Quest Journals
Journal of Medical and Dental Science Research
Volume 9~ Issue 6 (2022) pp: 40-44
ISSN(Online) : 2394-076X ISSN (Print):2394-0751
www.questjournals.org

Research Paper

Effectiveness of exercise program following soft tissue release around the shoulder in Children with Brachial Plexus Birth Palsy using Pediatric Outcome Data Collection Instrument

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ABSTRACT
Background*: - The most common injury in Brachial plexus birth palsy involves C5 – C6 (46%) and has the best prognosis for spontaneous recovery. But secondary Shoulder deformities can occur during recovery due to muscle imbalance. The imbalance is between the most powerful adductor-internal rotator and relatively the less powerful abductor-external rotator group. It can be treated by surgical soft tissue release around the shoulder followed by exercise program.* ***Objective of the study:*** *-To evaluate the effectiveness of exercise program following soft tissue release around the shoulder in children with Brachial plexus Birth palsy.* ***Methods:*** *-15 Children with partial Brachial plexus Birth palsy who underwent surgical soft tissue release procedure were selected. These children were undergone post-operative exercise program which includes splinting, stretching and strengthening exercises for shoulder and upper limb functional activities. The duration for each session was approximately 30 minutes with adequate rest periods in between. The exercise program was given for 4 weeks. Parent- reported PODCI questionnaire was administered to the parents of these children pre – operatively and 8 weeks post operatively. The study duration was 6 months. Analysis of data is based on the comparison of the pre-operative and post-operative score.* ***Results:*** *-The study revealed that exercises program is effective in following soft tissue release around the shoulder in children with Brachial plexus Birth palsy. The results showed that significant changes in PODCI scores P value (0.0005).* ***Conclusions:*** *-The exercise program is effective following soft tissue release around the shoulder in Brachial plexus Birth palsy children.*
Keywords: **-** Birth palsy, PODCI, Soft tissue release, Exercise program, children.

R*eceived 02 June, 2022;* ***R****evised 12 June, 2022;* ***A****ccepted 15 June, 2022 © The author(s) 2022.*
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I. INTRODUCTION

Brachial Plexus Birth Palsy {BPBP} is the result of an injury to the cervical and/or thoracic nerves (C5-T1) forming the Brachial Plexus sustained during birth. The nerves of the brachial plexus may be stretched, compressed, or torn in a difficult delivery. The incidence of birth palsy varies from 0.38 to 5.10 per 1000 live births in various countries. The largest epidemiological survey, conducted at the national level in the United States in 2008, reported 0.15% incidence of live births. The clinical manifestations of these injuries depend on the severity of the injury and the roots involved. Most injuries are mild and spontaneous recovery occurs in about 70% of the children within 4–6 months after birth. The remaining 30% is left with some kind of functional deficit.

The brachial plexus is responsible for cutaneous and muscular innervation of the entire upper limb. It is formed by the anastomosis of the ventral branches of the spinal nerves from C5 to T1, which give rise to seven terminal nerves and approximately ten collateral branches. It most often receives a ramus of C4 (prefixed plexus) and more rarely a ramus of T2 (post-fixed plexus). The C5 and C6 nerve roots join to form the upper trunk, C7 alone forms the middle trunk, whereas C8 and T1 anastomose to form the lower trunk. Each upper trunk is then divided into two anterior and posterior branches that form the secondary trunks. The two anterior branches of the upper and middle trunks anastomose to form the lateral cord, which gives rise to the musculocutaneous nerve and the lateral root of the median nerve, whereas the anterior branch of the lower trunk

alone forms the medial cord, which gives rise to the following nerves: medial cutaneous nerve of the arm, ulnar nerve, and the medial root of the median nerve. The posterior branches of the three upper trunks join to form the posterior cord to give rise to the axillary and radial nerves.

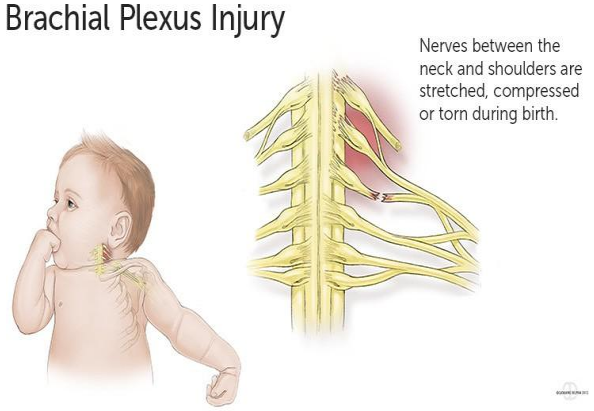
The most common mechanism is stretching of the Brachial plexus during the second stage of a dystocia delivery, either through traction on the head (cephalic presentation) or traction on the upper limb (breech presentation). The causes are probably multifactorial, but the two main risk factors are dystocia of the shoulders and macrosomia. Delivery with instrumentation (forceps/vacuum extractor), prolonged labor, primiparity, prematurity(breech deliveries), a history of BPBP during a preceding birth, and excessive maternal weight gain are also potential risk factors. The severity of neural involvement in BPBP varies from transient neuropraxia to avulsion-type root injuries. Upper plexus (C5-6) injury affects shoulder and elbow function. Furthermore, wrist function is affected to varying degrees in more extensive injuries that involve the upper and middle plexus (C5-7). In total injuries (C5-T1), finger function is also compromised (Bager 1997, Sheburn et al. 1997). The most common injury involves C5-C6 (46%) and the shoulder is the typical site of secondary deformity. It occurs during spontaneous recovery due to muscle imbalance and co-contractions from cross innervations leads to adduction and internal rotation contractures which often presenting as a lack of shoulder abduction. It limits the functional range of movement and lead to progressive glenoid dysplasia and joint instability. Children with persisting shoulder contracture may undergo surgical intervention to improve shoulder abduction and external rotation

Surgical treatment includes soft tissue release and muscle transfer to improve shoulder abduction. This procedure involves transfer of Latissimus dorsi and Teres Major to Teres minor at a very low position with the shoulder fully abducted without undue tension. This allows the functioning weak shoulder abductors to perform more efficiently in young patients with muscle imbalance secondary to obstetric brachial plexus palsy. Exercise program can be started after 4 weeks by a well-trained physiotherapist which included Range of motion exercises, stretching exercises along with strengthening exercises. An extension elbow-guard was used to prevent flexion of the elbow during active shoulder abduction. Outcome of secondary surgical interventions are mainly confined to changes in active or passive range of motion (AROM and PROM) and/or Mallet-scores. An instrument that is able to evaluate how well a child interacts with his environment would enhance the assessment of surgical outcomes. This Pediatric Outcomes Data Collection Instrument (PODCI) is a well-validated musculoskeletal health questionnaire that addresses activity and participation components of function. It can be used to understand the extent of perceived limitations and measure the success of treatment of children with a specific musculoskeletal disorder such as brachial plexus birth palsy (BPBP).

The Pediatric Outcomes Data Collection Instrument (PODCI) was developed in 1994, through the combined efforts of the American Academy of Orthopedic Surgeons, the American Academy of Pediatrics, Shriners Hospitals for Children, and the Pediatric Orthopedic Society of North America, to provide a standardized outcome assessment of pediatric musculoskeletal conditions.

The PODCI records patient and parent-reported measures across 5 domains: Transfers and Basic Mobility, Upper Extremity and Physical Function (UE Function), Sports and Physical Function (Sports Function), Pain/Comfort, and Happiness; a sixth measure, Global Function, is the average of the scores for the first 4 domains. The instrument has been validated (except for the happiness domain), and normative values for children without musculoskeletal limitations have been published. Huffman et al demonstrated that the PODCI can distinguish children with BPBP who are candidates for External Rotation tendon transfer from normal controls.

This study evaluates the effectiveness of Exercise program following soft tissue release around the shoulder in children with BPBP using Pediatric Outcome Data Collection Instrument.



II. MATERIALS AND METHODOLOGY

Study Design: A Quasi-experimental design
Study Setting: Ganga Hospital, Coimbatore.
Study Population: Brachial plexus birth palsy children
Sample Size: 15 subjects
Sampling method: Convenience sampling method
Study duration: 6 months
Treatment duration: 4 weeks
Inclusion Criteria:

- 2 -9 years
- Both male and female
- C5 –C 6 injury children
- Birth palsy children who underwent soft tissue release

Exclusion Criteria:

- Global Brachial plexus palsy
- Birth palsy children above 11 years
- Children with fracture
- Children with any cardio-respiratory disorder
- Children undergone nerve transfer surgery
- Children had botox injection.

Materials used:

- PODCI questionnaire
- Pen
- Computer
- Paper

Treatment Procedure:

15 Patients of brachial plexus birth palsy with secondary shoulder deformity among the age group of 2-9 years were selected. Parent reported PODCI questionnaire were administered pre operatively. After surgical intervention shoulder was immobilized in 110-degree abduction for 4 weeks. Exercise program was started after immobilization period and given for 4 weeks in all 15 patients. PODCI were administered at the end of 4^{th} week exercise program.

SURGICAL PROCEDURE:

Surgical management involves Transferring the Latissimus Dorsi and Teres Major to Teres Minor at a very low position with the shoulder fully abducted without undue tension, Release of subscapularis from the under surface of scapula and neurolysis of axillary nerve. Post operatively, the shoulder was immobilized in 110-degree abduction for 4 weeks.

EXERCISE PROGRAM

Elbow extension splint applied to prevent the elbow flexion during abduction. Passive stretching exercises for shoulder adductors by stabilizing the scapula. Passive external rotation exercises by placing the arm in adducted position. Active assisted exercises for elbow flexion and extension by arm in adducted position. Encourage hand to head and hand to back activities. Encourage the patient to touch the opposite shoulder through the back of his heads. Stimulating bimanual activities following soft tissue release procedure.

PODCI Administration:

PODCI were administered to the child's parent who elected for soft tissue release procedure. Parents of the selected child were well oriented about the questionnaire. Parent completes the PODCI questionnaire as proxy for a child by circling the choice of answer which will be suitable for their child. Most items use a categorical scale, with a range of 3-6 choices. Some items require to circle "yes" to all responses that apply to the patient**.** Questionnaire was filled by the parents before soft tissue release procedure and 3 months post procedure. Pre and post exercise program scores were compared.

III. 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 PODCI scores before and after treatment. Paired 't' test was performed to analyse the level of significance of the study

TABLE 1
Upper extremity and physical function scale values Pre and Post – Operatively

N	Pre - op score		Post -op score		Mean difference	SD	't' value
	Pre -op score	Pre-op mean	Post -op score	Post-op means			
15	852	56.8	1273	84.87	27.53	11.39	9.35

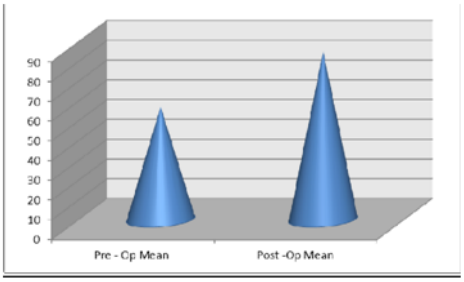


TABLE-2
Happiness scale values Pre and Post – Operatively

N	Pre - op score		Post -op score		Mean difference	SD	't' value
	Pre -op score	Pre-op mean	Post -op score	Post-op mean			
15	1060	70.67	305	87	16.33	6.11	10.34

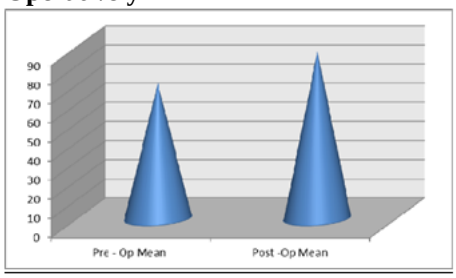
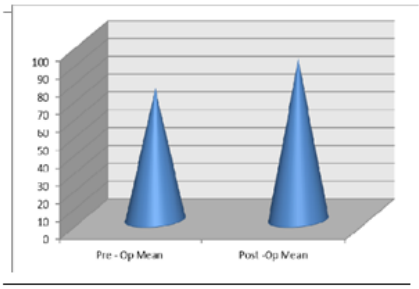


TABLE 3
Global function scale values Pre and Post – Operatively

N	Pre - op score		Post -op score		Mean difference	SD	't' value
	Pre -op score	Pre-op mean	Post -op score	Post-op mean			
15	1104	73.6	1352	90.13	16.53	7.18	8.9



IV. Results:

In the mother study "One hundred and fifty patients of Obstetric brachial plexus patients with shoulder deformity underwent shoulder muscle transfer along with soft tissue release followed by controlled rehabilitation program and measured with mallet score which was statistically significant at $p<0.05$" by Mukund tatted(2011). This study analyzed the effectiveness of PODCI in children with Brachial plexus birth palsy following soft tissue release procedure among the age group of 2-9 years.

The statistical analysis of the pre-operative and post-operative PODCI scores were calculated in three scales. The mean value of upper extremity scale was 27.53 and standard deviation was 11.39 and P value (0.005). The mean value of happiness scale was 16.33 and standard deviation was 6.11 and P value (0.005) and the mean value of Global functioning scale was16.53 and standard deviation was 7.18 and P value (0.005). Results of this study showed that there is a significant change in children with their functional activity level.

V. Discussion:

Brachial plexus birth palsy occurs 0.5 to 1 per 1000 live births. Erb's palsy or injury to the upper trunk is the most common type of Birth palsy and has the best prognosis for recovery. However, children with upper trunk injury often have residual weakness of shoulder external rotation and abduction, causing difficulty in activities of daily living.

Surgical soft tissue release around the shoulder followed by exercise program will improve the

shoulder abduction and external rotation range, but it is not known whether improved active range co-relates with the patient perceived functional gains. Thus, still further scope for this study to analyze the effectiveness of exercises program which includes activity training to improve functional outcome of these birth palsy children following soft tissue release procedure.

LIMITATIONS: -

- A large sample is required to make the study more reliable
- Time bound study
- Only pediatric age group were selected
- Only partial birth palsy children were selected
- This study was not included a control group

SUGGESTIONS: -

- Different age group
- Large size of samples
- Nerve transfer children can be taken
- Global brachial plexus birth palsy children can be included
- Compare parent reported PODCI scores and Adolescent reported PODCI scores

VI. CONCLUSION

The aim of this study was to evaluate the effectiveness of exercises program following soft tissue release procedure in Brachial plexus birth palsy children among the age group of 2-9 years. The effectiveness of exercises program was assessed by pre-and post-operative PODCI scores and analysis of the data showed that "There is a significant improvement in PODCI scores" which shows increased functional participation of children after exercise program in soft tissue release Birth palsy Children

Acknowledgment

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

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)

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