IJBPAS, April, 2016, 5(4): 812-825

ISSN: 2277–4998

International Journal of Biology, Pharmacy and Allied Sciences (IJBPAS)

'A Bridge Between Laboratory and Reader'

www.ijbpas.com

EFFECTS OF FUNCTIONAL PHYSICAL THERAPY ON MOTOR ABILITIES OF CHILDREN WITH SPASTIC CEREBRAL PALSY

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ABSTRACT

The motive of the current study was to discern whether the motor abilities of children with spastic cerebral palsy who acquired injuries and strokes during peri-natal period of birth and post-natal (up to 3 months after birth) were receiving functional physical therapy revamped more than the motor abilities of those children who were receiving physical therapy based on the proposition of improving the quality of movement in reference group. The subjects taken from four special education schools of Faisalabad city were sixteen children (nine boys, seven girls) with spastic/pyramidal cerebral palsy from which seven were diagnosed with mild pyramidal diparesis, five with moderate pyramidal hemiparesis four with moderate pyramidal pentaparesis. Participants of both the groups met therapy per week thricely for 50 minutes. Stratified sampling technique was used to allocate the children into two groups. Basic gross motor abilities such as lying & rolling (item 2 & 6), sitting (item 23 & 24), crawling & kneeling (item 43 & 46), standing (item 63 & 64) and walking, running and jumping (item 78 & 79) were measured by using Gross Motor Function Measure (GMFM-66). There were three follow-up assessments: 2, 4 and 6 months after the pre-test conducting by the therapists. Both the groups improved after

receiving treatment but efficacy of the functional physical therapy (with an emphasis on practicing functional activities) applied to children in experimental group was found more advantageous than physical therapy (with an emphasis on the principle of normalization of the quality of movement by soft tissue massage for joint mobilization or by posture re-education) applied to children in reference group.

Keywords: Cerebral Palsy, Functional, Therapy, Gross Motor.

INTRODUCTION

In April 2006, at an international workshop in Bethesda, MD (USA), it was recognized that the definition and classification of cerebral palsy should be revised under the new patterns of studies on neurology and pathology. The improved definition and classification of cerebral palsy by the Executive Committee provided a common conceptualization of cerebral palsy that met the needs of clinicians, professionals and families (Rosenbaum, P., Peneth, L., Leviton, A., Goldstein, M., Bax, M., Damiano, D., Dan, B., & Jacobsson, B., 2006). Cerebral palsy can be defined as a group of disorders that affect developmental milestones of bodily movements and posture causing sensational, perceptual, behavioral and communicational limitations posing hinderances in daily patterns of life (Goldstein, M. B., & Rosenbaum, M. P et al, 2005). Children with cerebral palsy find it difficult to sit, stand, run, walk and jump independently as the typically developing children do without any hesitation and difficulty. This is because of the tone of muscle mass that becomes low and therefore the strength of muscle mass gets automatic reduction in flexibility affecting mobility of children with cerebral palsy (Maximal, A. L., 1978). Functional therapies precipitate formidably constructive outgrowth such as strengthen of muscles, flexibility of joints, improved gait and sturdy position of the body as well as psychological gains such as feeling of greater well-being and upgraded engagement in multifaceted pursuits (Mcburney, H., Taylor, F. N., Dodd, J. K., & Graham, K. H., 2007).

Therapies improve the ability of impaired muscles and help to establish normal developmental patterns in children with cerebral palsy (Lunderberg, A., 1984). Interventions based on functional therapies can minimize the danger of vertebral fractures implausibly minimizing the danger of lower limb fractures in children with pyramidal cerebral palsy (Caulton, M. J., Ward, A. K., Alsop, W. C., Adams, E. J., &

Mughal, Z. M., 2002). Therapies have glaring outcomes as (Mackinnon, R. J., Noh, S., Lariviere, J., Macphail, A., Allan, E. D., & Laliberte, D., 2009) revealed therapeutic effects of horseback riding in a qualitative study for children with cerebral palsy. Aerobic exercises manifest improved physiological as well as psychological outcomes in children with cerebral palsy (Rogers, A., Furler, l-B., Brinks, S., & Darrah, J., 2008). Postural control mechanisms in children spastic cerebral palsy aging between 7-13 years are modifiable (Shumway-Cock, A., Hutchinson, S., Kartin, D., Price, R., & Woollacott, M., 2003). Likewise, training with body weight support treatments have significant effects on basic gross motor functions in children with cerebral palsy Cherng, R-J., Liu, C-F., Lau, T-W., & Hong, R-B., 2007).

Additionally, physical therapy plays a vital role in enhancing, restoring and maintaining physical, psychological and social well fare of children with cerebral palsy (Antilla, H., Autti-Ramo, I., Suoranta, J., Makela, M., & Malmivaara, A., 2008). Functional physical exercises strengthen muscles and improve basic motor functions of children with spastic cerebral palsy (Lee, H. J., Sung, Y. I., & Yoo, Y. J., 2008). Lower educational level of mothers is associated with lower involvement of children with spastic cerebral palsy in multifaceted enthusiastic activities that play energetic role in improving their basic gross motor skills (Zwier, N. J., Schie, E.m.van. P., Becher, G. J., Smits, D-W., Gorter, W. J., & Dallmeijer., 2010). Active video game playing provides a healthy base for physical therapeutic activities that undoubtedly promotes the ability of motor functioning by restoring natural alignment of muscles in children with cerebral palsy (Howcroft, J., Klejman, S., Fehlings, D., Wright, V., Zabjek, K., Andrysek, J., & Biddiss, E., 2012). Routine use of physical therapy has no well supported advantages in promoting self independency for children with spastic cerebral palsy (Palmer, B. F., Shapiro, K. B., Wachtel, C. R., Allen, C. M., Hiller, E. J., Harryman, E. S., Mosher, S. B., Meinert, L. C., & Capute, J. A., 1988). Children with Spastic Cerebral Palsy have significant lower levels of growth in their stature and weight as compare to normal developing children. Reference standard of growth patterns for children with quadriplegia cerebral palsy was found 5% shorter at the age of 2 years and 10% shorter at the age of 8 years as compare to the growth charts of National Centre for Health Statistics (Krick, J., Murphy-Miller, P., Zeger, S., & Weight, E., 1996). Day-to-day ambulatory physical activity works well

for mobility in children with spastic cerebral palsy (Bjornson, F. K., Belza, B., Kartin, D., Logsdon, R., & McLaughlin, F. J., 2006). The rate of physical fitness was found to be low as compare to typically developing children. Positive relationship was observed between fitness and fatigue as high level of fatigue depicts low level of fitness (Balemans, AC., van Wely, L., Becher, JG., & Dallmeijer, AJ., 2015).

Positive relationship is found between aerobic/non-aerobic fitness and improvement in mobility for children with spastic cerebral palsy as anaerobic fitness is more beneficial for improving mobility capacity in bilateral cerebral palsy rather than unilateral cerebral palsy (Astrid, C., Balemans, J., van Wely, L., Becher, GJ., & Dallmeijer, JA., 2015). Physical exercise programs provide strength and functional recovery to children with spastic cerebral palsy (Damiano, L. D., 2006). Effective motor control exercise program significantly enhances muscle movement for children with spastic cerebral palsy (Bryanton, C., Bosse, J., Brien, M., Mclean, J., McCormick, A., & Sveistrup, H., 2006). Functional physical therapy improves basic gross motor functional skills of daily routine for children with spastic cerebral palsy (Ketelaar, M., Vermeer. A., Hart. H't., Petegem-van. E. v., & Helders. JM. P., 2001). Exercise training programs have significant effects on physical fitness by improving quality of life for children with spastic cerebral palsy (Verschuren. O., Ketelaar. M., Gorter. W. J., Helders. J. M. P., Uiterwaal. S. P. M. C., & Takken. T., 2007).

Statement of the problem

The problem to be investigated was how well functional physical therapy taken as determinant contribute to improve the child's basic gross motor abilities such as laying, rolling, sitting, crawling, kneeling, standing, walking, running and jumping.

Research questions

Following questions were raised to address the research problem:

- What is the influence of independent variable (functional physical therapy) on dependent variable (basic gross motor abilities)?
- What is the significant contribution of independent variable (functional physical therapy) on dependent variable (basic gross motor abilities)?

Rationale of the study

Functional physical therapy optimizes the potential of impaired muscles in children with cerebral palsy. Progressive or non-progressive disturbances that occur during or after birth lead the spastic cerebral children towards restricted life span. Such limitations

require rehabilitation as well as therapeutic services for broaden the independent functional range of children with spastic cerebral palsy. Keeping this particular point in mind the need for research on the efficacy of functional physical therapy for children with spastic cerebral children was felt.

Objectives of the study

- To identify the effectiveness physical therapy (with massages) in improving, restoring and maintaining the natural ability of impaired muscles for children with spastic cerebral palsy.
- To identify the effectiveness of functional physical therapy (with activities/exercises) in improving, restoring and maintaining the natural ability of impaired muscles for children with spastic cerebral palsy.

Study design

Quantitative method was chosen for this study as it enabled the findings of the study to be generalized. Gross Motor Function Measure (GMFM-66) was administered on the subjects selected through stratified sampling technique. Subsequently, collected data was analyzed by Statistical Package for Social Sciences (SPSS) and results were interpreted through mean values and standard deviations.

Functional exercise program

Functional based physical therapies were developed that were easily implemented by the therapists working in special education schools. All the designed functional physical activities were related to lying & rolling (item 2 & 6), sitting (item 23 & 24), crawling & kneeling (item 43 & 46), standing (item 64 & 65) and walking, running and jumping (item 78 & 79) positions of the children with spastic cerebral palsy placed in experimental group. Each functional activity performed by each spastic cerebral palsy child during their school time in experimental group that were lasted between 1- 6 minutes long. Each session was lasted with 55 minutes including 5 minutes of break. After 6 months functional exercises with 3 follow up sessions at the end of 2^{nd} month, 4^{th} month and 6^{th} month, it was expected from the experimental group to improve their motor abilities and performed better while lying, rolling, sitting, crawling, kneeling, standing, walking, running and jumping as well. Likewise, physical therapies not functional in nature were designed and implemented on the participants placed in reference group. All the participants performed exercises during their school time that were lasted 1- 4 minutes long. Session timing along with break for reference group was as same as

determined for experimental group. Follow up sessions were performed at the same day for both the groups and all the participants followed the formulated schedule for the current study.

Activity

In the current study, gross motor functions were assessed by using all the dimensions A (item 2 & 6), B (item 23 & 24), C(item43 & 46), D(item 64 & 65) and E(item 78 & 79) of the Gross Motor Function Measure (GMFM-66). Theses dimensions measured gross motor skills of spastic cerebral palsy such as their laying, rolling, sitting, crawling, kneeling, standing, walking, running, and jumping positions. Researchers chose these basic gross motor positions as most of the children with spastic cerebral palsy find it difficult to lay, roll, sit, crawl, kneel, stand, walk, run and jump independently. Activities such as primitive motor reflexes: asymmetrical tonic neck reflex, symmetrical tonic neck reflex, tonic labyrinthine-prone and supine with practicing intervention positions of prone, prone extension, supine flexion, side lying, side sit, long leg sitting, 4-point quadruped, 2-point quadruped, squat, tall kneel, one half kneel, and standing and spot specific activities and balance/coordination activities to decrease falls were performed with the participants of experimental group for both the items while soft tissue massage for joint mobilization or by posture re-education was performed with the participants of reference group for both items.

Population and sample of the study

All the children with spastic cerebral palsy admitted in government as well as in private schools of Faisalabad City were chosen as the target population of the current study. Sixteen spastic children with cerebral palsy including both girls and boys were chosen from four special education schools as the sample of the current study.

Research instrument

The researchers used Gross Motor Function Measure (GMFM-66) to measure the dependent variables lying & rolling (item 2 & 6), sitting (item 23 & 24), crawling & kneeling (item 43& 46), standing (item 64 & 65) and walking, running and jumping (item 78 & 79) taken as determinants and their effects on child's motor ability.

Data analysis

Collected data was analyzed by Statistical Package for the Social Sciences (SPSS) using mean values and standard deviation to answer the research questions as how well the given factors contribute individually as well as collectively on child's motor ability.

Participant flow

Eligible participants were selected as figure 1 shows the participant flow from start to end of the study. 5 children with spastic cerebral palsy did not meet the eligible criteria. 3 of them were not willing to participate as they get tired soon and got no permission from their parents. Others took part with willingly and with parental permission.

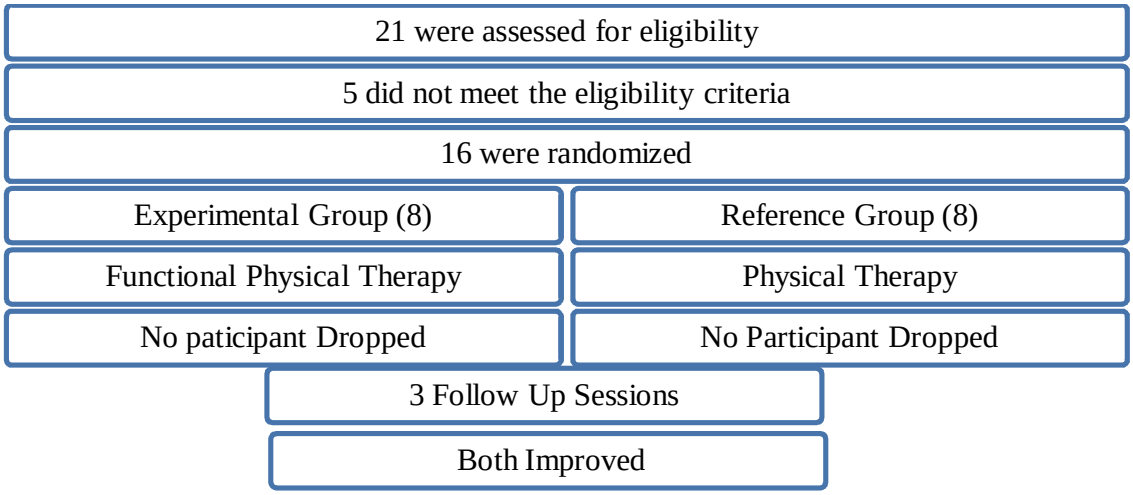


Figure 1: Following flow chart manifests criteria of assessment procedure and follow-up sessions till the end of 6th month program

Table 1: Compatibility model of baseline characteristics

Demography	Experimental Group (n=8)	Reference Group (n=8)
Males	**5**	**4**
Females	**3**	**4**
Mean Ages	**6.50000**	**6.3750**
Standard Deviations of Ages	**1.77281**	**1.59799**
Body Weight (kg)	**Between 31 to 39**	**Between 32 to 36**
Height (Feet and Inches)	**Between 3.2 to 3.9**	**Between 2.9 to 3.7**
CP level	**Mild to Moderate**	**Mild to Moderate**
Birth History	**Post-natal Injury/Stroke**	**Peri/Post-natal Injury/Stroke**
Exercise Capacity	**Below Normal**	**Normal/Below Normal**

RESULTS AND DISCUSSION

The study exposes great difference of results between experimental and reference group on post test with three follow-up sessions that clearly show that the effects of functional physical therapy are greater than the physical therapy working on the principle of tissues. Following are the results of pre-test for both the groups showing mean values and standard deviations with no particular difference at baseline. Afterwards, improvement was undoubtedly observed on the follow-up sessions but the degree of improvement of experimental group was tremendous.

Table 2: Differences between pre-test and F1, F2 and F3 outcomes for experimental group and reference group

Cat.	Pre-test Exp./Ref.	Post-test with F1, F2 and F3 Exp.			Post-test with F1, F2 and F3 Ref.		
Item	M(Std.)	M(Std.)			M(Std.)		
A/2	1.125(.991)	2.125(.640)	2.625(.517)	3.000(.000)	1.625(.744)	2.000(.755)	1.750(.462)
A/6	1.250(.886)	2.625(.575)	2.625(.517)	3.000(.000)	2.166(.701)	2.125(.834)	2.125(.834)
B/23	1.250(.886)	2.125(.640)	2.750(.462)	2.500(.534)	1.625(.744)	2.000(.534)	2.250(.707)
B/24	1.250(1.03)	2.583(.583)	2.750(.462)	2.750(.462)	2.166(.701)	2.500(.534)	2.250(.707)
C/43	1.375(1.06)	2.125(.640)	2.750(.462)	2.750(.462)	1.375(.517)	1.750(.462)	2.250(.707)
C/46	1.250(1.03)	2.625(.575)	2.750(.462)	2.875(.353)	2.125(.679)	2.125(.640)	2.250(.707)
D/64	1.250(1.03)	1.750(.462)	2.625(.517)	2.750(.462)	1.625(.517)	2.000(.755)	2.000(.755)
D/65	1.000(.755)	2.500(.659)	2.750(.462)	2.750(.462)	2.083(.717)	2.000(.755)	2.250(.707)
E/78	1.125(.991)	2.375(.517)	2.500(.534)	2.750(.462)	1.875(.640)	2.125(.640)	2.750(.462)
E/79	1.125(.991)	2.500(.589)	2.625(.517)	2.750(.462)	2.125(.679)	2.000(.534)	2.375(.744)

***F1, F2, F3 denotes Follow-up 1, Follow-up 2 and Follow-up 3**

Mean values of 2.125, 2.625 and 3.000 on 1st follow-up, 2nd follow-up and 3rd follow-up respectively manifests that there is greater importance of functional physical therapy applied on the participants of experimental group than the mean values of 1.625, 2.000 and 1.750 on 1st follow-up, 2nd follow-up and 3rd follow-up respectively denoting values for the reference group who received physical therapy (massages) for category A with the item of 2.

Mean values of 2.625, 2.625 and 3.000 on 1st follow-up, 2nd follow-up and 3rd follow-up respectively manifests that there is greater importance of functional physical therapy applied on the participants of experimental group than the mean values of 1.166, 2.500 and 2.250 on 1st follow-up, 2nd follow-up and 3rd follow-up respectively denoting values for the reference group who received physical therapy (massages) for category A with the item of 6.

Mean values of 2.125, 2.750 and 2.500 on 1st follow-up, 2nd follow-up and 3rd follow-up respectively manifests that there is greater importance of functional physical therapy applied on the participants of experimental group than the mean values of 1.625, 2.000 and 2.250 on 1st follow-up, 2nd follow-up and 3rd follow-up respectively denoting values for the reference group who received physical therapy (massages) for category B with the item of 23.

Mean values of 2.583, 2.750 and 2.750 on 1st follow-up, 2nd follow-up and 3rd follow-up respectively manifests that there is greater importance of functional physical therapy applied on the participants of experimental group than the mean values of 2.166, 2.500 and 2.250 on 1st follow-up, 2nd follow-up and 3rd follow-up respectively denoting values for the reference group who received physical therapy (massages) for category B with the item of 24.

Mean values of 2.125, 2.750 and 2.750 on 1st follow-up, 2nd follow-up and 3rd follow-up respectively manifests that there is greater importance of functional physical therapy applied on the participants of experimental group than the mean values of 1.375, 1.750 and 2.250 on 1st follow-up, 2nd follow-up and 3rd follow-up respectively denoting values for the reference group who received physical therapy (massages) for category C with the item of 43.

Mean values of 2.625, 2.750 and 2.875 on 1st follow-up, 2nd follow-up and 3rd follow-up respectively manifests that there is greater importance of functional physical therapy applied on the participants of experimental group than the mean values of 2.125, 2.125 and 2.250 on 1st follow-up, 2nd follow-up and 3rd follow-up respectively denoting values for the reference group who received physical therapy (massages) for category C with the item of 46.

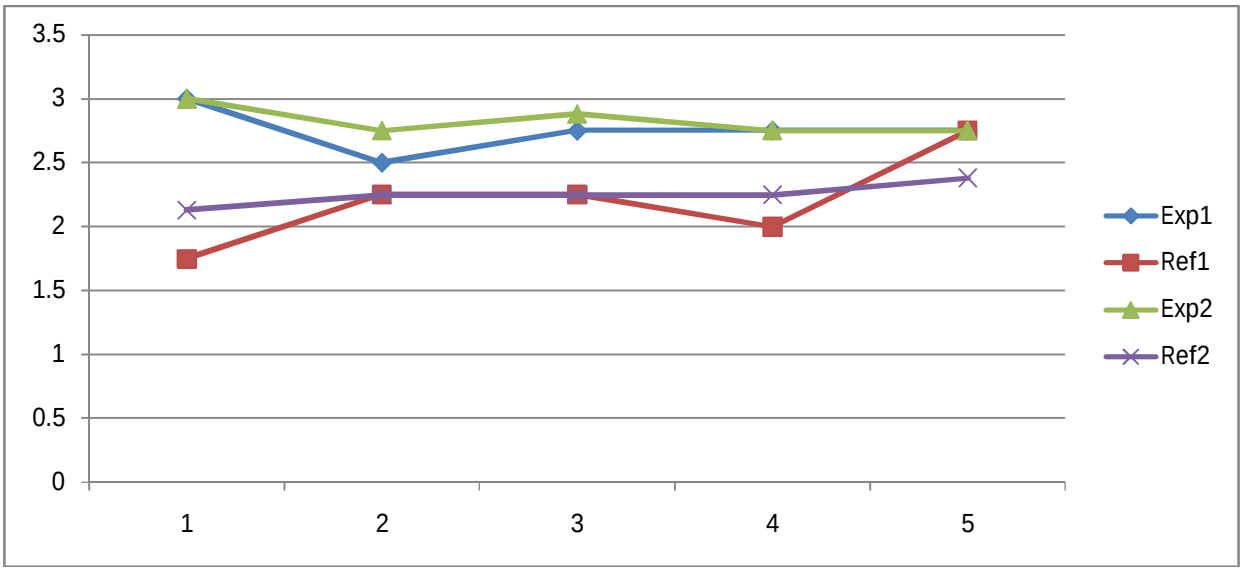
Mean values of 1.750, 2.625 and 2.750 on 1st follow-up, 2nd follow-up and 3rd follow-up respectively manifests that there is greater importance of functional physical therapy applied on the participants of experimental group than the mean values of 1.625, 2.000 and 2.000 on 1st follow-up, 2nd follow-up and 3rd follow-up respectively denoting values for the reference group who received physical therapy (massages) for category D with the item of 64.

Mean values of 2.500, 2.750 and 2.750 on 1st follow-up, 2nd follow-up and 3rd follow-up respectively manifests that there is greater importance of functional physical therapy applied on the participants of experimental group than the mean values of 2.083, 2.000 and 2.250 on 1st follow-up, 2nd follow-up and 3rd follow-up respectively denoting values for the reference group who received physical therapy (massages) for category D with the item of 65.

Mean values of 2.375, 2.500 and 2.750 on 1st follow-up, 2nd follow-up and 3rd follow-up respectively manifests that there is greater importance of functional physical therapy applied on the participants of experimental group than the mean values of 1.875, 2.125 and 2.750 on 1st follow-up, 2nd follow-up and 3rd follow-up respectively denoting values for the reference group who received physical therapy (massages) for category E with the item of 78.

Mean values of 2.500, 2.625 and 2.750 on 1st follow-up, 2nd follow-up and 3rd follow-up respectively manifests that there is greater importance of functional physical therapy applied on the participants of experimental group than the mean values of 2.125, 2.000 and 2.375 on 1st follow-up, 2nd follow-up and

3rd follow-up respectively denoting values for the reference group who received physical therapy (massages) for category E with the item of 79.



Graph 1: Graphic Presentation of differences between outcomes for both the groups

A positive effect of functional physical therapy was observed that evidently manifests improvement in getting high muscle tone while lying, rolling, sitting, crawling, kneeling, standing, walking, running and jumping as well. As above sketched graph presents clear picture of results that the participants of experimental group improved more than the participants of reference group while items 6, 24, 46, 65 and79 show worth mentioning improvement as compare to the items of 2, 23, 43, 64 and 78. Undoubtedly, participants of both the groups improved but the participants of experimental group upgraded their basic motor skills more than the participants of reference group.

Table 3: Exposure of difference between outcomes 3rd follow-up

Category	Grand Mean	Std.	Df	T	Sig. (2-tailed)
Exp. 1	2.750	.17678	4	2.557	.043
Ref. 1	2.300	.27081			
Exp. 2	2.825	.11180	4	6.782	.002
Ref. 2	2.250	.08839			

***As Exp. denotes experimental group for 1st items such as 2, 23, 43, 64 and 78.**
****As Ref. denotes reference group for 1st items such as 2, 23, 43, 64 and 78.**
***As Exp. denotes experimental group for 2nd items such as 6, 24, 46, 65 and 79.**
****As Ref. denotes reference group for 2nd items such as 6, 24, 46, 65 and 79.**

Experimental group with grand mean of 2.7500 and reference group with grand mean 2.3000 manifests that there is greater importance of functional physical therapy applied on the participants of experimental group than physical therapy applied on the

participants of reference group on 3rd follow-up for the items of 2, 23, 43, 64 and 78. Likewise, experimental group with grand mean of 2.8250 and reference group with grand mean of 2.2500 manifests that there is greater importance of functional physical therapy applied on the participants of experimental group than physical therapy applied on the participants of reference group on 3rd follow-up for the items of 6, 24, 46, 65 and 79.

Above mentioned data clearly manifests that the participants of experimental group approximately completed the given task assigned to them with grand mean of (2.750) and standard deviation of (.17678) as compare to the participants included in reference group who approximately completed their task partially with grand mean of (2.3000) and standard deviation of (.27081) for the items of 2, 23, 43, 64 and 78. Undoubtedly, it shows improvement in both the groups but data presents more improvement in the participants of experimental group.

Likewise, the above mentioned data presents a clear picture of difference found in outcomes at 3rd follow-up and exhibits that the participants of experimental group approximately completed their task assigned to them with grand mean of (2.750) and standard deviation of (.17678) as compare to the participants placed in reference group who approximately completed their task partially with grand mean of (2.3000) and standard deviation of (.27081) for the items of 6, 24, 46, 65 and 79. Undoubtedly, it again shows improvement in both the groups but data reveals more improvement in the participants of experimental group. Furthermore, both the groups showed greater difference in improvement on the items of 6, 24, 46, 65 and 79 with significance level of .002 as compare to the improvement on the items of 2, 23, 43, 64 and 78 with significance level of .043.

CONCLUSION

A 6-months exercise based program with standardized activities significantly improved, restored and maintained the impaired strength, flexibility and movement of muscles for children with spastic cerebral palsy. Results of the study showed significant improvement on the items of 6, 24, 46, 65 and 79 along with evidence of greater development in the status of basic motor skills for the experimental group. Such results throw light on the importance of functional physical therapy for restoring, improving and maintaining the status of impaired muscles for children with spastic cerebral palsy.

RECOMMENDATIONS

Primitive motor reflexes: asymmetrical tonic neck reflex, symmetrical tonic neck reflex, tonic labyrinthine-prone and supine with practicing intervention positions of prone, prone extension, supine flexion, side lying, side sit, long leg sitting, 4-point quadruped, 2-point quadruped, squat, tall kneel, one half kneel, and standing and spot specific activities and balance/coordination activities to decrease falls work well for children with spastic cerebral palsy. Such primitive motor reflexes should be applied as they often remove difficulties either changing position of the body in any direction or sharply transferring the direction of conscious/unconscious movement without losing agility and with relative sense of position.

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