THE EFFECTS OF STANDING AND WALKING WITH LEGS BY BEHIND THE KNEE SPLINTS ON FLEXOR MUSCLES TONUS AND KNEE FLEXION DEFORMITY OF CHILDREN WITH DIPLEGIA SPASTIC CEREBRAL PALSY

Rahman Amiri Joumi Lou1,*, Nader Matin2, Ramin Balouchi3, Ehsan Zareian4

1Master of Sports Pathology and Corrective Actions, Allameh Tabataba’i University, Tehran,
2PhD Student of Occupational Therapy, University of Social Welfare and Rehabilitation Sciences, Tehran,
3PhD in Corrective Action and Sports Pathology, Assistant Professor, Allameh Tabataba’i University, Tehran,
4PhD in Motion Behavior, Assistant Professor, Allameh Tabataba’i University, Tehran (IRAN)

*Corresponding author: rahmanamirilou.l@gmail.com

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ABSTRACT

A child with cerebral palsy, who shows spasticity in the lower extremities, is unable to bear correct weight on the lower extremities. The purpose of this study was to examine the effect of standing and walking with legs by behind the knee splints on flexor muscles tonus and knee flexion deformity of children with diplegia spastic cerebral palsy. Among children with cerebral palsy in Ardabil, 10 children with diplegia spastic cerebral palsy who had the desired characteristics noted by the researcher were participated in the study and were practiced for 8 weeks and studied by MODIFIED ASHWORTH, checkered surface, goniometer, and centimeter ruler criteria. Data analysis was performed by using paired t-test (correlated). The highest mean of knee flexion spasticity was reported in the initial evaluation 3.06 and in the secondary evaluation 2.12 and for the ankle plantar flexor (3.375, 2.625) respectively. Also the average distance from the heel to the ground were (5.52, 4.8), and the foot contact with the ground were (250, 375, 273) respectively. Results from statistical analysis indicate that the knee flexor muscle spasticity, plantar flexion of the ankle, and the distance from the heel to the ground decreases. Also, the contact area of the foot to the ground increases. The results of this study show that the use of behind the knee splints on flexor muscle tonus can improve motion function of lower extremities more effectively.

Key words: cerebral palsy, splints, muscle Tonus

1. INTRODUCTION

Cerebral palsy is a neurological developmental disorder that is caused by non-progressive and permanent lesions in one or more areas of immature brain in uterus, during birth or the first few years after birth (usually before age 4)(1, 2). In children with spastic Cerebral palsy, increased muscle tonus, durability of initial reflexes, and nuisance responses such as reactions related to Ativan’s movement become natural which delay the natural process of person’s motion development. And these chronic motion deficiencies seriously impede proper functioning and person’s independent participation in daily activities (3). One of the common methods used to improve these motion deficiencies, is using behind the knee splints (4-8). Diplegia spastic is one kind of cerebral palsy in which the spasticity is low in hands and severe in legs (9). Splint plan in terms of being removable or non-removable always has been a matter of dispute among researchers. However, removable splints unlike non-removable types, while stretching the spastic muscles, also provide movement ability for them and because of preventing inactivity over time, the use of splints can also result in positive outcomes (7, 10-12). But in healthcare centers often a non-removable splint which only holds spastic muscles sedentary in two lengthened positions is used (4).

Research findings show that children and adults with cp, have poor physical and performance ability, and in daily activities despite using more energy they suffer from premature fatigue (13). Children with spastic cerebral palsy due to spasticity in their lower extremities cannot properly and functionally have weight bearing on their lower extremities (9). The important reason of weight bearing on the lower extremities is to obtain movements which are useful not only for strengthening the postural balance, and preventing child with diplegia spastic cerebral palsy to fall back, but are useful during walking (14).

Kerrison et al (1997) studied the effect of two ANKLE-FOOT and SMO orthoses on walking of children with diplegia spastic cerebral palsy, then compared them and achieved significant results (15). In another study conducted by Lumfry and Morgan (1995) about c.s.i method on children with spastic cerebral palsy, they observed reduction in spasticity and improvement in motion function of children (16). Available information in the field of children with diplegia spastic cerebral palsy mobility is limited, thus in this study the researcher examines the effect of behind the knee splints on flexor muscles tonus and flexion deformity of the knee in children with diplegia spastic cerebral palsy.

2. METHODOLOGY

This research is a before and after interventional study that employs ABAB method. The statistical sample consisted of 10 children from diplegia spastic cerebral palsy community of Ardabil, who after filling questionnaires by their parents and assessment by therapists their characteristics were identified as: aged 8-16 years, IQ above 50, having control of the head and neck, and the spasticity in the lower extremities. Thus our sample group due to the limitation of qualified patients was just these 10 children. Before starting the study, in a briefing session, parents were invited and full details of research method were described to them, then they signed a consent form. In this study, evaluation was at 4 ranges of muscle tonus test, position of the knee joint, foot drawing, and the distance from the heel to the ground while standing, which lasted in two periods of one month time. At first, the initial assessment was performed and after 4 weeks of not using behind the knee splints, re-evaluation was performed. And then behind the knee splints were used for 4 weeks and at the end of this period the final or secondary assessment was performed to evaluate spasticity by MODIFIED ASHWORTH criteria which is defined as a response dependent on muscle speed to passive stretch rate. While holding the anterior distal of femur and anterior distal of tibia, the patient’s knee joint was taken from a condition of as much as possible flexed to a condition of as much as possible straighten in about 1 second. The same procedure was repeated for ankle joint, this test was repeated 8-5 times consecutively. Child was laid in
supine position on the mattress, the temperature was mild and assessment was performed during the morning hours of 8-10 in an environment quiet as much as possible. In this research, the plantar contact with checkered surface while weight bearing on the lower extremities and without using behind the thigh splints was measured. So that the child held WALLPAR rod with hands to prevent from falling and houses that were in the range of foot, were counted. To analyze the data, paired T-test was used (p ≤ 0.05). And statistical tests performed by SPSS software version 20.

3. RESULTS

The first and second research hypotheses
1. The effect of standing and walking with legs by behind the knee splints on changes of knee flexor muscles spasticity is statistically significant.
2. The effect of standing and walking with legs by behind the knee splints on changes of plantar flexor muscles of ankles is statistically significant.

The paired t-test (correlated) was used to analyze these hypotheses. In table (1), the results of the paired t-test for the subjects’ scores can be observed.

Table 1. The results of paired t-test to compare the mean scores of the pre-test and post-test subjects

<table>
<thead>
<tr>
<th>Criteria Variables</th>
<th>Paired differences</th>
<th>T-Score</th>
<th>Degree of Freedom</th>
<th>Level of Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Standard deviation</td>
<td>Error deviation from the mean</td>
<td></td>
</tr>
<tr>
<td>Right knee flexor muscle spasticity</td>
<td>1.100</td>
<td>.316</td>
<td>.109</td>
<td>11.28</td>
</tr>
<tr>
<td>Left knee flexor muscle spasticity</td>
<td>.900</td>
<td>.157</td>
<td>.179</td>
<td>5.98</td>
</tr>
<tr>
<td>Right ankle plantar flexor muscles spasticity</td>
<td>1.000</td>
<td>.156</td>
<td>.258</td>
<td>3.87</td>
</tr>
<tr>
<td>Left ankle plantar flexor muscles spasticity</td>
<td>.600</td>
<td>.156</td>
<td>.163</td>
<td>3.67</td>
</tr>
</tbody>
</table>

According to the results listed in Table (1), the calculated T value for right knee flexor muscles spasticity variable with 9 degrees of freedom is equal to 11.00 Which leads to a significance level of .000 and also the T value for left knee flexor muscles spasticity variable is 5.01 which leads to a significance level of .001; Given the significant level is smaller than 5%, therefore it is concluded that the difference between the two scores (pre-test and post-test) with 95% confidence coefficient is statistically significant. Also the T value for right ankle plantar flexor muscles spasticity is 3.87 and for the left ankle is 3.67 which is at a significant level for both ankles. As a result, standing and walking with legs by behind the knee splints has positive effect on changes in knee flexor muscles spasticity, changes in the ankle plantar flexor muscles spasticity and decreases both (knee flexor muscle spasticity and ankles plantar flexor muscles spasticity).

The third and fourth research hypotheses
3. The effect of standing and walking with legs by behind the knee splints on changes in the knee flexor deformities is statistically significant.
4. The effect of standing and walking with legs by behind the knee splints on changes in knee range of motion is statistically significant.

The paired T-test (correlated) was used to examine these hypotheses. In table (2) The Results of paired T-test for the subjects’ scores can be observed.

Table 2. Results of the paired T-test, to compare pre-test and post-test mean scores of subjects

<table>
<thead>
<tr>
<th>Criteria Variables</th>
<th>Paired differences</th>
<th>T-Score</th>
<th>Degree of Freedom</th>
<th>Level of Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Standard deviation</td>
<td>Error deviation from the mean</td>
<td></td>
</tr>
<tr>
<td>Right knee flexor deformity</td>
<td>7.700</td>
<td>3.33</td>
<td>1.68</td>
<td>4.56</td>
</tr>
<tr>
<td>Left knee flexor deformity</td>
<td>4.000</td>
<td>3.97</td>
<td>1.25</td>
<td>3.18</td>
</tr>
<tr>
<td>Changes in the right knee range of motion</td>
<td>-1.600</td>
<td>-7.07</td>
<td>-2.23</td>
<td>-6.70</td>
</tr>
<tr>
<td>Changes in the left knee range of motion</td>
<td>-6.00</td>
<td>-5.16</td>
<td>-1.63</td>
<td>-3.67</td>
</tr>
</tbody>
</table>

As shown in Table (2), the T value calculated for flexor deformity of the right knee and left knee are 4.56 and 3.18 respectively, which leads to the level of significance.001 and.011 for these value of T respectively; Also calculated T value for changes in right knee range of motion with 9 degrees of freedom is equal to -6.708 which leads to level of significance.000; and also the T value for left knee range of motion is -3.674 which leads to level of significance.005; Given the obtained significant level is smaller than 5%, therefore it is concluded that standing and walking with legs by behind the knee splints has positive effect on the knee flexor deformities and changes in the knee range of motion. In other words, it reduces knee flexor deformities and increases the knee range of motion.

The fifth and sixth research hypotheses
5. The effect of standing and walking with legs by behind the knee splints on the changes in distance from the heel to the ground is statistically significant.
6. The effect of standing and walking with legs by behind the knee splints on changes in the plantar surface in contact with the ground is statistically significant.

The paired T-test (correlated) was used to examine these hypotheses. In table (3), results from paired T-test for the subjects’ scores can be observed.
Table 3. Results from paired T-test, to compare pre-test and post-test mean scores of subjects

<table>
<thead>
<tr>
<th>Criteria Variables</th>
<th>Paired differences</th>
<th>T-Score</th>
<th>Degree of Freedom</th>
<th>Level of Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changes in the distance from the right heel to the ground</td>
<td>1.180</td>
<td>.737</td>
<td>.233</td>
<td>4.71</td>
</tr>
<tr>
<td>Changes in the distance from the left heel to the ground</td>
<td>1.180</td>
<td>.567</td>
<td>.179</td>
<td>6.12</td>
</tr>
<tr>
<td>Changes in the right foot contact with the ground</td>
<td>-14.700</td>
<td>9.718</td>
<td>8.073</td>
<td>-4.79</td>
</tr>
<tr>
<td>Changes in the left foot contact with the ground</td>
<td>-10.500</td>
<td>6.851</td>
<td>2.166</td>
<td>-4.84</td>
</tr>
</tbody>
</table>

As shown in Table (3), it is clear that, the calculated T value for changes in the right foot and left foot distance from the ground is 4.71 and 6.12 respectively, which leads to the level of significance.001 and.000 for these T values respectively; Also the calculated T value of changes in the right foot contact with the ground with the degree of freedom of 9 is equal to -4.78 which leads to the level of significance.001 and also the T value for the changes in the left foot contact with the ground is -4.84 which leads to a level of significance.001; Given the obtained significant level is smaller than 5%, therefore it is concluded that standing and walking with legs by behind the knee splints has positive effect on the changes in the heels distance from the ground and changes in foot contact with the ground.

4. DISCUSSION

Children with spastic cerebral palsy have plenty of movement and balance problems. Successive falling of these patients due to their weakness in postural sway and dynamic balancing is very common. Functional tasks such as holding an object in both hands, stop and stand or remove an object from the room floor which needs balance control when standing, if not impossible, for these children is difficult and causes other problems (17).

Considering proponents’ viewpoints of both neuro-developmental treatment and developmental treatment that emphasize the use of weight bearing as a therapy to reduce tonus, and Bobath approach who used plaster molds flexible orthoses as a tool to reduce dynamic and static deformity of the lower limb, in this study by providing behind the knee splints and creating favorable conditions for weight bearing on legs, muscle tonus, the knee extension, distance from heel to the ground, foot contact with the ground before and after treatment were measured.

According to the obtained results in general:

1. The knee and ankle spasticity in both limbs fell, but this was more in the right lower limb. Tonus loss in the lower extremities due to weight bearing, at first may be caused by weight bearing on the muscle tension which this tension facilitated extensor muscles and created tightened coordination of all the organs.
2. The knee extension increased in both organs, but these improvements in the right knee were greater than the left knee. According to this result, decline in flexion deformity from higher slope to lower slope was greater in right knee compare to the left knee. Hyperextension of the knee is because of facilitation effect that weight bearing has on extensor muscles. Also facilitation condition in their muscle strength was created by repeated contraction of the extensor muscles of the lower limb which can be effective to increase the rate of knee extension during standing and weight-bearing.
3. Significant increase in the amount of foot contact with the ground was observed and was higher on the right foot. This could cause by extension of ankle plantar flexion muscles during weight bearing and could be a facilitation effect of weight-bearing on ankle dorsiflexion muscles.
4. The distance from the heel to the ground also declined. This reduction for the right foot was greater than the left foot.

5. CONCLUSIONS

The results of this study show that the use of behind the knee splints for one month period by children with diplegia spastic cerebral palsy to stand and walk was effective. In the evaluation, spasticity, distance from the heel to the ground, knee extension, foot contact with the ground and in the case of weight bearing without the splints, increased after treatment compare to before treatment. Changes can be observed and recorded more comprehensively by increasing the number of treatment sessions and increasing and validating the tests. As the overall result, using behind the knee splints as a therapy improves the performance of the lower extremities of children with cerebral palsy.

REFERENCES