacto leve (Δ% = 58,6%); y, en el MIF, se observaron evoluciones en el autocuidado, la movilidad y la locomoción (Δ% = 64,82%). **Conclusiones:** la estrategia con la paciente, permitió una nueva percepción de su propio cuerpo, requiriendo un trabajo de gran atención y concentración, así como favoreció la readquisición de percepciones sensomotoras, mejorando las actividades y la independencia funcional de la paciente.

Descriptores: Equilibrio postural; Modalidades de terapia física; Lesiones cerebrales traumáticas; Propiocepción; Rehabilitación.

INTRODUCTION

The Dynamic Muscle Reprogramming ("RDM") method was created by Brazilian physiotherapist Francisco Miguel Pinto in the year 2000. It is a self-therapy induced by corrective postures and aims to stimulate the neuromuscular system through a combination of micro-flexions in the joints of the human body and its applicability is through the use of elements made from special polymers (Proprioceptive Elements/EPC - RDM Kit) inserted into strategic points of the body, which are identified in the examination of postural vectors.[1,3]

RDM works in the rehabilitation of postural and orthopedic alterations and the treatment of pain. Its main characteristic is to re-establish symmetry and reorganize proprioceptive and neuromuscular stimulation, breaking down blockages between muscle and joint, teaching/re-educating the patient to achieve self-control of the body. EPCs act as a support/facilitator for microflexioning, activating proprioceptors when they come into contact with the skin.[2-4]

One of the possible dysfunctions that can be treated with RDM is Traumatic Brain Injury (TBI), which can be defined as a trauma that causes an injury to the brain, resulting in permanent or momentary changes of a cognitive and/or functional nature. Carteri and Silva (2020) analyzed the data available on the DATASUS platform on cases of TBI in Brazil, from 2008 to 2019, pointing to the occurrence of 1,572,178.00 hospital admissions. The Brazilian annual average was 131,014.83 hospitalizations associated with TBI and the incidence was 65.54 per 100,000 inhabitants.[5-7]

Many patients present with polytrauma, so the heterogeneous neuropathological results of TBI possibly express the multifaceted acute and chronic post-trauma processes that are capable of contributing to neural degeneration. Therefore, the damage to the neuropsychomotor system can be vast and complex, varying according to the location and extent of the injury suffered. To this end, the type of injury is an aggravating factor in the prognosis of TBI victims.[8-10]

In view of the above, the aim of this study was to ascertain the effects of using the Dynamic Muscle Reprogramming/Reeducation (RDM) method on patients after TBI.

METHODS

The research has a descriptive experimental clinical design, with a quantitative, cause and effect approach, carried out by the Laboratório de Estudos em Neurociências e Comportamento (LENC) of the Universidade Federal do Amazonas (UFAM).

The sample consisted of a female patient with a diagnosis of sequelae after traumatic brain injury (TBI), a wheelchair user, seen twice a week, 45-minute session, from 2018 to 2020, by the Multiprofessional Neurofunctional Rehabilitation Center Program (PRONEURO), signing the Informed Consent Form (ICF), approved by the Ethics and Research Committee of the Federal University of Amazonas (CEP/UFAM), with CAAE 14991119.7.0000.5020, with Opinion number: 3.511.484.

After taking an anamnesis, the patient underwent a static posture assessment using a symmetrograph to analyze the frontal, posterior and lateral views, followed by a dynamic assessment to analyze range of motion and balance.

The patient was then assessed using the ASIA scale. The ASIA scale gets its name from the fact that it was developed by the American Spinal Injury Association (ASIA) in 1984 and underwent revisions in 1992, 2002 and the most recent version in 2019. To be more precise, the name of the assessment is: International Standards for Neurological Classification of Spinal Cord Injury (ISNCSCI).

In the ASIA, the result has classifications for each type of sensitivity (light touch and pain), with a total score of 56 points, where the sum of both sides (right and left) results in a maximum of 112 points.[11]

The Functional Independence Measure (FIM) is part of the "Uniform Data System for Medical Rehabilitation" and is widely used internationally. In this instrument, individual performance is assessed in the motor and cognitive/social domains in the following aspects: eating, hygiene, dressing, toilet use, urine control, stool control, transfers, locomotion, comprehension, expression, social interaction, problem solving and memory. Each item varies in seven levels with the respective measurements, level seven being total independence and level one being high dependence.[12,13]

When it comes to RDM, the individual performs each micro-movement using EPCs such as rollers (77cm) and hexagonal polymers (23cm) in green, blue and yellow, a postural modifier, podal palms, a correct, foldable pillow and a flat mattress. All the movements are performed with the EPCs of the three colors, which have varying densities, going from the densest (green), to the medium density (blue) and ending with the least dense (yellow).

Each maneuver is planned according to the vectors evaluated, primarily where the EPCs are positioned, and with each intervention and evolution, progress is made in each color (green - blue - yellow).[3]

In dorsal decubitus (DD) posturing, the micro-movements are started in a caudal to cranial direction, one by one, then together, depending on the patient's difficulty, and in the relaxation phase the micro-movements are carried out as in the initial phase. The postures in the posturing phase vary according to each case and can be: dorsal decubitus (DD), ventral decubitus (DV), lateral decubitus (DL) and sedestation.

The service will therefore take place in three stages:

- **1st half:** Insertion of the elements, always with light pressure on the element. Slow, regular and progressive breathing.
- **2nd half:** Microflexion on exhalation. Maintaining tension within cycle A (6 seconds), B (10 seconds) or C (20 seconds).
- **3rd half:** Beginning the return with a deep inhalation, relaxing the muscles slowly, thus reducing the tension on the elements according to the cycle used.

Case Report

J.F.C.S, female, 21 years old, single, completed high school, with an etiological diagnosis of sequelae of traumatic brain injury (TBI), 5 years ago, caused by a motorcycle accident, leaving her in a vegetative state for 6 months. According to the clinical examinations, the patient had a reduction in brainstem volume, a complete lesion of the right brachial plexus with active denervation, and the presence of degenerative changes in the cervical spine. She started at PRONEURO on August 21, 2018, where we found that the patient had monoplegia in the right upper limb, monoparesis in the right lower limb, dysarthria, changes in sensitivity, significant postural changes and pain complaints according to the VAS scale, functionally dependent, used a locomotion aid (wheelchair).

Based on the analysis of the evaluations, the patient's treatment protocol was put together (Chart 1).

Table 1 - Description of rehabilitation exercises

Dynamic Muscle Reprogramming Protocol®			
Moment 1	Post-clearance: preparation of decompression maneuvers Progressive guidance of controlled breathing associated with movement of the abdomen and chest.	Sitting	Wheelchair or platform with corrector, for 10"
Positioning of the proprioceptive elements of the RDM, according to the examination of the vectors:			
In DD: green EPC (initial color) on the head in neutral posture, on the shoulders (left diagonally and right horizontally) and on the lower back (diagonally on the line of the posterosuperior iliac crest); cylinder under the semi-flexed knees; EPC on the posterior region of the calcaneus, blue palm on the back of the hands, with the upper limbs supine on the side of the body.			
In DL: Head in neutral support with EP 3-fold mattress with active stimulus; EPC in the lateral region of the trunk between the 3rd and 5th ribs (horizontal); cylinder in the medial and proximal region of the knee in flexion or positioned in extension over the EP cylinder; blue corrector in the dorsal region; EPC in the scapular region positioned between the blue corrector.			
Sitting position: blue corrector on the back, EPC on the head for active stimulation, on the lumbar spine and shoulders; cylinder arranged vertically on the side of the body to support the MSD; blue palmar on the back of the hands; orthosis on the MID due to marked inversion.			
In orthostasis: On the orthostatic stretcher, EPC on the head for active stimulation; on the shoulders (left diagonal and right parallel) on the thoracic and lumbar (diagonal on the line of the posterosuperior iliac crest); blue palmar on the back of the hands; orthosis on MID due to marked inversion.			
Microflexing maneuvers on EPCs			
Moment 2	Microflexion maneuver for the cervical spine, shoulders, hips and feet (part 1): Dorsiflexion of the ankle, anteversion of the pelvis, retropulsion of the shoulders with the upper limbs extended and the forearms supinated next to the hip, alignment of the head.	DD	Board

	Shoulder, hip and foot microflexion maneuvers. Shoulder retropulsion + shoulder depression D, anterus and hip retroversion with knees at 90 degrees to the cylinder, foot eversion D.	DLE	Board
	Microflexion maneuvers for the cervical spine, shoulders and hips. Extension of the neck over the EPC, retropulsion of the shoulders + depression of the D shoulder with the upper limbs extended and the forearm supine next to the hip, the lower limb resting on the cylinder on the side, anterus and retroversion of the hip.	Sitting	Board
	Microflexion maneuvers for the cervical spine, shoulders and hips. Extension of the neck over the EPC, retropulsion of the shoulders + depression of the D shoulder with the upper limbs extended. Corrective maneuvers with elevation of the upper limbs.	Ortostasis	Orthostatic stretcher
Moment 3	Global billing Withdrawal of EPs	DD Sitting	Board

RESULTS

With regard to the objectives of the study, different results were obtained during the course of the interventions, such as a reduction in pain, a reduction in postural deviations, an improvement in range of motion (ROM), sensitivity, especially in the MSE and an increase in strength, with greater control in performing movements and better postural control, centralization of the head, a reduction in lumbar rectification, among others, as shown in Table 1 below.

Table 1 - Results of Static Postural Assessments

ITENS	1st Evaluation (2018)	2nd Evaluation (2019)	3rd Evaluation (2020)
Head	L Inclination	L Inclination (-)	L Inclination (-)
	Counterclockwise rotation	Rotation(-) Centralization(+)	Rotation(-) Centralization(+)
	Anteriorizada →	Anteriorização (-)	Anteriorização (-)
L shoulder	Depression↓	Depression	Depression
R shoulder	Elevation↑	Elevation	Elevation(-)
	R Shoulder protrusion →	R Protrusion (-)	R Protrusion (-)
Thales Triangle	< L larger	< L smaller	< L smaller
Neck	Hyperlordosis	Hyperlordosis	Hyperlordosis
Lumbar	Rectification	Rectification	Rectification(-)
Scoliosis curved to the L	sharp	(-)	(-)
Trunk	Clockwise rotation	Clockwise rotation	Clockwise rotation(-)
R Hip	Elevation↑	Elevation↑	(-)
L Hip	Depression↓	Depression↓	Depression↓
R Foot	Sharp inversion	Sharp inversion	Sharp inversion

With regard to the results of the dynamic postural assessment, we observed that in the first assessment the patient was very restricted in the execution of some movements, as well as no movement in the MSD, but we could see significant improvements from the second and third assessments, such as in the range of movement and the ability to execute movements that require balance and postural control (Table 2).

Table 2 - Results of the Dynamic Assessments

ITENS	1st Evaluation (2018)	2nd Evaluation (2019)	3rd Evaluation (2020)
MMSS-Anterior	Negative R-side L-side restriction	Negative R- side Normal L-side	Negative R-side Normal L-side
MMSS-abduction	Negative R-side L-side restriction	Negative R-side Normal L-side	Negative R-side Normal L-side
MMII-Anterior	R-side restriction L-side restriction	R-side restriction(-) Normal L-side	R-side restriction (-) Normal L-side
MMII-abduction	R-side restriction L-side restriction	R-side restriction L-side restriction (-)	Normal
Head-rotation	Restriction for L	Restriction for L	Restriction for L (-)
Head- tilt	Restriction for R	(-)Restriction for R	(-) Restriction for R
Trunk-extension	Negative (does not perform without support)	Restriction (sitting)	Restriction(-) (sitting)
Trunk-rotation	R to L(-)	R to L(+)	R to L(+)
Balance Unipodal support	Negative for MID and MIE	Negative for MID MIE (with external support)	MID restriction (only with orthosis) MIE (without external support)
Balance Sitting	Cannot perform without external support (wheelchair user)	Positive (without external support)	Positive (without external support maintaining alignment)
Orthostatic balance	Negative	Performs with restrictions (external support, MID orthosis)	Performs (with or without MID orthosis)

March	Does not perform (wheelchair user)	Performs with restrictions = short steps, short distance (external support and orthosis on MID)	Performs with restrictions = short steps, moderate distance (with or without external support, with MID orthosis)

As for the ASIA sensitivity assessment, sensitivity with the needle (Δ% = 51.8%) and sensitivity to light touch (Δ% = 58.6%). The patient showed greater alteration in the loss of sensitivity to light touch, especially on the right side, and this evolved positively in the results of the other assessments (Table 3).

Table 3 - General ASIA results

Sensitive	1st Evaluation (2018)	2nd Evaluation (2019)	3ªr Avaliação (2020)
Needle stimulation index (max.: 112)	75	97	100
Light touch stimulation index (max.: 112)	58	92	99

The assessment of the degree of independence (MIF) recorded the evolution of the patient's functional independence (Δ% = 64.82%), covering all the categories assessed by the MIF (Table 4).

Table 4 - General results of the MIF

1st Evaluation	2nd Evaluation	3ªr Avaliação
70	95	109

DISCUSSION

RDM is a new method, so the number of studies is limited. Currently, there are 3 articles that have researched and discussed the application of the method in clinical practice. Among them, two of the articles deal with postural balance and low back pain in industrial workers and the other article deals with the use of the RDM method in patients with spinal cord injury.

In view of this, this study is a pioneer in the experimental investigation of the effect of reprogramming muscle dynamics on sensory-motor treatment resulting from head trauma.

In this study, the patient's degree of muscle strength was preserved in most of her body segments (MSIE grade 4 and MID grade 3 in hip flexion and extension), but the acquired sensorimotor deficits and the loss of proprioceptive stimuli led to a disassociation of the muscle synergies combined to execute the movements.

However, Pinto3 gives us the concept of the method on two bases: the balance of the proprioceptive system and neural reprogramming in the actions of the muscular system. This action is regulated according to the intensity of each proprioceptive element (PE), which triggers the mechanoreceptors that send a new message to the central nervous system (CNS). As the somatosensory system identifies and interprets the message, biochemical and bioelectric actions are sent in response, so the muscular system is being triggered according to the continuous stimuli caused by EPCs positioned in each region of the body.

The human body's proprioceptive complex can adapt with specific exercises to react more efficiently to improve strength, motor coordination, balance and reaction time. Proprioception, skin sensitivity and muscle strength are essential factors in contributing to balance control. Therefore, this sensory feedback to improve motor control is an important tool for recovering the functionality of patients who have suffered neurological trauma.[14,15]

Motor learning, following neurological injury, is a process in which the nervous system modifies motor responses, i.e. it stimulates the patient to activate the cognitive process and it is an implicit, slow process that requires constant repetition, because its tissue has undergone changes in development and maturation.[16]

The RDM protocol applied to the patient in this clinical study, in the period from 2018 to 2020 years of rehabilitation, leads us to declare that it resulted in an evolution of sensory-motor perception. In this way, we can clarify that the study by Martini[4], with a patient with spinal cord injury, is in line with our study, as he also points out in his findings that rehabilitation with RDM has alleviated postural changes and enabled improvement in the control of dynamic movements and gains in the performance of the patient's basic activities of daily living.

A study[17] found after the intervention period that proprioception measures and balance (static and dynamic) improved after sensory motor training, as this corrects muscle imbalance.

Improving postural alignment could also be a factor in improving mobility in people with severe disabilities following traumatic brain injury.[18]

A narrative review of clinical practice guidelines for the treatment of moderate and severe TBI[19] reported that the use of rehabilitation that addresses the needs of people after TBI in all domains of care becomes fundamental in functional outcome. However, it reported the scarcity of intervention trials addressing the outcomes of this population. The study that reviewed existing clinical practice guidelines for TBI rehabilitation found that the main recommendations included multidimensional treatment (education, physical rehabilitation, repetitive practice of specific ADL tasks, cognitive/behavioral feedback, compensatory memory, psychological strategies).[20]

Therefore, the results obtained here lead us to deduce that RDM also provided multidimensional rehabilitation, precisely because of all the changes in the patient's behavior, aided by the microflexion exercises (posturing and corrective), showing an improvement in her functional condition.

Therefore, we can clarify that RDM allowed the patient to feel and interpret each micro-movement, individually or associated, collaborating with motor and cognitive re-learning, understanding that rehabilitation provided the patient with functional independence in carrying out activities of daily living, giving this individual physical, psychological and social well-being.

CONCLUSION

The strategy of re-educating the patient through individual and combined RDM microflexion movements enabled a new perception of her own body, requiring a great deal of attention and concentration, as well as favoring the reacquisition of sensory-motor perceptions, improving the patient's individual activities of daily living and functional independence. However, as this is a new technique, further research is recommended in order to obtain more quantitative and qualitative clinical evidence.

Declaration of interest

The authors report no conflicts of interest.

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