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Case Report

Effects on Muscle Dynamics Reprogramming (RDM) in Spinal Cord Sequelae

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Abstract

Introduction

Muscle Dynamics Reprogramming (RDM) is a physiotherapy technique that works with micro flexions by stimulating the central nervous system by sensory receptors (vision, hearing and touch). Spindle trauma is a disabling neurological injury that can cause paralysis, sensory loss, and neurofunctional dysfunction in young males of the middle socioeconomic class.

Objective

To investigate the effects of muscle dynamics reprogramming (RDM) on spinal cord sequelae.

Method

A descriptive experimental study conducted at the Laboratory of Neuroscience and Behavior Studies of the Faculty of Physical Education and Physiotherapy of the Federal University of Amazonas, approved with CAAE31075814.0.0000.5020. The sample consisted of one (1) male patient with spinal cord injury (wheelchair user), with cervical arthrodesis, attended 2 times a week, 45 minutes each session, totaling 12 sessions by PRONEURO (Multiprofessional Neurofunctional Rehabilitation Nucleos-Program), after signing the informed consent form. The evaluations were based on static assessment data sheet, anamnesis and sensitivity assessment. Rehabilitation by RDM comes from self-therapy induced by corrective stances and microflexions, inserted in articular points, called "body codes" identified in the postural examination. This process facilitates the central nervous system to decode the new movements, reorganizing the tensions and nervous compressions by the movements themselves, stabilizing the loss of motor capacity, sensitivity, motor control.

Results

In regards to the objectives, it was observed that the patient obtained an improvement during the application of the RDM, improving sensitivity, increased strength, dorsi and plan, posture, seated trunk control, motor coordination, range of motion (ADM) and, reducing joint and / or muscle pain, reported during the anamnesis. In the course of the therapy, it was difficult to perform the micro flexing due to the absence of active movements and because the RDM respects the patient's body condition and does not cause injury. Yet, it teaches the patient point by point to self-recognize and recognize their own changes, rehabilitating the movements of the body.

Conclusion

The RDM improved trunk control and increased ADM. Also on functional independence it allowed the patient to assist in feeding, bathing, dressing and lifting of the chair for the transference, reducing the caregiver's overload. However, further investigations involving factors that influence the efficiency of the technique with more individuals are recommended.

Introduction

Rehabilitation by muscular dynamic reprogramming (RDM) comes from self-therapy induced by corrective postures and microflexions (lying, sitting, and standing), inserted in articular points, called "body codes" identified in the postural examination. This process facilitates the central nervous system to decode the new movements, reorganizing the nervous tensions and compressions by the movements themselves, stabilizing the loss of motor capacity, sensitivity, motor control [1].

The RDM was created by the physiotherapist, Dr. Francisco Miguel Pinto in the 90's, researching a type of treatment that would support not only the spine but also the dynamics of other joints and muscles, soothing pain, postural changes and that would stimulates the neurological system, increasing motor control and self-recognition of body limits, as well as overcoming them, through the proprioceptive system [1,2].

The RDM works from child to the third age, in a progressive, continuous and evolutionary way for the body self-control (the patient in control). One of the characteristics that distinguishes the RDM method is to teach, with a progressive therapeutic pedagogy, the patients to know themselves and to recognize their changes with resistive micromovements in each EP that presents variable densities, and thus, to rehabilitate the movements of the body, reconstructing its scheme by conditioning, avoiding the return of the problem and eliminating or controlling every aspect of the postural reconstruction process [2].

The spinal cord injury (LM) is characterized by serious complications that can be devastating to the human being in terms of physical, psychological and social injuries. It can promote injury to the structures of the spinal canal, especially to the spinal cord, causing motor, sensory, autonomic and psychoaffective alterations. The alterations may be due to the affection manifested, mainly due to the paralysis or paresis of the limbs, altered muscle tone, superficial and deep reflexes, alterations or loss of different sensitivities, among others [3,4], preventing the individual from performing their daily activities of daily living, through complete or partial interruption of sensory and / or motor paths [4].

Nowadays, the incidence of LM is 30 to 40 cases per 10000 individuals, with approximately 10,000 new cases per year exclusively in the USA, where 48% of individuals evolve to death, in which 80% at the site of the accident and 4 to 15% after hospital admission. And in Brazil, it is estimated to occur about 40 new cases per million of population, resulting in 6-8 thousand cases a year, raising health care costs (FREITAS, 2016).

Therefore, the purpose of the study was to verify the effects of muscle dynamics reprogramming (RDM) on the spinal cord sequelae.

Material and Method

This is a descriptive and exploratory experimental study, with a quantitative and qualitative approach, developed in a patient diagnosed with lower limb paraplegia and cervical arthrodesis, performed by PRONEURO (Multiprofessional Nucleus of Neurofunctional Rehabilitation), which is developed in the Laboratory of Neurosciences and Behavior Studies of the Faculty of Physical Education and Physiotherapy of the Federal University of Amazonas, approved by the Ethics Committee for Human Research CAAE31075814.0.0000.5020.

The sample consisted of one (1) male patient, 56 years old, with a diagnosis of spinal cord injury (wheelchair user), with cervical arthrodesis, who attended 2 times a week, 45 minutes each session, totaling 21 sessions.

The procedures consisted of filling in the assessment file, presenting the study to the patient, informing about the objectives and processes to be adopted, being invited to participate in the study then signing the Informed Consent Form (TCLE).

Next, the patient was evaluated utilizing the Static and Dynamic Posture Evaluation Form from the Muscular Dynamics Reprogramming Method (RDM), also by the Borg CR10 Scale and by the OASIS: AID / AIVD information set, before and after the sessions of rehabilitation [5].

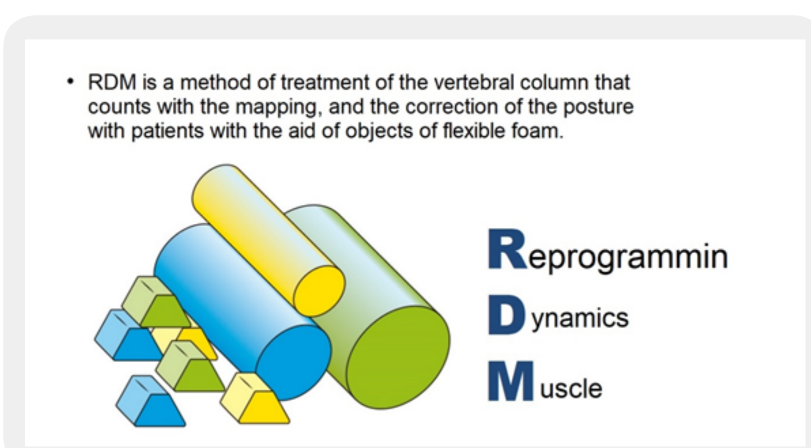
Regarding the instruments, the static posture evaluation is based on patient identification, in posterior, frontal, and right and left lateral views; identification of postural deviation; profession, medications, hypertension, family sickness, and muscle strengthening and relaxation. As for the dynamic evaluation, the degree of flexion, extension, adduction, abduction of body segments, rotation of head and trunk and, by balance in orthostatic position on one lower limb (MMII) and the other flexed near the trunk.

In addition, OASIS (Center for Health Services and Policy Research, 1997) has fourteen (14) items that investigate how to dress up, ability to dress the lower body, showering, toileting, transfer, transportation (driving a car, picking up taxis, buses, etc.), laundry (washing your clothes and / or taking them to the laundry), housekeeping, going to shopping and the ability to use a telephone (answer, enter), where each item can be punctuated from 0 to 5, plus a letter "D" for unknown if it does not respond, determining that the lower the score the better the result.

Regarding the RDM program, the technique is applied in an individualized way, respecting the bodily state of each patient without promoting lesions, because it teaches patient to know themselves and recognize their changes. The elements used are epcs (special proprioceptive foams) in the form of rollers (77 cm) and hexagonal polymers (23 cm), in anti-allergic material in green, blue and yellow colors, in combined densities, postural modifier, calyx palmar, corrective, folding pillow and plain mattress.

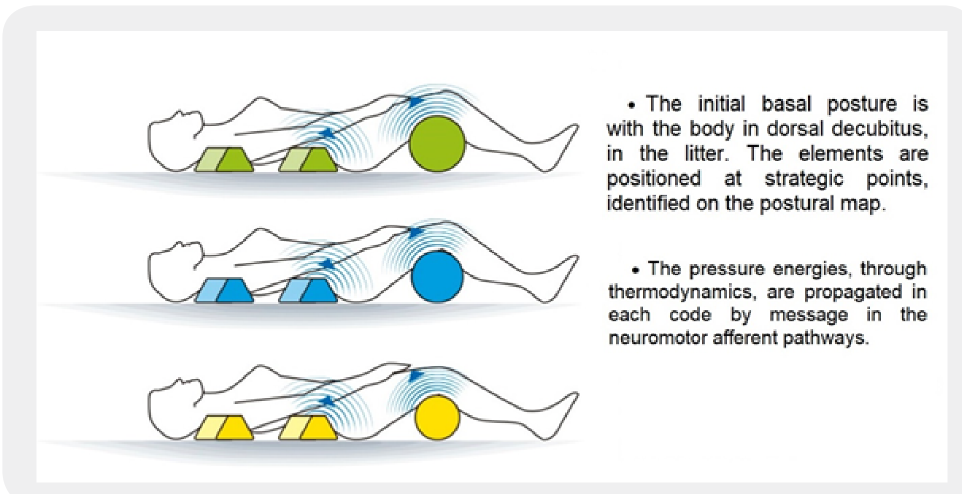
In this methodology the head requires a more efficient connection of the sensory motor system to identify the flexions, extensions and rotations performed by the feet and thus respond to the movement and the posture desired in a precise, deep and controlled manner. Between these two body regions, heads and feet, is where acts perception and adaptation of the whole body against gravity. This process occurs through self-therapy induced by corrective stances (it is the initial phase of the placement of EP - Propriopercetive Elements, made of special polymers with rectangular, cylindrical and quadrangular wedge shapes), see figure 1. [1].

Figure 1: *RDM EPC*



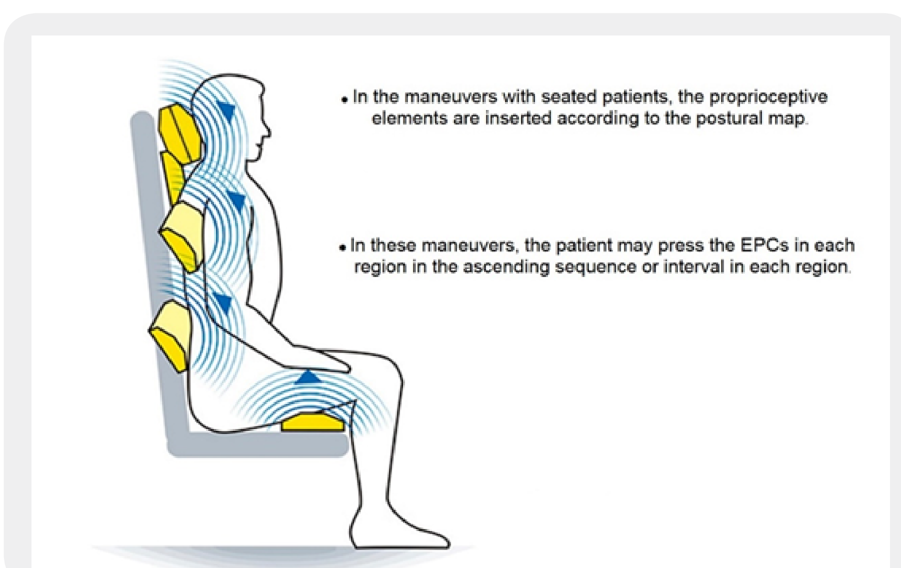
The posture is the first maneuver of the RDM method. This procedure has, in the context of its maneuvers to start the strategies for application of the method, standard postures that need a plane of rigid resistance or regular stiffness. Its use follows the following patterns of posture to initiate the insertion of the EP in each region of the body. Dorsal decubitus, lateral decubitus, ventral decubitus and seated for micro movements. See Figure 2 for the dorsal decubitus pattern.

Figure 2: *Description of posture*



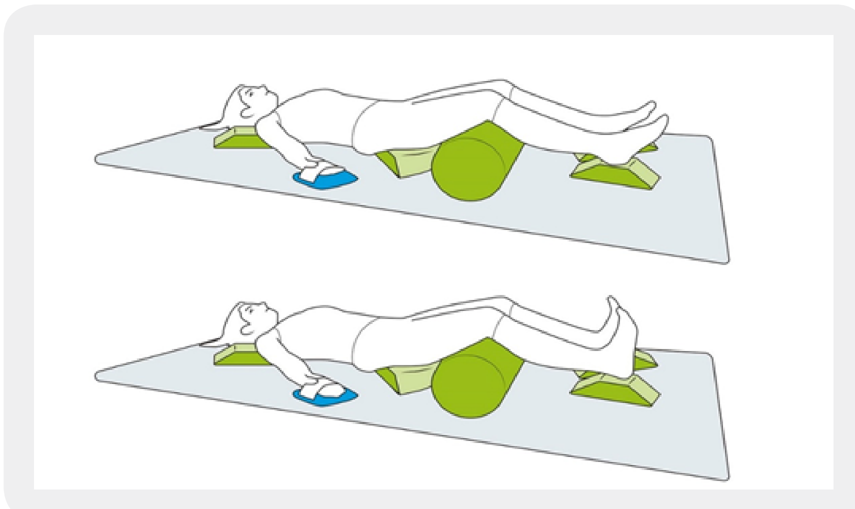
In this case study, we used the posture, sitting to maintain the stimulus pattern at each point of the posture. Seated in the wheelchair the patient was positioned with the insertion of the EP in each region of the body, because it is necessary to adapt the pattern to the limits of the patient in each phase of the treatment, to perform the micro movements. See Figure 3.

Figure 3: *Description of sitting posture.*



In the PE insertion phase, the micro-flexions are performed (it is the phase where the patient performs the pressure movement in the body region where each PE is inserted). All EPs are micro movement facilitators and proprioceptive stimulators in contact with the skin. See Figure 4.

Figure 4: *Description of microflexions.*



Case Report

Patient Marco Aurélio (fictitious name), male, 56 years old, married, occupational safety technician, and diagnosed with spinal cord injury for 1 year and 5 months. In the history of the current illness, the patient reported that he came home very tired and went straight to the bathroom. Sometime later, he woke up disoriented in a hospital and did not know what had happened with him. His relatives reported that he had slept in the toilet and that he fell on the floor hitting his forehead and was taken to the emergency room. Still, they stated that with the fall, the patient broke his nose, the cervical spine (C5 and C6) and underwent a fixation surgery (arthrodesis).

Upon arriving at the clinic the patient was in a wheelchair pushed by his relative presenting an aspect of sadness, bent posture, anxious and afraid to move, feeling pain and making it difficult to transfer the wheelchair to the stage.

Regarding the history of the previous disease, the patient presented complementary tests that indicated the diagnosis of spinal cord injury, with cervical spine arthrodesis (C5 / C6) and controlled systemic hypertension. In regards to the social history and family history, he reports that there was no similar accident, and reported that he used analgesic, but did not do physiotherapeutic rehabilitation.

After the anamnesis, a physical examination was performed to verify that the vital signs had the following values:

Table 1: *Vital Signs*

Items	1st Evaluation	2nd Evaluation
Heart Freq	56 bpm	58 bpm
Respiratory Freq	19 ipm	21 ipm
Blood pressure	120 mmHg	120 mmHg

During physical examination, it was noticed that the muscle tone, assessed by the muscular belly on palpation, was normotonic in the upper limbs (MMSS) and lower limb hypotonic (MMII); muscle strength was presented in different degrees for the MMSS and MMII muscles, according to the Oxford scale, shown in Table 2 and 3 below.

Table 2: *Muscle Strength MMSS*

ITEMS	1st Evaluation		2nd Evaluation	
	Right	Left	Right	Left
Deltoideus	3	3	4	4
flexors handle	1	1	2	2
Curl	3	3	4	4
Extender handle	3	3	3	3
Triceps	2	2	2	2
Pronation	2	2	3	3
supination	2	2	3	3

Table 3: *Muscle Strength MMII*

ITEMS	1st Evaluation		2nd Evaluation	
	Right	Left	Right	Left
hip adductors	0	0	2	2
Quadriceps	2	2	2	3
iliopsoas	2	2	2	3
anterior tibialis	2	2	2	3
gluteus maximus	0	0	2	2
Gastrocnemius	0	0	2	2
gluteus medius	2	0	3	2

Next, the patient underwent a physical therapy rehabilitation program, utilizing muscle dynamics reprogramming technique (RDM), for a total of 21 sessions of 45 minutes each. At the end of the sessions, a new evaluation was performed, with the same protocols, totalling two evaluations at the end of the study, showing a positive evolution of the patient.

In what comprises the rehabilitation program, it was developed in two phases as follows:

Table 4: *Description of rehabilitation exercises.*

<table>
<tr><th colspan="4">Dynamic Reprogramming Protoco®</th></tr>
<tr><td>Moment 1</td><td>Posture that is the preparation of the maneuvers for decompression and in the reprogramming of the muscular dynamics.</td><td>Sitting posture</td><td>Wheel chair</td></tr>
<tr><td colspan="4">Positioning proprioceptives elements of RDM®: Fold pillow with 2 levels greener EPC cervical, EPC green on the shoulders and back and EPC green on the back, positioned (9 points), EPC green for cervical support, shoulders, elbows and backs of hands. Posture seated in the wheelchair by 90 degrees.</td></tr>
<tr><td rowspan="4">Moment 2</td><td>Microstructures maneuvers in the proprioceptive elements.</td><td rowspan="2">Seated Posture</td><td rowspan="2">Wheelchair</td></tr>
<tr><td>Micro flexion of the cervical spine, shoulders and hips (part 1) Cycle A, 6 repetitions of 10 “Micros movements for flexion and extension of the cervical, shoulder retropulsion with extended upper limbs and forearms in supination to the side of the hip on the chair, angle knees 90 degrees, support of elbows and back of the hands throughout the procedure in the chair 7 points in the green color</td></tr>
<tr><td>Micro flexion maneuver of the cervical spine, shoulders and hips (part 2): for blue color in 7 points Cycle A, 6 repetitions of 6 “. Micros movement of flexion and extension of the cervical spine, retropulsion of the shoulders with extended upper limbs and hand in supination to the side of the hip on the wheelchair, minimum micro antero movements and retroversion of the hip with knees in 90 degrees in the blue color.</td><td rowspan="2">Posture</td><td rowspan="2">Tablado</td></tr>
<tr><td>Laying Micro flexion maneuver of the cervical spine, shoulders and hips (part 3): Change of the elements to yellow in the 5 points except the dorsal one. Cycle A, 6 repetitions of 6 “. Micro movement of flexion and extension of the cervical, shoulder retropulsion with upper limbs extended and the hand in supination to the side of the hip on the wheelchair, antero and retroversion of the hip with knees in 90 degrees in the yellow</td></tr>
</table>

During the treatment sessions, regarding evidences, it was observed that the patient was exhibiting improvement in the increased range of motion (AM) after the amounts of EPC which were used, as example 1 EPC: folding pillow and wedge to, 1 epc: wedge (between the 6th and 10th session), as well as in the sensitivity and reacquisition of strength.

Also, that the sensorimotor perceptions evolved in terms of lower limb movements (MMII), which at first presented only outline in muscle contraction and it had to be aided in full execution of the movement (dorsiflexion) and started to perform the movement with more control.

Among the MMIIs, the patient had more difficulty in performing the movement on the right limb (MD) and that from about the 10th session on the therapist only assisted in the dorsal flexion of MMIID with a slight touch, while the left one the patient performed the movement in its fullness.

Results

In the scope of this study, different results were verified in the static postural evaluation, as indicated in Table 5 below. In this study, it was possible to observe that there was an improvement in the patient's posture, where it was found that all the evaluated items obtained a decrease after the intervention by the RDM, pointing to the decrease of the angle of the scoliosis and the increase of the amplitude of movement (AM) in the cervical region.

Table 5: *Results of Static Postural Assessment.*

Static Posture		
ITEMS	**1st Rating**	**2nd Rating**
Scoliosis left	sharp	(-)
Shoulder D	Elevation ↑	Normal
Shoulder And	Depression ↓	Normal
Head	Tilt↖D	Tilt↖(-) D
Thales triangle	<largest	E> lower and
anterior head	→ →	(-)
Rotation clockwise rotation	↻accentuated	↻arthrodesis decreased
Blood pressure	NORMAL	NORMAL
cervical	Very limiting	+ AM

Within dynamic results, were identified differences of the movements performed and the AM between the 1st and 2nd evaluation, as described in Table 6 below. These results reveal that improvement in body functionality was obtained.

Table 6: *Results of the Dynamic Evaluation.*

Dynamic		
Items	**1st Assessment**	**2nd Assessment**
Glenohumeral Elevation	Bilateral Restriction	Positive Bilateral + AM
Arm Extension	Bilateral Restriction	Positive Bilateral + AM
Glenohumeral Abduction	Bilateral Restriction up to 60°	Bilateral Positive up to 80°
Glenohumeral Elevation joining the palmar region	Bilateral Restriction up to 60° hands closed	Positive Bilateral up to 70° + AM of the hands
Head up and down	Restriction for both	+ AM for both
Bilateral head rotation	Restriction 20°	Positive 30°
Free trunk rotation	DOES NOT EXECUTE	Restriction 20°
Bilateral trunk bilateral flexion	Restriction 10° - without balance	
Lumbar extension 2x hand on the waist and knee	DOES NOT EXECUTE	SKETCH
Lumbar / extended bracing of the torso (hands crossed on the chest)	DOES NOT EXECUTE	Restriction 10°
Embrace standing knee (balance)	DOES NOT PERFORM	SEATED SKETCH

Regarding the level of pain, the 1st and 2nd evaluation, as described in Table 7 below. According to this, it is clear that the pain in these body regions were suppressed.

Table 7: *Results of PAIN LEVEL.*

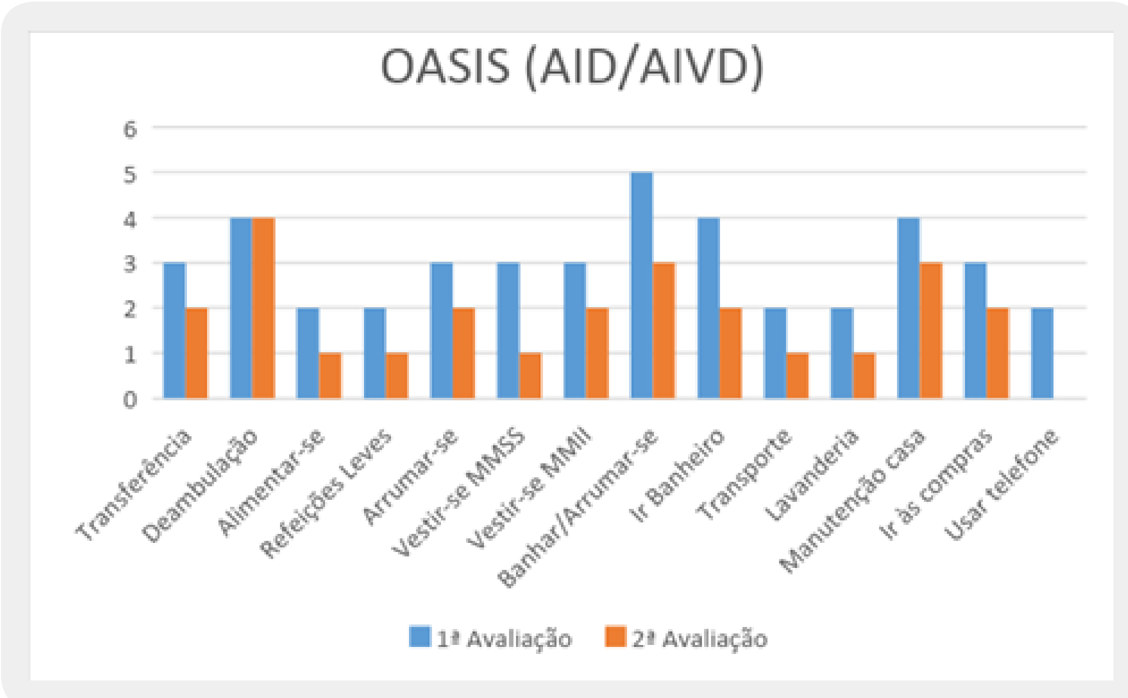
Pain Scale/Level		
Items	**1st Evaluation**	**2nd Evaluation**
High Lumbar	5	0
Shoulder	3	0

In what concerns the evaluation of the individual and patient's individual daily life activity, there was evolution in 13 of the 14 items, as indicated in Chart 1 below, as well as the improvement of the patient, decreasing the score from 42 to 25, according to Table 8 below. However, it is possible to perceive that the patient has evolved positively in the individual and individual activity of daily life.

Table 8: *Results in OASIS (AID / AIVD).*

OASIS (AID / IADL)	
1st Rating	**2nd Rating**
42	25

Chart 1: *Representation of the Individual and Individual Activity of Daily Life*



Discussion

During this study, it was established the existence of two articles that discussed muscular dynamics reprogramming (RDM), addressing postural balance, reducing back pain and reducing pain in industrial workers.

Regarding the sensorimotor deficits caused by the spinal cord injury, this is the first experimental study that was performed, therefore there is no other article comparing to the RDM.

Consequently, we have chosen to compare the results obtained with other researchers who discuss similar and sensorimotor techniques, which may support the results of this study.

According to Neves *et al.* (2014) the study performed with 18 athletes (age = 23.2 ± 3.15 years) distributed in 2 groups, in capsule-ligament lesions that can generate mechanical instability and varied symptomatology, during 6 weeks using a sensorimotor program that promoted improvement in the postural control in dynamic tasks in the time of stabilization after receiving a jump [6].

Somatic sensation makes the primary reception in the parietal cortex, where the lower limb is located (MMII) and, with the organization of dermatomes of the periphery, there is replacement by a somatotopia in the cortex emphasizing the acuity of the sensation [7]. The brain receives information from all its parts, as well as sends the commands to produce the movements, allowing the control and awareness of the sensations [8].

Vieira and Cistia (2016) studied cerebral palsy (CP) with the objective of evaluating the evolution of the training of dynamic postural balance through varied proprioceptive strategies in an experimental manner as the "case study" type with the participation of a teenager at a fifteen years old age group. The final results showed evolution and increase in postural adjustments, both compensatory and anticipatory in the control of dynamic postural balance in stable and unstable surfaces [9].

Sensory reeducation allows reversal of errors on sensory reproduction, gauging new representation of the affected parts for reorganization of the sensory "map" [8].

Oliveira *et al.* (2018) clarifies that the reduction of proprioceptive acuity promotes the individual functional deficits, being essential the muscular control in the participation of the protective response during a movement. Also, that the proprioceptive exercises reestablish the deficits originated from musculoskeletal lesions [10].

Leao *et al.* (2017) studied individuals with spinal cord injury at thoracic level presenting impairments in their functionality and quality of life, using virtual reality as a therapeutic resource, aiming to increase balance and range of motion through simulation of sports and daily activities. It showed the effectiveness of the technique for the improvement of balance and quality of life, allowing greater safety for the accomplishment of the activities in the postures of sedestation and standing [11].

However, it is understood that the sensory-motor stimulation is essential for the rehabilitation of the individual spinal cord sequelae, and that through this it is intended to promote more functionality in the individual's daily life activities, enabling a better quality of life for the individual and for the family, as well as for social welfare.

Conclusion

The scope of this new technique in rehabilitation instigates this population because it values its potential, favoring the reacquisition of its sensory-motor perceptions since, there is an active participation in the therapy without causing injuries.

Nevertheless, we can understand that it is possible to find barriers that will limit the functionality of the paraplegic patient, within social and family environment, that may stop the continuity of the therapy and act retroactively on its functionality.

Therefore, in this single and first case, it is possible to infer that rehabilitation with RDM promoted improvement in the individual and individual activities of the patient's daily life, to gain more range of motion and to improve their sensorimotor perceptions.

But, as any new technique and with a single individual, it is recommended further investigation in order to produce more evidence, quantitatively and qualitatively, of the evolution on patients with spinal cord injury.

Bibliography

1. Alcântara Lamb, Souza Man & Almeida, R. J. (2015). Aspects of the quality of life of people with spinal cord injury in Brazil: an integrative review. *Health and Research Review, 8*(3), 569-575.

2. Borg, G. (2000). *Borg's scale for pain and perceived exertion.* São Paulo: Manole.

3. Stokes, M. (2000). *Neurology for Physiotherapists.* Premier: São Paulo.

4. Lion, C. D., Barros, G. M., Santos, M. C. S. & Oliveira, L. S. Impact of virtual reality on balance and quality of life in individuals with spinal cord injury

5. Miranda, T. A. B. (2016). Analysis of induced sensory-motor cortex reorganization by physical activity in an experimental model of spinal cord injury. Thesis, Faculty of Medicine, University of São Paulo: São Paulo.

6. Moura, R. C. R. (2016). The treatment of task-specific dystonia in musicians: motor and sensory aspects involved in the process. OPUS, 22(1).

7. Neves, A. M. S., Melo, F. M. S. & Oliveira Rans (2014). Effects of a sensory-motor program on postural control and the prevalence of injuries in corneal athletes. Master's thesis of the University of Lisbon, Faculty of Human Motricity.

8. Vieira, E. N. & Cistia, C. S. D. (2016). Evolution of dynamic balance training in diphasic adolescent spastic subjects submitted to the proprioceptive exercise program - case study. Postgraduate Studies in Developmental Disorders, São Paulo, 16, nº2, 77-88.

9. Oliveira, J. B., France, D. B., Batista, É. V. & Pontes, S. S. (2018). Cuttings of approaches and proprioceptive rehabilitation: narrative bibliographic review. *Give Science in Focus, 2*(1), 128-140.

10. Pinto, F. M., Knoplch, J. & Dantas, E. M. H. (2010). The Dynamic Muscular Reeducation in Postural Equilibrium and Reduction of Low Back Pain in Industrial Workers. Sao Paulo. World of Health.

11. Pinto, F. M., Dantas, E. M. H., Silvia, B. C. & Bertoni, G. (2012). Effects of Muscle Dynamic Re-education on Pain and Drug Reduction in Industrial Workers. Spain. *Journal Physiotherapy.*