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Original Article

Orthopaedics Section

Highlighting the Outcome of Single Stage Multilevel Soft Tissue Surgery in Patients of Cerebral Palsy with Static Contracture (s)

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ABSTRACT

Introduction: The impact of single stage multilevel soft tissue surgeries needs to be evaluated in spastic cerebral palsy children to offer a convenient treatment option for the majority of children who are lost to follow-up.

Aim: Assessment of improvement in functional abilities and locomotion after single stage multilevel soft tissue surgery by using Gross Motor Functional Classification Scale (GMFCS) scores, Functional Mobility Scores (FMS) and physical examination and to study the different complications associated with this method of treatment.

Materials and Methods: This was a prospective study where, a total of 20 patients (17 boys, 3 girls; mean age 7 years 3 months; range 4 to 14 years) with spastic cerebral palsy were included. Single stage multilevel soft tissue surgery was performed. Various operative procedures done were fractional lengthening of hamstring tendon, adductor tenotomy and release, lengthening of achilles tendon using white's method, Vulpius release and posterior tibial tendon transfer. Pre and post operative physical examination was done and GMFCS scores as well as FMS scores were calculated. The patients were followed up for six months using the above mentioned parameters.

Results: All patients showed an improvement of atleast one GMFCS level ($p<0.001$). Similar change was also observed in functional mobility scale at three and six months ($p=0.001$). Range of motion of all the operated joints improved postoperatively, resulting in significant improvements in posture, sitting, gait, and hygiene of the patients.

Conclusion: In developing country like India single stage multilevel soft tissue surgery is proved to be a cost effective and logistic approach. For achieving satisfactory results it should be a team effort of surgeon and rehabilitation unit.

Keywords: Functional mobility scores, Gross motor functional classification scale scores, Spastic

INTRODUCTION

Cerebral Palsy (CP) is defined as a disorder of movement and posture caused by a non progressive defect or lesion in the growing brain [1]. The incidence is two to three per thousand live births with a prevalence of 2.4 per 1000 children [2,3]. Children between the age of 3-10 years are affected the most. Males are slightly more affected as compared to females [4]. Bax M et al., classified it into four subtypes namely spastic (70%), dyskinetic (athetoid, choreiform, ataxic), hypotonic and mixed [5]. Topographically, it is classified as diplegia, quadriplegia, monoplegia and hemiplegia. Management of CP involves conservative management in the form of physiotherapy, neurodevelopmental therapy. Treatment options for management of spasticity include oral antispastic medications and use of botulinum toxin injections. But, the patients having static deformities and contractures require operative management. In a developing country like ours where children with CP report late to the hospitals and are frequently lost to follow-up, performing multiple surgeries for the multiple deformities is not feasible. So, impact of single stage multilevel surgeries need to be evaluated to offer a convenient treatment for the poor children.

We conducted this study with the aim of assessment of improvement in functional abilities and locomotion after single stage multilevel soft tissue surgery by using GMFCS scores, FMS score and physical examination. Various operative procedures done were fractional lengthening of hamstring tendon, adductor tenotomy and release, lengthening of achilles tendon using White's method, Vulpius release and posterior tibial tendon transfer. Second objective was to study the different complications associated with this method of treatment.

MATERIALS AND METHODS

This prospective study was conducted in Department of Orthopaedics, Lady Hardinge Medical College and associated Kalawati Saran Children Hospital and Dr. Ram Manohar Lohia Hospital. A total of 20 patients (17 boys, 3 girls; mean age 7 years

3 months; range 4 to 14 years) with spastic CP were included over a span of two years from November 2011 to March 2013. Children with fixed spinal deformity, prior surgery for correction of lower limb deformity, dyskinetic or mixed CP, requiring bone surgeries, severe mental retardation and medically unfit children were excluded from the study. An informed consent was taken and single stage multilevel soft tissue surgery was performed. All patients with static deformities with soft tissue contractures and GMFCS score more than two were recruited for surgery. Pre and postoperative physical examination was done, GMFCS score and FMS score were calculated [6,7]. The physical examination consisted of strength of isolated muscle group, degree and type of muscle tone, degree of static muscle and joint contracture, range of motion, fixed and mobile foot deformity, balance, equilibrium responses, standing posture and gait by observation. Thomas test and Prone Rectus test were used to measure hip flexion deformity [8]. To assess hamstring tightness, popliteal angle and Phelps-Becker test were used [8]. Silverskiold test was used to assess Tendo Achilles tightness [8]. Modified Ashworth scale was used to measure spasticity. Surgery was performed under general or regional anaesthesia. Various operative procedures done were fractional lengthening of hamstring tendon, adductor tenotomy and release, lengthening of achilles tendon using White's method, Vulpius release and posterior tibial tendon transfer.

Postoperative protocol: After knee surgeries, groin to toe cast and above knee cast in cases of equinus deformity were applied. After six weeks, physiotherapy was started following removal of the casts. AFO's (Ankle foot orthoses) with or without assistive devices were used to help patients walk.

STATISTICAL ANALYSIS

Statistics were applied using statistical package for social sciences (SPSS) version 19.0. The p-value of <0.05 was considered statistically significant.

RESULTS

The mean pre and post operative GMFCS scores were 3.15 and 1.85, respectively and the change was statistically significant (p<0.001) [Table/Fig-1]. All patients showed an improvement of at least one GMFCS level [Table/Fig-2]. Similar change was also observed in functional mobility scale at three and six months (p=0.001) [Table/Fig-3]. There was a significant improvement in range of motion of all the joints which helped patients a lot in improving not only their gait but also posture. Of twenty patients who could not walk, ten could ambulate with the use of a walker or crutches postoperatively. The mean popliteal angle increased at three months and was maintained at that level at six months too (p-value= 0.001) [Table/Fig-4,5]. No surgical complications were observed in any case. Two cases developed stiff knee gait at three months follow-up, both being from non-walker group [Table/Fig-6-10].

GMFCS	n	Mean	SD	Std. Error
Pre surgery	20	3.15	0.671	0.150
3 Months	20	2.20	0.834	0.186
6 Months	20	1.85	0.587	0.131
Total	60	2.40	0.887	0.114

[Table/Fig-1]: Preoperative and postoperative mean GMFCS.

GMFCS Score	Number of patients		Significance (p-value)
	Preoperative	Postoperative	
Level I	-	5	0.001
Level II	3	13	0.001
Level III	11	2	0.001
Level IV	6	-	0.001
Level V	-	-	-

[Table/Fig-2]: GMFCS scores* in the pre-op and post-op period.

FMS	n	Mean	SD	Std. Error
Pre Surgery	20	7.05	3.332	0.745
3 Months	20	5.50	2.236	0.500
6 Months	20	10.00	2.734	0.611
Total	60	7.52	3.337	0.431

[Table/Fig-3]: Preoperative and postoperative mean FMS.

Left Popliteal Angle	n	Mean	SD	Std. Error
Pre surgery	15	92.33	15.337	3.960
3 Months	15	159.33	9.424	2.433
6 Months	15	159.33	9.424	2.433
Total	45	137.00	33.935	5.059

[Table/Fig-4]: Preoperative and postoperative popliteal angle on left side.

Right Popliteal Angle	n	Mean	SD	Std. Error
Pre Surgery	13	93.08	17.265	4.788
3 Months	13	158.08	10.712	2.971
6 Months	13	160.00	8.165	2.265
Total	39	137.05	33.828	5.417

[Table/Fig-5]: Preoperative and postoperative popliteal angle on right side.

DISCUSSION

Spastic CP is the most common subtype of all CP cases. Most common clinical presentation is diplegia followed by hemiplegia and quadriplegia. It is an irreversible state because changes occur at cerebral level. The aim of surgery is just to improve quality of life by correcting the contractures and deformities and strengthen musculoskeletal system by physiotherapy. In our country, majority of the spastic CP children are neglected and unfortunately reach hospital only after they have developed deformities across many joints and are unable to stand or walk. Such patients will not be available for follow-up, hence, the best option for such patients is single stage multilevel corrective surgery to provide them maximum



[Table/Fig-6]: Medial hamstring exposed. **[Table/Fig-7]:** Adductor tenotomy. **[Table/Fig-8]:** Fractional lengthening of aponeurotic tendon of gastronemius.


[Table/Fig-9,10]: Posterior tibial tendon transfer.

benefits in one go.

Majority of our cases were males, no other study observed male predominance. 56.52% cases were from outside Delhi as our center is a referral hospital. Average age of patients in our study was 7.55 years with a range of 3 to 14 years. In this study, most cases were from lower socio-economic group. 12 (52.17%) children were not attending school of which 11 cases could not walk independently and one independent walker of four years age was not admitted to school due to frequent fall during walking. In our study group, 14 (60.8%) cases achieved independent sitting at or before two years of age, out of which 8 (57.1%) were independent walkers before age of five years. One child walked independently at six years. This finding is in accordance with the observation by Bleck EE who found sitting at or before two years of age is a favorable sign for walking [9]. We found 74.6% cases of independent walkers, walked before seven years of age; this observation is similar to that of Bleck [9].

GMFCS score increased to 3.13 from pre surgery level of 2.56 at three months, suggesting deterioration of motor function. Then, it decreased to 2.38 at six months, still less than pre-surgical value indicating motor function has not reached pre-surgical value. But at 12 months, GMFCS score was 2.22 indicating improvement in motor function from base line. The change from presurgery to six months in GMFCS score is significant (p-value=0.001). Gross motor function in children with CP deteriorates temporarily after surgery. This is due to decreased use of the released muscle and the operated joints ultimately leading to weakness. But eventually the strength will return to normal pre operative level. Children who have already acquired standing and walking skills will have a greater decrease in motor function score after surgery than those who have not yet acquired walking [10]. We observed no change in percentage of children in GMFCS-2 before and after surgery. There was slight increase in percentage of children in GMFCS-1 from presurgery to 12 months by up gradation of some children from GMFCS-2. We observed more improvement of motor function in children with GMFCS-4. All these children had one grade improvement of GMFCS and shifted to GMFCS-3. Gupta A et al., similarly observed atleast one grade improvement in GMFCS score [11]. But Palisano R et al., observed that GMFCS is stable over time and not responsive to changes after surgery [12]. Khan MA et al., observed improvement in walking ability in untreated non-walkers (GMFCS-4 motor level) after multilevel surgery [13].

Functional mobility scale is a measure of assistance required by children with CP to move over distances, 5, 50, and 500 meters representing mobility at home, school and community. This scale has been shown to be valid, reliable and sensitive to change after surgery as it can reliably detect both initial deterioration and final improvement in mobility after surgery [14]. FMS score was calculated by summating scores for 5, 50 and 500 meters for ease of statistical analysis. We observed similar change in FMS as that for GMFCS, it decreased at three months and then increased at six months and 12 months. The change is statically significant (p value= 0.001). Ma FK et al., observed similar improvement in functional mobility scale after combined lengthening and transfer of medial hamstrings as a part of multilevel surgery to correct gait in CP children [15].

We found improvement in passive ankle dorsi flexion, range of motion in knee extension at three months which was maintained at that level up to 12 months and this change is significant.

The mean popliteal angle increased in all cases at three months (first measurement done after surgery at three months) and was maintained at that level up to six months.

Our study thus highlights that single stage multilevel surgery

helps in improving the functional mobility of CP patients. It has a lot of implication in our country, where patients are frequently lost to follow-up and cost is a major concern. Our findings are similar to a recent study conducted by Rutz E et al., [16]. They observed significant improvement in gait as well as functional mobility after single stage multilevel surgery. However, as opposed to our study, they found that GMFCS remained stable after surgery. Hence, more studies are needed to confirm above mentioned findings.

LIMITATION

The foremost limitations are the small sample size and a short follow up period. Complications like recurrence of deformities and deterioration of gait appear years after surgery which could not be observed in the present study.

CONCLUSION

Our study showed positive results after performing single stage multilevel surgery. In developing country like India single stage multilevel soft tissue surgery is proved to be a cost-effective and logistic approach. The simultaneous correction of deformities at many joints is effective, produces less morbidity and offers the advantage of only one period of hospital stay and rehabilitation. For achieving satisfactory results it should be a team effort of surgeon and rehabilitation unit. As highlighted above, more studies are needed to support or refute the usefulness of single stage multilevel surgery. Our study will help in improving the understanding of the same.

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