International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2020): 7.803

A Study on Effectiveness of Exercise Program on Improvement of Hand Function Following Wrist Tendon Transfer Surgery for Spastic Hemiplegic Cerebral Palsy Children

A. Aroona[1], Marcelin Ancy.R[2], S.Nancy[3]

[1]Professor and HOD in Paediatric Physiotherapy Department in Cherraan's institute of health science, Coimbatore, Tamilnadu, India

[2]Assistant Professor in Cherraan's College of Physiotherapy , Cherraan's Institute of Health Science, Coimbatore, Tamilnadu, India

[3]Clinical Physiotherapist, Ganga Hospital Coimbatore. Tamilnadu, India

Abstract: ***Background: Cerebral palsy is a group of permanent disorder of the development of movement and posture causing the activity limitation, that are attributed to non-progressive disturbances that occurred in the developing fetal or infant brain. Spasticity, the most common type occurs in about 60% of cases and results from disharmony of muscle groups. Children with spastic hemiplegic cerebral palsy often presents with upper limb imbalances. Majority of children falls in this category. Objective of the study: To evaluate the effectiveness of exercise program on improvement of hand function following wrist tendon transfer surgery for spastic hemiplegic cerebral palsy children. Methods: 15 subjects with spastic hemiplegic cerebral palsy children were randomly allocated. The subjects were undergone Shriners Hospital Upper Extremity Evaluation (SHUEE) preoperatively. After surgical intervention, the same subjects were undergone exercise program and regular follow up. The exercise program was given daily 2 sessions. Treatment duration was 30 minutes. The time intervals between each session were approximately 1 hour. The study duration was 6 months. The post-operative functional outcome of children is based on effects of exercises, hand functional training and evaluated by Shriners Hospital Upper Extremity Evaluation. Results: The study revealed that exercise program is effective on the improvement of hand function for spastic hemiplegic cerebral palsy children following wrist tendon transfer surgery among the age group of 9 to 15 years of children. The result showed extremely significant changes in functional outcome p value (0.0005). Conclusions: Systematic exercise program is effective on improvement of hand function following wrist tendon transfer surgery for spastic hemiplegic cerebral palsy children.***

Keywords: Spastic, exercises program, Tendon transfer, wrist, cerebral palsy, Shriners Hospital Upper Extremity Evaluation (SHUEE), children

1. Introduction

Cerebral Palsy (CP) is the musculoskeletal manifestation of a non-progressive central nervous system lesion that usually occurs due to a prenatal affront to the brain. Though the cerebral offend is static the musculoskeletal pathology is progressive. Spasticity of the muscles precedes to shortening of musculoskeletal units which in turn causes fixed contractures and eventually leads to torsional abnormalities of long bones, joint instability, deformities. Spastic cerebral palsy is caused by the damage to the motor cortex and the pyramidal tracts of the brain which connects the motor cortex to the spinal cord. Motor cortex and pyramidal tracts may be damaged by Prenatal brain damage, Lack of oxygen to the brain, train trauma or infection after birth Cerebral palsy is classified according to the type of the body movement and posture. Spastic (pyramidal) cerebral palsy non-spastic (extra pyramidal) cerebral palsy. Spastic cerebral palsy is a common type. There are 4 types of spastic cerebral palsy grouped according to how many limbs are affected. One arm and one leg on the same side of the body (hemiplegia) or both the legs (diplegia). These are the most common types of cerebral palsy. One arm or leg affected (monoplegia). Either both the arms and one leg or both legs and one arm are get affected (triplegia). Both arms and both legs are affected (Quadriplegia). The non-spastic forms of cerebral palsy include – Dyskinetic, Athetoid, Dystonic, Ataxic, Mixed. Dyskinetic cerebral palsy is associated with muscle tone that oscillate between loose and tight. In many cases rapid and jerky or uncontrolled slow continuous movements occur involuntarily these movements most often affect the face, neck, hands, and feet. Athetoid -It is caused by damage in the basal ganglia which regulate the voluntary motor function. Symptoms include unusual facial expression, jerky movements, writhing. Dystonic - In this type the body and neck are held in stiff position. 3 cases per 1000 live births. The number of spastic cerebral palsy patients continues to increase due to an increased survival rate of premature births. Children with spastic hemiplegic cerebral palsy often present with upper limb muscle imbalances. 50% of the children falls in this category. Though the disease is non progressive but the deformities are in this condition can be progressive as the child grows. Upper limb deformities can have great impact on the appearance and overall confidence of the affected children if not treated appropriately the children totally ignore the involved upper limb and the hands becomes non-functional the extent of upper extremity involvement varies between individuals, with the most common deformities being internal rotation at the shoulder, elbow flexion, forearm pronation, wrist and finger flexion, and thumb in-palm. The deformities in spastic cerebral palsy can be prevented by applying splintage are started early.

Clinical evaluations have repeated throughout the childhood allow clinicians to monitor the deformities and select intervention strategy that optimize health and function in children with CP. Assessment of these children involves examination of body function in connection to brain- injury pattern and assessment of the nature and level of motor impairment. Therefore, a standardized assessment should be including the rating of the child's skill level for performing specific motor tasks, activity measures, and overall motor performance assessments. However, children can develop strategies to improve their skills even though they cannot easily change their motor impairment neck, and thumb in palm. Surgical procedures have evolved to treat these kinds of deformities based on multimodal preoperative evaluation including history, physical examination, functional testing. The goals of surgical intervention are set depending on the pre-operative functional status repeated as an outcome measure. The ideal age for the surgery is disputable. Four to six years are recommended because at this age adequate maturation of the nervous system has occurred. Surgical treatment of upper extremity deformity in children with spastic hand is a challenging problem.

Many procedures have been described in the literature that corrects the all or partial flexion and pronation deformities and attempt to provide functional improvement of involved extremity. Since 1942 first described by Green the procedure is FCU to ECRB/ ECRL. Spastic hemiplegic cerebral palsy children can be benefited from this tendon transfer, Fractional lengthening of flexors, re-routing the pronator teres, thumb adductor slide has been one of the standard procedures used in the treatment of forearm pronation, wrist flexion, fingers flexed and thumb in adducted position. or hyperextended. There are many protocols such as early controlled motion, immobilization protocol, late mobilisation. The systematic tendon transfer treatment regime can be start on the 4 weeks. The postoperative cast is removed at 4th week. The patient is placed into a custom-made splint maintaining the wrist in 30-degree extended position. The splint is worn full time for 4 weeks, removing only for active motion exercises and hygiene. Exercises include active donor tendon action followed by transferred tendon action. Therapy can do graded from passive, active assisted, active, stretching and strengthen ing manner. Gentle protective controlled movement should be allowed Training was focussed on fine motor skills with emphasis on keeping wrist in new position

Shriners Hospital Upper Extremity Evaluation:

Shrines Admin 2012 written that the SHUEE is an evaluation tool developed at shrines hospitals for children, Greenville is now used in more than 20 countries world wise. This tool was published in 1996.

The SHUEE is a video-based tool used to assess upper limb movement and function in children with hemiplegic cerebral palsy. It focuses on three domains; spontaneous function (SFA), dynamic position (DPA) and the ability to grasp/release (G/R). Function of the thumb, fingers, wrist, forearm and elbow are assessed. The SHUEE is used as an assessment tool to help plan interventions and then repeated as an outcome measure. study evaluates the functional outcome of wrist tendon transfer in spastic hemiplegic cerebral palsy children using the shrines hospital upper extremity evaluation.

2. Materials and Methodology

- **Study Design:** A Quasi experimental design
- **Study Setting:** Ganga Hospital, Coimbatore
- **Study Population:** Spastic Cerebral palsy children with hemiplegic type
- **Sample Size:** 15 subjects
- **Sampling method:** Conventional sampling method
- **Study duration:** 6 months
- **Treatment duration:** 8 weeks

Inclusion Criteria:
- 9 - 15 years children
- Both male and female
- Cerebral palsy children with spastic hemiplegia
- Spastic Children with wrist tendon transfer procedure

Exclusion Criteria:
- Subjects with fracture
- Any cardio-respiratory disorder
- Children undergone nerve transfer surgery
- Children had Botox injection
- Undergoing any illness

Materials used:
- Shrines hospital upper extremity evaluation form
- Camera
- Shriners material - 100 Rupees note
- Fold wallet, Stiff cord for String & Bead, Bottle, Fork, Playdoh, Coin, Ball, Socks and a Shoe with lace
- Pen
- Paper

3. Procedure

Surgical management: Surgical procedure includes FCU to ECRB Tendon transfer, Fractional lengthening of flexor and Thumb adductor slide. Following tendon transfer procedure, the patient hand has to be immobilised in full volar cast which maintain the wrist in 30 degree extension, MCP joint in 60 degree flexion and IP joint in extended position. Exercise program Following immobilization the therapy was given as follows:

5th week

The slab is converted into thermoplastic splint with wrist in extended position with fingers free. Passive wrist extension exercises followed by active wrist flexion till neutral, Active assisted finger flexion and extension exercises has to be given, Passive stretching exercises for fingers and thumb has to be given. Passive thumb abduction exercises have to be given, encourage opposition exercises Each exercise has been done 25 repetitions, 2 times a day. Splint should be removed only during exercise and hygiene.

6th week

Active assisted wrist extension exercises can initiate at this week, encourage active fingers and thumb mobilisation, Active assisted thumb abduction and opposition exercises has to be given, do not flex the wrist into passive flexion, Scar massage has been done over the suture lines

7th week

Encourage Active wrist extension exercises often. Strengthening exercises can be started once the active wrist extension movement has improved. Strengthening and stretching exercises for fingers and thumb by keeping the wrist in protective extended position. Ball pressing exercises, Thera putty has to be given to improve the finger flexors, Encourage thumb opposition.

8th week

Encourage the patient to start using the hand for activities of daily living. Encourage Bimanual activities, Gentle wrist flexion exercises can do beyond neutral, After the treatment regime, can take the post-operative assessment of SHUEE, to determine functional progression of patients this will helpful.

4. Data Analysis and Interpretation

The statistical analysis used in this study was dependent "t" test. The improvement in the functional activity and participation was measured using SHUEE scores before and after surgery. Paired 't' test was performed to analyse the level of significance of the study.

Table 1: Spontaneous Functional Analysis values Pre and Post – operatively

N	Pre - op score		Post -op score		Mean difference	SD	't' value	Significance level
	Pre -op score	Pre-op mean	Post -op score	Post-op mean				
15	608.13	41.21	965.8	65.97	23.83	13.75	6.70	0.0005

Table 2: Dynamic positional Analysis values Pre and Post – operatively

N	Pre - op score		Post -op score		Mean difference	SD	't' value	Significance level
	Pre -op score	Pre-op mean	Post -op score	Post-op mean				
15	659.4	43.96	1063.75	70.91	26.82	16.69	6.21	0.0005

Table 3: Comparing the means of Grasp and Release values pre and post operatively

N	Pre - op score		Post -op score		Mean difference	SD	't' value	Significance level
	Pre -op score	Pre-op mean	Post -op score	Post-op mean				
15	982.6	65.5	1282.6	85.5	20	17.51	4.42	0.0005

5. Results

In the Mother study "Tendon transfers and Releases for the Wrist and hand in Spastic hemiplegic cerebral palsy following post-operative protocol between the 9 to 12 years age group in both gender were included in this study by Carolien. P. Roode (2010) and study in Hand function in children with Cerebral palsy after upper limb tendon transfer and muscle release in the age group between 6 to 12 years age by Ann christen Eliasson (2000)

This study analysed the effectiveness of upper limb tendon transfer Exercise program with spastic hand cerebral palsy children among the age group of 9 to 15 years and their functional outcomes were analysed using Shriner's hospital upper extremity evaluation before and after surgical intervention. The statistical analysis of pre-and post-operative scores were calculated in three scales.

The mean value of spontaneous functional analysis was 41.216 and standard deviation was 13.75 and p value (0.0005). The mean value of Dynamic positional analysis was 82.42 and standard deviation was16.69 and p value (0.0005). The mean value of Grasp and release was 65.50 and standard deviation was 19.08 and p value (0.0005). The results of this study revealed that there is a significant changes in the improvement of their functional activities and coordination.

6. Discussion

The Spastic flexors of wrist weakens and makes grasping very difficult and it leads to inability of using hands in day-to-day activities. Better wrist position can be gained through tendon transfer followed by regular physiotherapy. Post-operative Exercise programme includes not only the range of motion exercises but also activities of daily living. So, it improves their hand function and make them more independent there by we can improve their quality of life. Exercise program includes systematic exercises with the new position of wrist, which improves their hand function . SHUEE is a video based analytic tool and it is able to demonstrate not only the individual can accomplish a task but also how he performs it. SHUEE generates information relevant to surgical decision making and also it evaluates the result after surgery. Thus, still further scope for this study to analyse the effectiveness of exercise program following wrist tendon transfer surgery using this video based analytic tool to evaluate the improvement of hand function in spastic hemiplegic cerebral palsy children.

7. Limitation

- Smaller group of population were studied.
- Time bound study
- Regular follow up
- Only children undergone wrist tendon transfer surgery were selected

8. Future Suggestions

- A large sample is required to make the study more reliable
- Longer duration of the study with serial evaluation
- Early exercise program

9. Conclusion

The conclusion of the study was to evaluate the effectiveness exercises program in spastic hemiplegic cerebral palsy children following wrist tendon transfer procedure among the age group of 9 to15 years. The effectiveness of exercises program was assessed by pre-operative and post-operative scores and the analysis of data showed that "There is a significant improvement in SHUEE scores" which shows that the increased functional outcome of children after exercises program following wrist tendon transfer surgery.

10. Acknowledgment

We would like to thank all the participants who participated in this study

11. Declarations

Conflicts of interest: Nil

Funding sources: Self

Ethical clearance: Verbal consent and written consent were taken from each child's parents/guardians who participated in the study and Ethical clearance from our Institutional Ethical committee (IEC)

References

[1] Butler EE, Ladd AL, Louie SA, Lamont LE, Wong W, Rose J. Three-dimensional kinematics of the upper limb during a Reach and Grasp Cycle for children. Gait Posture. 2010;32(1):72-7.
[2] Carlson MG, Spin cola LJ, Levin J, McDermott E. Impact of video review on surgical procedure determination for patients with cerebral palsy. J Hand Surg Am. 2009;34(7):1225- 31.
[3] Heathcock J. Assessment of bilateral function in children with upper extremity dysfunction. Dev Med Child Neurol. 2011;53(5):393.
[4] DeLuca SC, Case-Smith J, Stevenson R, Ramey SL. Constraint-induced movement therapy (CIMT) for young children with cerebral palsy: effects of therapeutic dosage. J Pediatr Rehabil Med. 2012;5(2):133-42.
[5] Van Heest AE, Ramachandran V, Stout J, Wervey R, Garcia L. Quantitative and qualitative functional evaluation of upper extremity tendon transfers in spastic hemiplegia caused by cerebral palsy. J Pediatr Orthop. 2008;28(6):679-83.
[6] Klingels K, De Cock P, Desloovere K, Huenaerts C, Molenaers G, Van Nuland I, et al. Comparison of the Melbourne Assessment of Unilateral Upper Limb Function and the Quality of Upper Extremity Skills Test in hemiplegic CP.Dev Med Child Neurol. 2008;50(12):904-9.
[7] Arnould C, Penta M, Renders A, Thonnard JL. ABILHAND-Kids: a measure of manual ability in children with cerebral palsy. Neurology. 2004 28;63(6):1045-52.
[8] Bourke-Taylor H. Melbourne assessment of unilateral upper limb function: construct validity and correlation with the pediatric evaluation of disability inventory. Dev Med Child Neurol. 2003;45(2):92-6.
[9] Damiano D, Abel M, Romness M, Oeffinger D, Tylkowski C, Gorton G, et al. Comparing functional profiles of children with hemiplegic and diplegic cerebral palsy in GMFCS Levels I and II: Are separate classifications needed? Dev Med Child Neurol. 2006;48(10):797-803.
[10] Davids JR, Peace LC, Wagner LV, Gidewall MA, Blackhurst DW, Roberson WM.Validation of the Shriners Hospital for Children Upper Extremity Evaluation (SHUEE) for children with hemiplegic cerebral palsy. J Bone Joint Surg Am. 2006;88(2):326-33.
[11] Davids JR, Sabesan VJ, Ortmann F, Wagner LV, Peace LC, Gidewall MA, et al.Surgical management of thumb deformity in children with hemiplegic-type cerebral palsy. J Pediatr Orthop. 2009;29(5):504-10.
[12] Holmefur M, Aarts P, Hoare B, Krumlinde-Sundholm L. Test-retest and alternate forms reliability of the assisting hand assessment. J Rehabil Med. 2009;41(11):886-91.
[13] Holmefur M, Krumlinde-Sundholm L, Bergström J, Eliasson AC. Longitudinal development of hand function in children with unilateral cerebral palsy. Dev Med Child Neurol. 2010;52(4):352-7.
[14] Krumlinde-Sundholm L, Holmefur M, Kottorp A, Eliasson AC. The Assisting Hand Assessment: current evidence of validity, reliability, and responsiveness to change. Dev Med Child Neurol. 2007;49(4):259-64.
[15] Law K, Lee EY, Fung BK, Yan LS, Gudushauri P, Wang KW, et al. Evaluation of deformity and hand function in cerebral palsy patients. J Orthop Surg Res. 2008;3:52.
[16] Waters PM, Zurakowski D, Patterson P, Bae DS, Nimec D. Interobserver and intraobserver reliability of therapist-assisted videotaped evaluations of upper-limb hemiplegia. J Hand Surg Am. 2004;29(2):328-34.
[17] Gilmore R, Sakzewski L, Boyd R. Upper limb activity measures for 5- to 16-year-old children with congenital hemiplegia: a systematic review. Dev Med Child Neurol. 2010;52(1):14-21.
[18] Ellison AC, Krumlinde-Sundholm L, Rösblad B, Beckung E, Arner M, Ohrvall AM, et al. The Manual

Ability Classification System (MACS) for children with cerebral palsy: scale development and evidence of validity and reliability. Dev Med Child Neurol. 2006;48(7):549-54.
[19] DE Matteo C, Law M, Russell D, Pollock N, Rosenbaum P, Walter S. The reliability and validity of quality of upper extremity skills test. Phys Occupy Ther Pediatric. 1993;13(2):1-18.
[20] Jepsen RH, Taylor N, Trieschmann RB, Trotter MJ, Howard LA. An objective and standardized test of hand function. Arch Phys Med Rehabil. 1969;50(6):311.
[21] Novak I, McIntyre S. The effect of Education with workplace supports on practitioners' evidence-based practice knowledge and implementation behaviors. Aust Occup Ther J. 2010;57: 386-393.
[22] Snakeskin L, Zivania J, Boyd R. Efficacy of upper limb therapies for children with unilateral cerebral palsy: systematic review and meta-analysis update. Pediatrics. In press.
[23] Verschuren O, Darrah J, Novak I, et al. Health enhancing physical activity in children with cerebral palsy: more of the same is not enough. Phys Therapy. 2013;94:1-9.
[24] Rosenbaum PL, Walter SD, Hanna SE, et al. Prognosis for gross motor function in cerebral palsy. JAMA. 2002;288:1357-1363.
[25] World Health Organisation (WHO). International Classi Carlson MG, Brooks C. The effect of altered hand position and motor skills on stereognosis. *J Hand Surg Am.* 2009; 34: 896–899.