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The Effect of Strengthening Exercise Using the Sprinter/Skater Patterns

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Background and Purpose

In a physical therapy, therapeutic exercise is regarded as motor learning, and clinical emphasis is being placed mostly on the aspects of teaching. We educate patients on how to develop their motor skills and how to implement home exercise programs. We also teach them to change their lifestyle in order to prevent health problems and maintain wellness. Nevertheless, although most physical therapists consider this education as an important matter, only few raise the question of how to teach more effectively. Until recently, we could find very few researches dealing with the subject of learning principles and teaching methods in therapeutic education.

Another important factor in successful therapeutic exercise program is adopting effective exercising methods. Sumway-Cook and Wollacott(1995) reported that the neurofacilitation approach, which emphasize facilitation of normal movement patterns, does not effectively result in a functional transfer. Thelen and Smith(1994) advocated the comprehensive action approach focused on functionality. Marjolijn(2001) also supported the functional approach, where therapists direct patients to find solutions to their problems on their own, rather than providing them with the direct results - therapists would then select functional tasks based on the characteristics of each patient, and the patient would repeat the tasks in his/her functional circumstances.

In spite of these changes in therapeutic exercise theories, PNF is still holding onto the same conventional concepts, with the instructors more or less keeping the same regimen. Therefore it would be meaningful to discuss the effects and benefits of resistive exercise using the Sprinter/Skater Patterns, which includes all PNF concepts and at the same time, in which further applications are possible in terms of motor control and motor learning principles.

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Methods

1. Case study

This patient, a 26-year-old female, came to my clinic on June 28, 2004. She had her brain damaged from a car accident on December 9, 2003, and had been hospitalized and treated at a university clinic until some time in 2004.

When she first came to my clinic, she was not able to move her right arm at all, and had foot drop on the right leg. She could not put on her shoes on her own and required assistance to walk.

We trained her with resistive exercise using the Sprinter & Skater Patterns, for 2 hours per session, 3 to 4 times per week. Then we measured the results by recording the form changes in the Printer & Skater Patterns at supine, sidelying, longsitting, sitting, and standing positions, after 3, 8, 9, and 10 months.

Results

The results of the Sprinter/Skater Patterns exercise with the subjects with damaged nervous system are as follows:

1. SUPINE

Fig.1 is at around 3 months into the treatment. She was not able to do the right elbow flexion of the Sprinter pattern. But, Fig 2 is at 8 months - she can do the elbow flexion. 9 months - she's doing the Sprinter without shaking the arms But her hand is in front of her face(Fig 3). 10 months - looks much better, with the hands off the face(Fig 4). 14 months - she's much more stable(Fig 5).

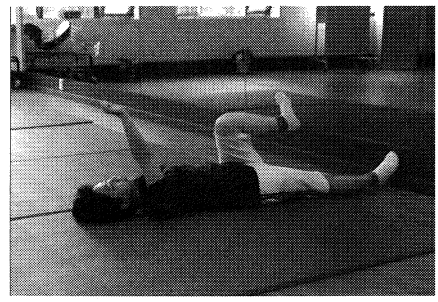

Fig 1. Right arm sprinter pattern at 3months after treatment

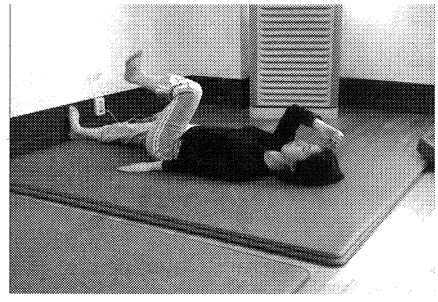

Fig 2. Right arm sprinter pattern at 8months after treatment

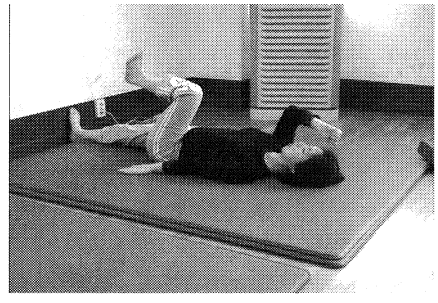

Fig 3. Right arm sprinter pattern at 9months after treatment

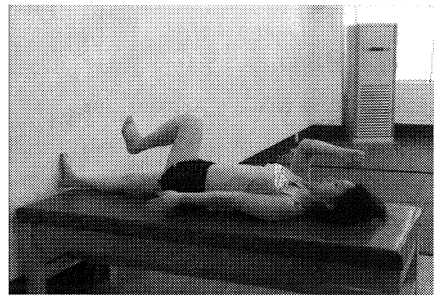

Fig 4. Right arm sprinter pattern at 10months after treatment

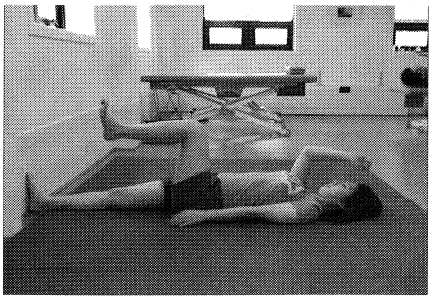

Fig 5. Right arm sprinter pattern at 14months after treatment

2. SIDELYING

At 3 months - she's not able to use her right arm yet, so she's using her left arm to support her body. Her right leg seems a bit shaky(Fig 6). 8 months - She seems in position, but the right arm is very shaky(Fig 7). 9 months - He right arm looks much more stable(Fig 8). 10 months - Showing a firm stance, but the elbow is too open(Fig 9). 14 months - much more stable(Fig 10).

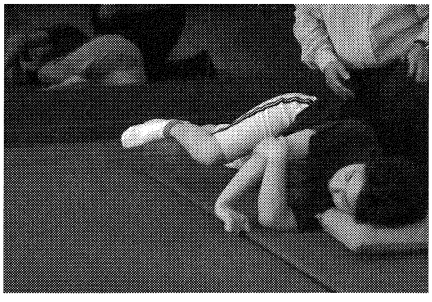

Fig 6. Right arm sprinter pattern at 3months after treatment

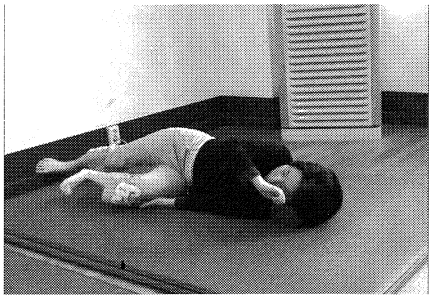

Fig 7. Right arm sprinter pattern at 8months after treatment

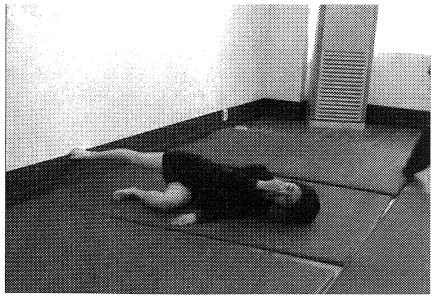

Fig 8. Right arm sprinter pattern at 9months after treatment

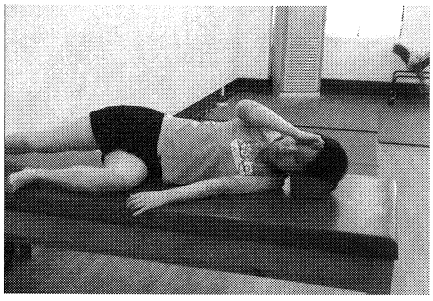

Fig 9. Right arm sprinter pattern at 10months after treatment

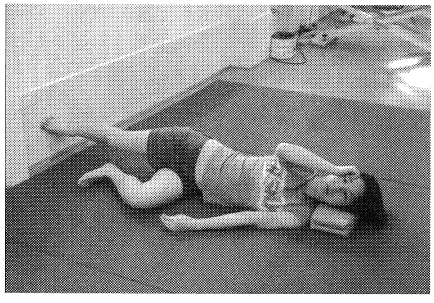

Fig 10. Right arm sprinter pattern at 14months after treatment

3. LONGSITTING

This is at 3 months - her arms look very clumsy and shaky(Fig 11). At 8 months - her Sprinter is not precise yet, but her arms are showing some improvement. One elbow is drop, though(Fig 12).

9 months - her arms are quite stable(Fig 13). 10 months - she's lifting her arms more gracefully(Fig 14).

14 months - we are seeing a big difference here(Fig 15).

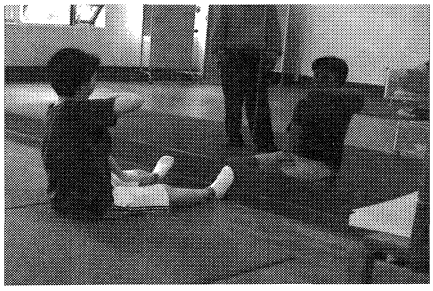

Fig 11. Right arm sprinter pattern at 3months after treatment

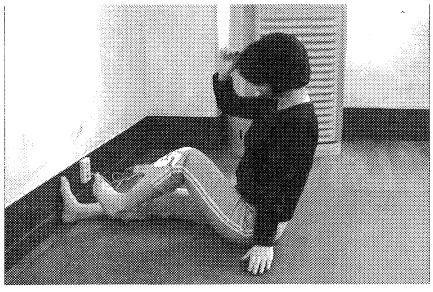

Fig 12. Right arm sprinter pattern at 8months after treatment

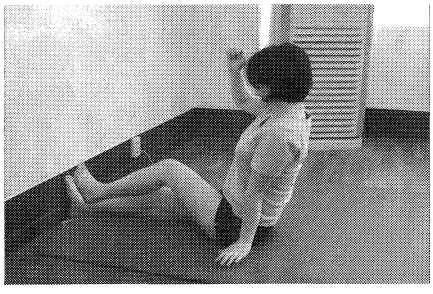

Fig 13. Right arm sprinter pattern at 9months after treatment

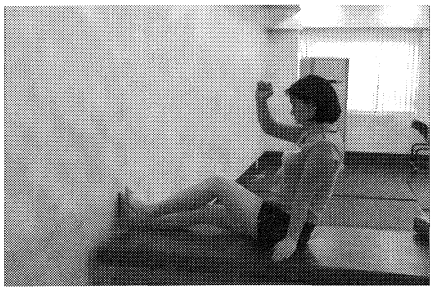

Fig 14. Right arm sprinter pattern at 10months after treatment

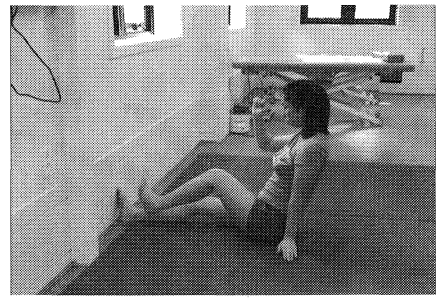

Fig 15. Right arm sprinter pattern at 14months after treatment

4. SITTING

3 months - she's not able to lift her right arm yet(Fig 16). 8 months - she can lift her arm now, but it looks very unstable(Fig 17). 9 months - her arms move much better, but she has the trunk too far back(Fig 18). 10 months - Not enough extrnal rotation on her upper body. She can't bring her elbows inward (Fig 19). 14 months - A big progress. Much better controp on the upper body(Fig 20).

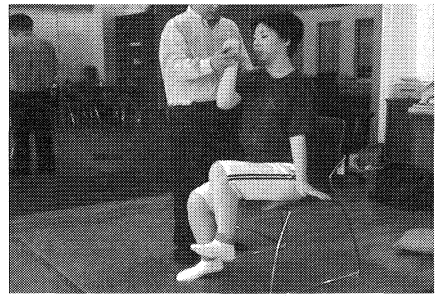

Fig 16. Right arm sprinter pattern at 3months after treatment

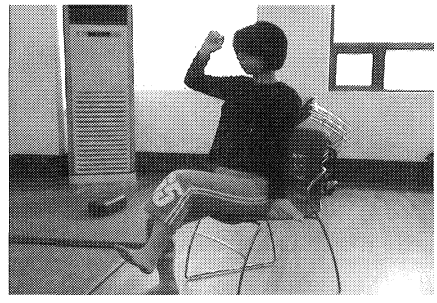

Fig 17. Right arm sprinter pattern at 8months after treatment

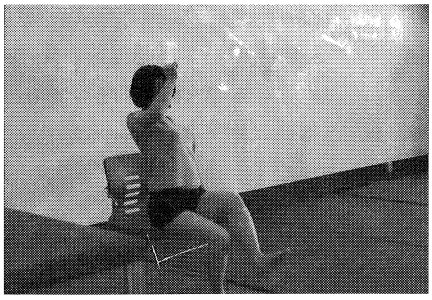

Fig 18. Right arm sprinter pattern at 9months after treatment

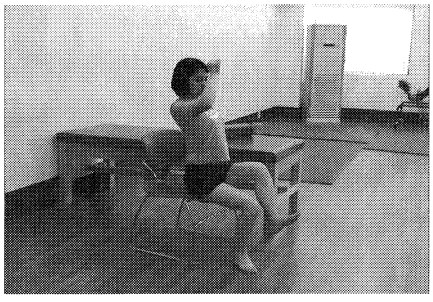

Fig 19. Right arm sprinter pattern at 10months after treatment

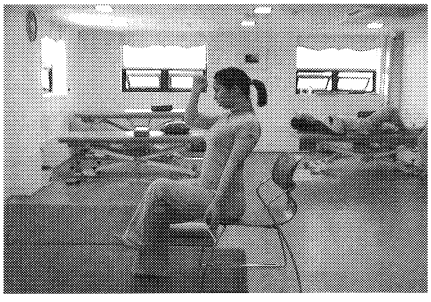

Fig 20. Right arm sprinter pattern at 14months after treatment

5. STANDING

After 10 months - she still has difficulty standing on her right leg. She's standing with her weight on the left leg. This one shows her walking, taken very recently (Movie File 1).

Discussions

From these results, the benefits of the Sprinter /Skater Patterns exercise are summarized as the following:

1. With simplified coordinative structures in motor control, the Sprinter/Skater exercise is an excellent motor learning method for attaining and remembering movement patterns.

The Sprinter/Skater Patterns were devised from actual sporting scenes. Every sport requires motor skills of responding to environment changes and necessary tasks in order to achieve one's objectives. For this, human body generates the most efficient movements and maintain stability with maximum energy in the least amount of time.

The Sprinter/Skater Patterns use the most efficient and functional movements. Also, these patterns well explain very complicated interactions of the independent limbs and the trunk and the head that support the limbs, in simplified coordinative structures.

Additionally, the Sprinter/Skater Patterns exercise is in accordance with the explanation of Turvey et. al (1982), on muscle linkage and coordinative structure in motor control theories, regarding the issues of degree of freedom and context conditioned variability. Furthermore, the Sprinter/Skater exercise is the most simplified(using two patterns) form of degree of freedom in movements. It provides answers to the question of how muscles are functionally linked together and an easy explanation of complicated motor control processes.

From the motor learning aspects, the Sprinter/Skater Patterns are easy to remember

for the learners, since human movements are stored in the memory in abstract forms rather than in specific forms(Schmidt, 1987).

2. The Sprinter/Skater Patterns provide answers as to how to utilize irradiation functionally.

Irradiation in PNF is used in indirect treatment by inducing patient responses. However, the responses may vary in directions and degrees when used by different therapists. There are various PNF patterns, of which several patterns can result in same irradiation on a certain area, whereas one pattern may cause many different responses depending on the situation.

The Sprinter/Skater Patterns require whole body and uses movements induced according to a certain pattern, thus can be used to induce irradiation response for functional facilitation on desired parts. For example, using the Sprinter/Skater Patterns with one leg in the close chain state(one foot on the ground or on the wall), therapist can predict the direction and degree of patient's responses and maximize the desired effects through irradiation.

3. The Sprinter/Skater Patterns enable clear assessment of the effectiveness of a motor learning process, by evaluating SP&SK form changes.

Motor learning is an invisible process. Achievement of the learning objectives is seen as performance improvement and behavioral changes. Another expected result of motor learning is self-organization of the brain, which means the brain creates a new coordinative structure and, in other words, one's forms adapt to the new environment.

Motor skill learning is the process of creating a form, which is the result of harmonic coordination of all body parts involved in a movement, in order to generate the movement most efficiently.

The Sprinter/Skater Patterns include a certain form in various positions. When applied to patients in different positions, the Sprinter /Skater Patterns clearly show the forms in both quality and quantity. Since this enables us to easily grasp the degree of limitation in body movements, we can measure the effectiveness of motor learning and detect problems in the process.

4. The Sprinter/Skater Patterns allow us to define specific objectives, and assign tasks according to difficulty levels, to maximize the effectiveness of a motor learning process.

Locke and Lathem(1985) claimed that specific and challenging tasks make the learners to concentrate better and work harder than simple and easy tasks. They explained that specific and challenging tasks provide the standards to which the learners can compare their achievement to, thus are more effective in having them remain focused.

In motor learning, position choices for movements determine the difficulty level of a task. The Sprinter/Skater gymnastics and exercise programs that we developed include various positions designed in the order of increasing difficulty levels, and present more challenges for the learners.

The programs feature specific learner achievements as well as objectives. We use stopwatches and rulers to measure the

preciseness, duration and speed of the sprinter /skater positions, and present the results in numbers. This way we can better motivate the learners and maximize the effectiveness of motor learning.

5. The Sprinter/Skater Patterns exercise reflects the PNF philoscophy of strengthening the weaker using the stronger, and increases the trunk stability regardless of the body parts used.

Ammons(1956) claimed that the motor effects from the arm and leg on one side of the body transfer to the other side. He explained that the transfer occurs from one hand to the other hand, from one foot to the other foot, or from the hand to the foot, with the maximum transfer occurring between the arms and the legs on opposite sides of the body.

Hellebrandt and Waterland(1962) asserted that the largest bilateral motor skill transfer is achieved by training with excessive loads, and short-term training programs are not effective enough to evoke bilateral transfers. He suggested training should be repeated for a certain period of time to cause effective transfers.

The Sprinter/Skater Patterns convey the answer to the question of "how can we strengthen the weaker using the stronger?" Applying resistive exercise on healthier parts, while having weaker parts in the close chain state with or without a support, is effective in reinforcing the muscles. This therapeutic process is the result of formulating a therapeutic exercise method.

On the other hand, the Sprinter/Skater Patterns emphasize the abdominal muscle enhancement that contributes to the trunk stability. This is in alignment with the PNF concept of stressing the importance of the trunk. The Sprinter/Skater Patterns use both upper and lower extremity movements in all positions to instigate contraction on the abdominal muscles, in order to reinforce the trunk.

6. Since the Sprinter/Skater Patterns include coordinative movements of the limbs that appear in gait cycle, they are effective in developing gaiting capability.

Gaiting is a coordinated act of various body parts, consisting of rhythmic movements of the upper and the lower extremities in swing and stance phases in turns. Shepherd and Carr(2005) suggested that gaiting exercises on individual parts are ineffective, and that it is necessary to implement weight bearing exercise followed by lower limb control and muscle enhancement regimens.

The Sprinter/Skater Patterns incorporate movements of the arms and the legs in swing and stance phases, represented as the Sprinter and the Skater. Using these two patterns dynamically and rhythmically in any positions, combined with proper resistive exercise, facilitates coordinative movements of the limbs and helps enhance gaiting capability.

7. The Sprinter/Skater is a bilateral exercise highly effective in correcting asymmetrical and poor postures.

From a motor learning aspect, using only unilateral movement patterns may lead to asymmetrical and poor postures due to excessive efforts from the learners, wrongful direction from the therapists, or excessive

resistance. The Sprinter/Skater is a bilateral exercise that works the limbs on both sides and without placing excessive pressure on either side of the body. Therefore, the Sprinter /Skater exercise is an effective way of facilitating proper postures retention while exercising. Researches have shown that bilateral exercises are very effective in correcting poor postures resulted from skeletal system problems.

8. The Sprint/Skater Patterns are more efficient learning method for PNF instructors and learners.

In Korea, a large number of physical therapists are investing considerable amount of time and money in PNF training, with a growing number of therapists already completed PNF training. However, most of them still conceive the PNF patterns and techniques as difficult to comprehend. This stems from the fact that most PNF training courses do not assign enough time for practice sessions and the learners do not have opportunities to practice with actual patients but only practice with each other. Additionally, training contents tend to vary with different instructors, which makes learning more challenging.

Since the Sprinter/Skater includes all PNF patterns, and at the same time, uses only two simplified patterns, it enables the learners to acquire PNF elements in a short time. Also, it uses music to facilitate the learning and motivate the learners to experience the patterns with their own body to maximize the learning results. The Sprinter/Skater exercise is an effective training method that helps the therapists apply the PNF patterns to their patients in actual clinical situations.

Conclusion

From the results of the research, it is concluded that resistive exercise using the Sprinter/Skater Patterns has significant advantages to the existing PNF methods, since it includes all conventional PNF concepts and modern motor learning principles at the same time, and uses the human body as a whole. Additionally, we believe it is an excellent complementation to conventional PNF, in that it is easier to apply to learning processes of motor control and skills and provides better means of measuring the learning effectiveness.

However, more researches should be done on this matter, to develop effective practice system based on actual data.

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