Developing the Kabat Concept: Progressive Modular Rebalancing System (RMP) with Neurokinetic Facilitations

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Abstract

Background: In consideration of a significant amount of scientific studies produced, presently there is no rehabilitation techniques unanimously accepted and recommended. This article presents a new approach to rehabilitation, the Progressive Modular Rebalancing (RMP) System with Neuro Kinetic Facilitation based on the development of Proprioceptive Neuromuscular Facilitations (PNF), a treatment method conceived in the United States in the 40s by Kabat.

Method: Based on scientific evidence of consolidated neurophysiological principles and clinical practice, several recommendations concerning the use of the RMP System in rehabilitation have been developed. Such recommendations deal with four elements biarticular functions, postural exercises, pyramid progressions, stretching exercises and consequent assessments. Compared to PNF approach, this method permits to offer a rehabilitation program tailored on the patient's needs.

Discussion: The four new elements of RMP System allow defining a patient-specific therapeutic program compared to what you can get with PNF.

Conclusion: It is possible to state that RMP System represents an innovative and versatile rehabilitative approach that contemplates the integration of several basic disciplines (motor learning–feed-forward) and permits to identify specific therapeutic program for the Neurological Rehabilitation area, in particular to treat patients affected by Parkinson's disease.

Keywords: Neurorehabilitation; New technique; Neurophysiology

Introduction

The Proprioceptive Neuromuscular Facilitations (PNF) is a motor learning approach used in neuromotor development training to improve motor function and facilitate maximal muscular contraction. The PNF method was developed at the end of the 40s in the United States by a physician and neurophysiologist, Herman Kabat [1,2].

The experiences of Sister Elisabeth Kenney, an Australian nurse who treated the patients affected by poliomyelitis with specific stretching activities and muscular building up, soon influenced the ideas of Kabat. At that time Sister Kenney's work was considered a routine treatment but not supported by a sound neurophysiologic justification.

Kabat discovered that by stimulating the distal segments even the proprioceptors in the proximal segments were stimulated, using proprioceptive techniques on young patients affected by cerebral palsy and other neurological diseases. He integrated Sister Kenney's work with Sherrington [3] discoveries about subsequent induction, mutual innervations and inhibition, thus conceiving a rehabilitation technique called "Proprioceptive Facilitation". The method's aims were creating and improving movement in the areas where neurological system had

been compromised. The purpose of Kabat was developing a practical method to enable physicians to analyze the motor act of a patient and, at the same time, identifying the most effective strategies of functional movements. Therefore, PNF is an instrument which allows to assess and rehab neuromuscular dysfunctions.

In the mid-1940s Kabat work caught the attention of a rich businessman, Henry Kaiser, whose son was affected by Multiple Sclerosis. Together they created Kaiser-Kabat Institute of Washington, DC. In 1948, another Kaiser-Kabat Institute was opened in Vallejo, California, and a third one in Santa Monica, California, in 1950.

In 1945 Kabat started collaboration with Margaret (Maggie) Knott, a therapist. Together they kept on improving and developing the treatment techniques and procedures. In 1953 Dorothy Voss joined the group; in 1954 she integrated the technique name, conceived by Kabat (Proprioceptive Facilitation), adding the term "Neuromuscular".

In 1956 Dorothy Voss, together with Margaret Knott, published the first book on PNF [4]. The three colleagues continued developing and refining the essential concepts of the technique, today known as PNF. In order to obtain a functional motor act, the muscles should work in synergy and this would happen if they stretch and contract alternating. A dysfunctional movement is often associated to an alteration of the

body neuromuscular-proprioceptive afferences, which makes the muscles inhibited or less facilitated.

Each highly functional motor act, simultaneously requires different types of muscle contractions; while a body segment performs a mobility function through the use of concentric and eccentric muscle contractions, another segment performs a stability function, using isometric muscle contractions. The alteration of the process cause inability to create a mobility and stability relationship in the structure.

PNF method uses specific techniques for muscle recruitment either to facilitate or to inhibit the muscle contraction thus improving the above-mentioned relationship.

At the end of the '60s Monari introduced this technique in Italy. Thanks to his experience in several study groups in Italian universities, he developed and transformed it in as much to change its name before into Facilitazioni Neurocinetiche Progressive (Progressive Neurokinetic Facilitation)[5] and then into Sistema di Riequilibrio Modulare Progressivo con Facilitazioni Neurocinetiche (Progressive Modular Rebalancing System with Neurokinetic Facilitations) (RMP) [6].

Monari, aware of the non-ductility of PNF, tried to turn this system into a new approach to rehabilitation, especially for neurological diseases. The aim of this article is to present the new RMP system.

Method

Differences between PNF and RMP

Activation of PNF schemes in biarticular functions (1st Development: period '74-'80).

PNF method: The motor schemes activating the musculature in synergistic fashion are not distinguished from the ones using biarticular function.

Muscle contraction regulation is obtained with a stimulus-response model and through a feedback motor system [7].

RMP development: Use of the "proprioceptive system" [8] and of the whole "motor sensory system" [9].

In RMP system the schemes activating biarticular muscles are distinguished from those producing a synergistic musculature activation. It is also stressed the importance of the biarticular function, a more advanced cortical integration process [10] compared with synergistic musculature activation. Kinesiology books describe the musculature biarticular function [11-13], but it is not explained the difference between biarticular or synergistic muscle activation.

The therapeutic exercise activating biarticular muscle has extremely important peculiar features:

- It forces the muscle to modify its length thus determining a certain level of elasticity that would be otherwise lost. This observation originated the importance of defining and assessing muscle lengths;
- It forces the muscle to divide its effort between proximal and distal insertion;
- It permits to regulate the muscle recruitment between the two elements according to the request and needs (intelligent function) through a feed forward motor learning system [14-17] (cortical modulation of the action);

The synergistic muscle activation is much simpler:

- The muscle not "decide" on which percentage its recruitment has to be distributed; it concentrates all its strength either on one or on the other insertion (poor cortical activation);
- The muscle does not modify its length, as when it shortens on an insertion, it proportionally stretches on the opposite one.

Biarticularity is less powerful than synergistic activation (qualitative recruitment) but it allows organizing translation functions such as human walking.

The postural passages (2nd development: period '74 –'80)

PNF method: The postural passages are used to teach the patient to move in the space in order to become autonomous (e. g .rolling on the bed, be seated, etc.).

Postural passages are used only as muscle recruitment and no specific assessment is proposed.

RMP development: Being able to move or not within a space is an important indicator of the integration capacity of the different truncal movements of a muscle recruiting deficit or, mainly, of a reduction in muscle lengths. In RMP, postural passages are indicators of a specific assessment; according to the manner the passage is carried out, it is possible to assess if subject presents a strength or muscle length deficit.

The trunk moves on different planes and it is possible to distinguish among four essential movements:

- Rotation, developed on the horizontal plane;
- Flexion and extension, developed on the sagittal plane;
- Inclination, developed on the front plane.

Integration among these basic movements performed on different planes determines a correct function of the trunk and supports the lower limbs action during deambulation.

Pyramidal progressions (3rd development: period '78-'86)

PNF method: Not present.

RMP development: With RMP system it is introduced the concept of "Pyramidal Progressions". The passage from a position to another of the body in the space (prone, supine, lateral and vertical) [18] occurs according to a pyramidal progression where, as for stability and balance, a physics formula is developed [19] the wider is the support base, the lower is the barycentre height and the greater the stability. In this way, it is possible to predict a series of body positions in the space implementing such physics principles. A gradual variation of body positions in the space gradually reduces the support base while raising the barycentre height. Such positions are correlated among them in structuring verticalization and contribute to configure a pyramidal complex providing elements to assess the patient's stability during verticalization and walking [20].

Stretching exercises (4th development–from the 90s to date)

PNF method: Stretching techniques [21-27]. Selective muscle stretching techniques carried out on a single motor scheme [28].

RMP elaboration: Selective and global muscle stretching techniques.

Active Global Stretching Exercises carried out using movement combinations defined by PNF as Reciprocal Bilateral Asymmetric

Motor Schemes (BAR) (exclusively used for muscle recruiting). They permit to eliminate compensation producing a real muscle stretching so making possible to develop a specific scale of measurement of the articular Range Of Motion (ROM) [29,30].

In RMP system the stretching techniques objectives are:

- Recovering muscle elasticity (facilitating the muscle contracting capacity and enhancing the muscle strength through stretching exercise to improve elasticity [31-33] as first activity and muscle recruitment immediately after)

- Muscle rebalance [34,35] (recovering a more balanced function or group of functions by stretching the antagonist musculature and immediately after recruiting the agonist one).

The measurement of muscle lengths, also those not considered stricto sensu pathological, permits to understand and point out the existing imbalances and to set up a specific and appropriate therapeutic approach tailored according to the specific possibilities of each single subject.

The assessments (5th Development –from the year 2000 to date)

PNF method: Not present.

RMP elaboration: Key concepts such as assessment of variable neurokinetic chains are presented through tridimensional schemes conceived and studied by H. Kabat who revolutionized the old concepts of segmental assessment. Four assessments have been included in the rehabilitation path: two of them based on observation and the remaining ones on technical-manual assessments.

- Postural passages assessment sheet: It assesses truncal functions both considered as mobility in the space and muscle recruiting capacity in performing the four basic movements.

- Balance assessment sheet: It verifies the gradual pyramidal progression in the four positions in space (prone, supine, lateral, vertical), the structuring of verticalization considering the constant relationship between size of support base and barycentre heights, and its correlations.

- Muscle length assessment sheet selective assessment of muscle lengths carried out in combination with motor scheme (BAR/BSR) without any possibility of compensation; it is an objective assessment defined in terms of range of articular mobility (ROM). The assessment is developed according to 4 levels: 3=maximum tension; 2=average tension; 1=mild tension; 0=no tension.

- Muscle recruitment assessment sheet: It assesses the different muscle recruitments methods in a "pyramidal" progression both with respect to gravity and to recruitment quality (synergistic/biarticular schemes).

Treatment program in RMP

After an initial assessment, performed using the assessment sheets described above, the specific Rehabilitation Program can be planned [36].

The purpose of the program is treating the existing unbalance (or Rebalancing) in other words:

- Recreating the correct relationship between shortened (inflexible) and hypotonic-hypostenic structures.

- A movement may be limited due to the antagonist muscle tension; in this case it is necessary to recreate the correct relationship between agonist and antagonist (muscle rebalancing). The principle behind this kind of approach is the following: "The antagonist muscle stretching and the agonist muscle recruitment are two sides of the same coin".

- The movement limitation may be due to the antagonist weakness: it is therefore important to recover muscle elasticity (elasticization) and a greater contracting capacity through stretching exercises and the following recruiting in biarticular fashion.

- Agonist and antagonist muscles may both be shortened and weakened.

- The task of rehabilitator is defining what kind of unbalance is present and he must work out the most suitable solution to the problem.

- Recovering the correct relationship between pathologic and physiologic schemes.

- Recovering the correct relationship between visual control and kinesthesis.

- Recovering the correct relationship between elements organizing the virtualization and exercising the function.

Discussion

RMP system innovations, such as bi-articular functions, postural exercises, pyramid progressions, stretching exercises, allows a proper assessment to define a patient-specific therapeutic program compared to what you can get with PNF.

The work focused on unbalance is defined Modular because based on specific exercises distinguished in progressive and variable treatment modules according to the pathology treated, to the patient affected and to the disease status (acute, sub-acute or chronic ones).

The treatment modules are variable also with respect to the patient's capacity to collaborate, to the patient's age, to the severity of the pathology and to the presence of sensibility disorders.

The work is also defined as Progressive since the therapeutic exercise will be adaptable to the different pathologies and to the patient's level of recovery. The progression may be proposed in different ways according to:

- Severity;

- Kind of contraction produced to performed the movement (if concentric, eccentric or isometric ones);

- Scheme organization (space-time configuration) whether simple or complex ones;

- Relationship associated to gravity, i.e. the relationship between the width of the support base and the barycentre height.

It is therefore possible to state that RMP represents a versatile rehabilitation approach which allows to obtain advantages in specific aspects of neuro-rehabilitation through its assessments and multiform therapeutic approach

The preliminary data on the effectiveness of Progressive Modular Rebalancing System to treat patients affected by Parkinson's disease were presented at the 41st SIMFER Congress in Rome.

Declaration of Interest Section

The authors report no declaration of interest.

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