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Original Article

Evaluation of Single Event Multilevel Surgery (SEMLS) in Cerebral Palsy Children with Lower Limb Deformities

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Abstract:

Background: For ambulatory cases with spastic diplegic cerebral palsy, single event multilevel surgery (SEMLS) has replaced previous methods of treatment for improving gait. This research aimed for investigation if single event multilevel surgery improved gait and function among cases with spastic cerebral palsy.

Patients and methods: This was a prospective interventional study carried out on 24 children with spastic lower limbs attending to pediatric orthopedic unit in Zagazig University Hospital and managed with lower limb single event multilevel surgery. Clinical as well as radiological assessments were applied pre- and 6 months post-operative.

Results: Single event multi-level surgeries performed in the children with CP generated positive outcomes in the GMFM which changed significantly from (45.67±3.70) in the preoperative assessment to (52.63±3.34) in follow up after 2 years postoperative with p value<0.001. A paired samples t-test revealed that spasticity significantly decreased from pre- (M=15.46, SD=2.187) to post- (M=10.71, SD=2.293) intervention, t(23)=17.53, p<.05, d=1.327, for Spasticity (after intervention) a statistically significant difference was found between groups (2, 21) = 17.502, p < 0.001. Also, a marked improvement occurred in the range of motion (ROM) as determined by ROM score which changed from (44.67±8.67) preoperatively to (33.00±9.09) after 6 months with P value <0.001.

Conclusion: The results of SEMLS regarding deformity correction and quality of life improvement are considered satisfactory with minimal complications.

Key Words: Single Event Multilevel Surgery, Cerebral Palsy, Lower Limb Deformities

Introduction

One in every 323 children is diagnosed with cerebral palsy (CP), making it the most frequent motor disability among children. Muscle control, as well as the ability to stand upright and keep one's balance, are all impaired in those with cerebral palsy [1]. To put it simply, it happens when either the developing brain is abnormally formed or is injured. Approximately 90% of those who develop CP had brain injury before or after birth. Congenital CP is the presence of CP at birth; in acquired CP, the infant develops CP after birth due to brain injury [2].

Spastic, dyskinetic, ataxic, as well as mixed cerebral palsy are the four subtypes of CP that identify the underlying movement abnormality. Impairments such as muscle weakness, aberrant muscle tone, static or dynamic muscle contracture, improper joint alignment, or restricted range of motion result from a lack of motor control [3].

Seventy percent of children with CP can walk by the age of five, with or without aids. These children that are able to walk may have a wide variety of gait patterns, but there are a few common ones that are always present [4].

Single-event multilevel surgery (SEMLS) patients had better outcomes thanks to technological advancements in orthopedic internal fixation systems that allow for more control of osteotomies, less casting, and quicker weight bearing as well as rehabilitation. Single-event hospitalization, anesthesia, and recovery are only some of the benefits of SEMLS. As an added bonus, when a surgeon just fixes one issue at a time, secondary limitations such muscle contractures might develop. Some experts consider SEMLS to be the standard of care for improving function and gait in ambulant children with CP [5]. The treatment of CP patients using SEMLS is now considered the standard of care. Because of these developments, patients can be quickly mobilized, which shortens their time spent in rehabilitation [6].

We hypothesized that single event multilevel surgery (SEMLS) in Single Event procedure is good option to correct hip, knee, ankle, and foot deformities, it is supposed to be very effective in correction of deformities in CP patients as it is simple and easy to perform, so this research was conducted for investigation if single event multilevel surgery had improved gait and function among cases with spastic cerebral palsy.

Patients and methods

This was a prospective interventional study carried out on 24 children with spastic lower limbs attending to pediatric orthopedic unit in Zagazig University Hospital during the period from February 2022 to February 2023. The follow-up period was 2 years. Written informed consent was obtained from all participants parents and the study was approved by the research ethical committee of the Faculty of Medicine, Zagazig University, **Institutional Research Board (IRB) number (#9803) The Declaration of Helsinki, issued by the World Medical Association to ensure the protection of people participating in medical research, was strictly followed during this study.**

Inclusion Criteria: Cerebral palsy children aged from both genders aged 3 to 10 years old with spastic lower limbs or lower limb deformities.
Exclusion Criteria: Children who were younger than 3 years or older than 10 years, quadriplegic patients or cases with lower limb spasticity due to any other cause rather than cerebral palsy.
All patients underwent the following:

Clinical evaluation: Full history including Patient complaint, present, past, and family history. Data was collected about cerebral palsy types and Gross Motor Function Classification System (GMFCS). Each patient was evaluated twice: first a week before surgery, and again 12 months later. The assessments included GMFM-88 score for evaluation of the motor functions and ability among children who had CP [7], The Spinal Alignment and Range of Motion (ROM) Measure was utilized to quantify range of motion restrictions [8]; The range of motion (ROM) score was calculated by adding the scores from the hips (12 items), knees (4 items), and ankles (2 items) (4 items). Numbers from 0 to 80 were used for the score. A higher score indicated more severe limitation in range of motion and Spasticity was measured using the modified Ashworth scale [9]; The severity of spasticity was measured on a scale from 0 to 30, where higher scores indicated more severe symptoms. Assessment of child's gait was done to choose the correct procedure to perform.

Operative documentation: We performed an examination with the case under general anesthesia as many cases have difficulty to relax in the clinic. Operative approach, level of management, technique of operation and intraoperative complications were recorded. For Hip soft tissue operations, it included hip adductors, and psoas lengthening.
For Soft tissue procedures, at first, with the patient lying in prone position, an Achilles tendon lengthening (TAL) is performed by making an open posterior longitudinal incision over the tendon, dissecting through the subcutaneous tissues while avoiding the nerves and blood vessels, and finally making tenotomies in a slide or Z-lengthening fashion while the foot is in a dorsiflexed position.. If a knee flexion deformity of less than 5 degrees was observed, a medial hamstring lengthening was performed through a 3–5 cm midline incision in the distal portion of the posterior thigh, and the semitendinosus was exposed. Also, semitendinosus lengthening, semimembranosus lengthening, and biceps femoris lengthening was performed according to the condition. Tenotomy of the adductor longus,

sequential release of the gracilis and adductor brevis as necessary, and then release of the psoas tendon at the level of the insertion or proximally at the pelvic brim in the myotendinous junction were used to perform the hip adductor and psoas release with the patient in the supine position.

For Bony procedures: it was performed for Static contractures or Progressive joint breakdown. For Hip procedures it included: Proximal femoral varus osteotomy, for knee, it included distal femoral extension osteotomy, for ankle it included supra malleolar osteotomy, a cast was applied for foot dorsiflexion, hip abduction and knee extension for 4-6 weeks (Figure 1).

Postoperative follow up: We checked the wound regularly and on day 14 suture removal were done, the window was closed, and cast continued for 6 weeks. After 4-6 weeks post operative we removed the immobilizer during the day, used a knee immobilizer at night for 6-12 months. Follow up was done for 2 years to all cases with clinical assessment of GMFM-88 score, ROM score and spasticity scores with recording of any complications.

Postoperative Rehabilitation Program and follow up:

From the day of surgery until six weeks after, Cast applied to the surgically repaired limb. It was suggested that, when tolerated, assisted active to active ROM exercises be performed for unfixed joints (e.g., hips, toes), and that isometric progressed to isotonic workouts be performed to strengthen the muscles functioning on the unfixed joints. The time frame between 6 and 12 weeks post-op was crucial for restoring mobility and strength. Joints with limited mobility have begun range-of-motion exercises. It was usual practice to apply heat to sore, stiff joints in order to alleviate pain and increase range of motion. Specific patient-specific instructions for the use of orthotic devices. From 6-9 months, it was advised to keep using the orthotic devices during the day as before. In addition, it was recommended that patients resume their normal activity level and community involvement prior to surgery. The improvement in walking, standing, and moving about that occurred between 9 and 12 months was remarkable.

Statistical analysis

The statistical work was performed in SPSS 28. (IBM Co., Armonk, NY, USA). The t-paired, tests were used to examine categorical data Aswell as the Anova Test, which were then displayed as frequencies and percentages.

Results

The study included 24 cerebral palsy children with spastic lower limbs. Ten of them were females (41.7%) and fourteen were males (58.3%), the children ranged in age from 3 to 9 years with a mean ± SD of 5.0 ± 1.794. Age ranged between 3-4 years old in four children (16.7%), 4-5 years old in ten children (41.7), 5-6 years old in two children (8.3%), 6-7 years old in two children (8.3%), 7-8 years old in three children (12.5%), 8-9 years old in two children (8.3%), and 9-10 years old in one (4.2%) child. All included children suffered from spastic cerebral palsy. One patient (4.2%) presented with hemiplegic cerebral palsy, two (8.3%) presented with monoplegic palsy, and the majority of children (n=21) were diplegics (87.5%), For GMFCS score, we found that seven (29.2%) were in class I, eleven (45.8%) were in class II, and six (25.0%) were in class III. None of the included patients were in class V, nine patients suffered from involvement of the knee and ankle (37.5%). Seven patients suffered from the involvement of the hip and knee (29.2%) and the same number presented with hip, knee, and ankle involvement. Only one patient suffered from hip and ankle involvement (Figure 2).

The results revealed a statistically significant increase in GMFM scores from pre to post, with a mean score of 45.67 (SD=3.703) before and 52.63 (SD=3.347) after the intervention. The t-value was -15.117 ($p < 0.001$), indicating that the intervention led to significant improvements in gross motor function, with an effect size of 2.255. Furthermore, there was a strong positive correlation between pre- and post-intervention GMFM scores (r=.800), suggesting that those with higher baseline scores tended to have higher post-intervention scores (Table 1).

The results showed a statistically significant decrease in ROM from pre- (M=44.67, SD=8.676) to post- (M=33.00, SD=9.094), with a t-value of 16.117 and p<.001. The effect size was d=3.535, indicating a large reduction in ROM. A strong positive correlation was also found between pre- and post-intervention ROM scores (r=.922) (Table 1).

Spasticity significantly decreased from pre- (M=15.46, SD=2.187) to post- (M=10.71, SD=2.293) intervention, $t(23)=17.53$, $p<.05$, d=1.327. This finding suggests that the intervention was successful in reducing spasticity levels with a substantial effect size. Furthermore, there existed a strong positive correlation between pre- and post-intervention spasticity scores (r=.826) (Table 1).

For the GMFM (after intervention) score, a statistically significant difference was found between groups as determined by one-way ANOVA F (2, 21) = 7.502, p = 0.003. Tukey post hoc test revealed that GMFM score (after intervention) was statistically significantly higher in patients with GMFCS level I (55.71±8.97) than with level II (52.00±7.47) and p = 0.024 and with level III (50.17±8.21) and p = 0.003. For ROM (after intervention) a statistically significant difference was found between groups as determined by one-way ANOVA F (2, 21) = 17.318, p < 0.001. Tukey post hoc test revealed that ROM (after intervention) was statistically significantly lower in patients with GMFCS level I (23.00±5.29) than with level II (34.09±5.47) and p < 0.001 and with level III (42.67±8.50) and p < 0.001. It was statistically significantly lower in patients with level II than those with level III and p was also < 0.001 (Table 2).

For Spasticity (after intervention) a statistically significant difference was found between groups as determined by one-way ANOVA F (2, 21) = 17.502, p < 0.001. Tukey post hoc test revealed that Spasticity (after intervention) was statistically significantly lower in patients with GMFCS level I (8.71±2.36) than with level II (10.45±2.08) and p = 0.059 and with level III (13.50±2.81) and p < 0.001. It was statistically significantly lower in patients with level II than those with level III and p was also < 0.001 (Table 2).

Male patient, 4 years old, had Spastic diplegic cerebral palsy (GMFCS III), the preoperative GMFM score: 33.1, ROM score: 60, Spasticity score: 24. He was undergone Adductor muscle release, medial hamstring release, and Bilateral above knee cast. Postoperative GMFM score: 38, the postoperative ROM score: 46, and the postoperative spasticity score: 16 (Figure 3).

Male patient, 4 years old, Spastic diplegic cerebral palsy (GMFCS III), preoperative GMFM score: 37.3, the preoperative ROM score: 58, the Spasticity score: 19. He was undergone Adductor muscle release, medial hamstring release, and Tendon Achilles lengthening. Postoperative GMFM score: 45.1, the postoperative ROM score: 44 and the postoperative spasticity score: 13 (Figure 4).

Table 1: Paired sample tests comparing the GMFM scores, ROM and spasticity before and after the intervention.

Paired Samples Statistics					
		Mean	**N**	**Std. Deviation**	**Std. Error Mean**
Pair 1	**ROM(before)**	44.67	24	8.676	1.771
	ROM (after)	33.00	24	9.094	1.856
Pair 2	**GMFM (before)**	45.67	24	3.703	.756
	GMFM (after)	52.63	24	3.347	.683
Pair 3	**Spasticity (before)**	15.46	24	2.187	.446
	Spasticity (after)	10.71	24	2.293	.468

Paired Samples Test				
		N	**Correlation**	**Sig.**
Pair 1	**ROM(before) & ROM (after)**	24	.922	.000
Pair 2	**GMFM (before) & GMFM (after)**	24	.800	.000
Pair 3	**Spasticity (before) & Spasticity (after)**	24	.826	.000

Paired Samples Test								
	Paired Differences					**t**	**df**	**Sig. (2-tailed)**
	Mean	**Std. Deviation**	**Std. Error Mean**	**95% Confidence Interval of the Difference**				
				Lower	**Upper**			

Pair 1	**ROM(before) - ROM (after)**	11.667	3.535	.721	10.174	13.159	16.170	23	.000
Pair 2	**GMFM (before) - GMFM (after)**	-6.958	2.255	.460	-7.911	-6.006	-15.117	23	.000
Pair 3	**Spasticity (before) - Spasticity (after)**	4.750	1.327	.271	4.190	5.310	17.536	23	.000

Paired Samples Effect Sizes						
			Standardizer[a]	**Point Estimate**	**95% Confidence Interval**	
					Lower	**Upper**
Pair 1	**ROM(before) - ROM (after)**	**Cohen's d**	3.535	3.301	2.266	4.323
		Hedges' correction	3.593	3.247	2.229	4.252
Pair 2	**GMFM (before) - GMFM (after)**	**Cohen's d**	2.255	-3.086	-4.051	-2.108
		Hedges' correction	2.293	-3.035	-3.985	-2.073
Pair 3	**Spasticity (before) - Spasticity (after)**	**Cohen's d**	1.327	3.580	2.471	4.676
		Hedges' correction	1.349	3.521	2.431	4.600

a. The denominator used in estimating the effect sizes.
Cohen's d uses the sample standard deviation of the mean difference.
Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

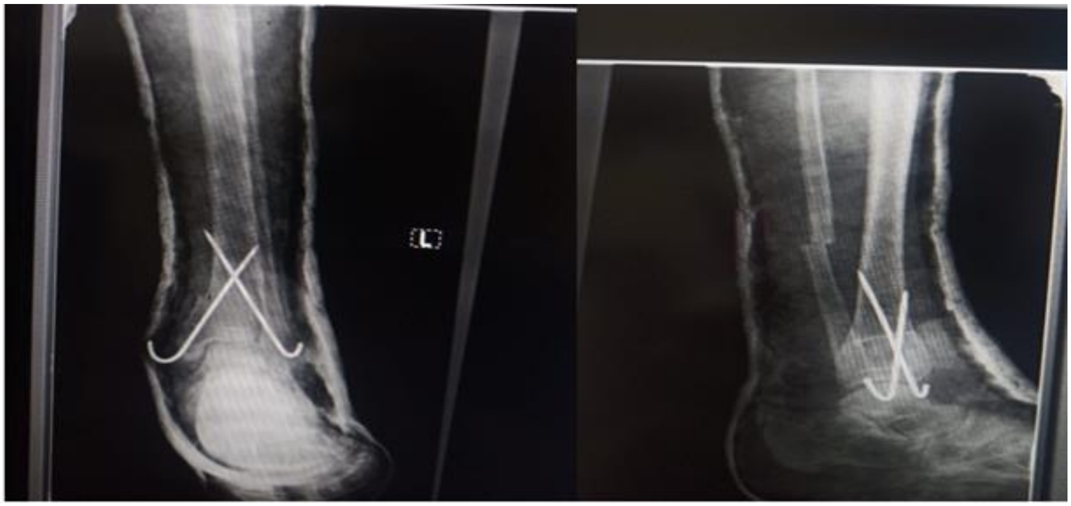
Table 2: Anova test comparing GMFM scores, ROM and spasticity before and after the intervention.

ANOVA						
		Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
GMFM (before)	**Between Groups**	71.273	2	35.636	3.066	0.068
	Within Groups	244.061	21	11.622		
	Total	315.333	23			
GMFM (after)	**Between Groups**	107.363	2	53.682	7.502	0.003
	Within Groups	150.262	21	7.155		
	Total	257.625	23			
ROM(before)	**Between Groups**	1034.597	2	517.299	15.592	0.000
	Within Groups	696.736	21	33.178		
	Total	1731.333	23			
ROM (after)	**Between Groups**	1273.758	2	636.879	21.289	0.000
	Within Groups	628.242	21	29.916		
	Total	1902.000	23			

Spasticity (before)	**Between Groups**	79.274	2	39.637	27.128	0.000
	Within Groups	30.684	21	1.461		
	Total	109.958	23			
Spasticity (after)	**Between Groups**	75.302	2	37.651	17.318	0.000
	Within Groups	45.656	21	2.174		
	Total	120.958	23			

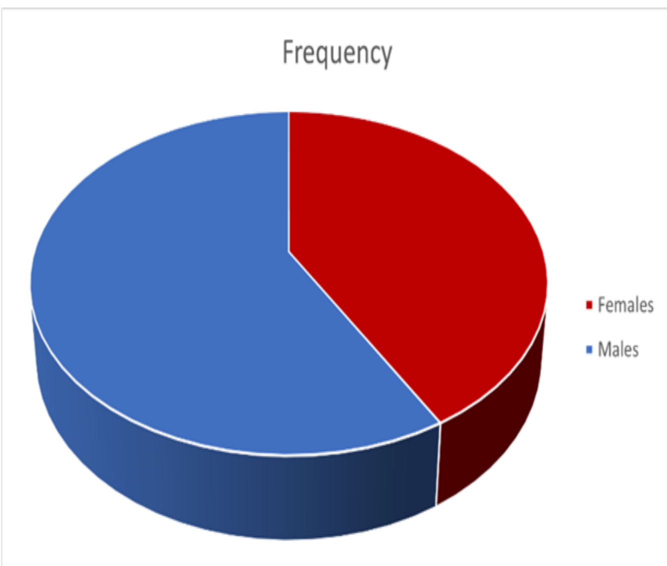
(A)


(B)

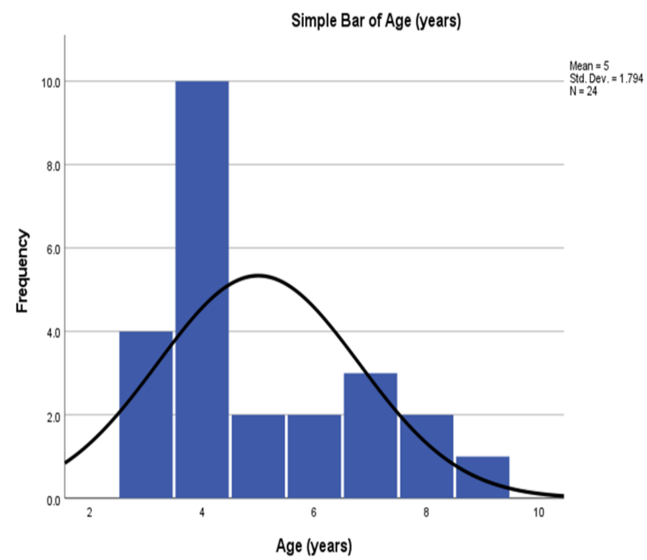


(C)

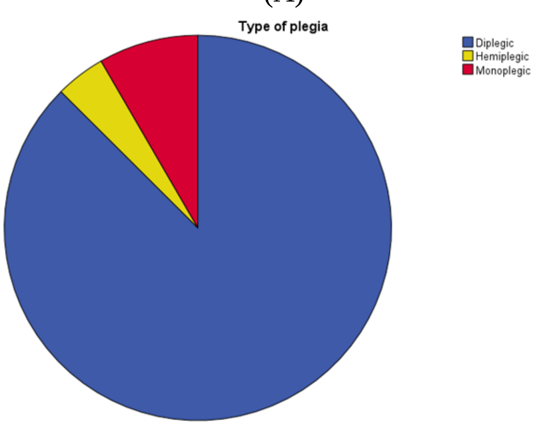
Figure 1: (A): Hip reconstruction procedure, (A1): radiograph before surgery, (A2): varus derotation osteotomy of the femur and triple pelvic osteotomy were performed, (B): post operative distal femoral osteotomy, (C): post operative supramalleolar osteotomy



(A)



(B)



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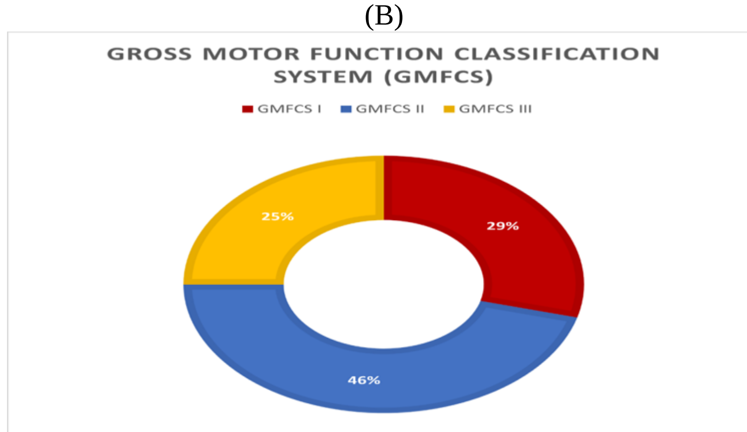
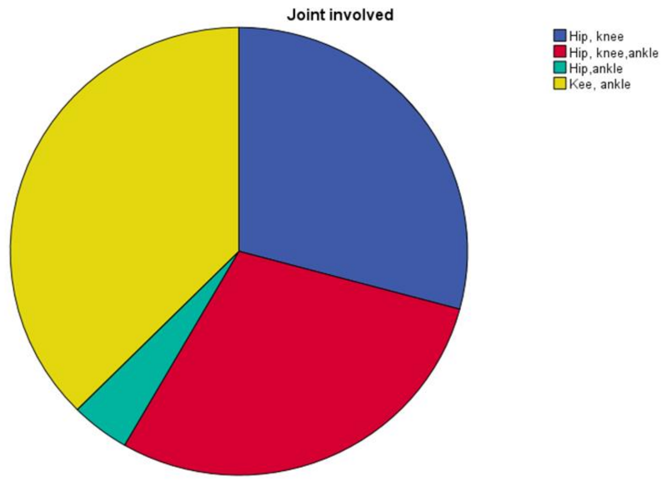


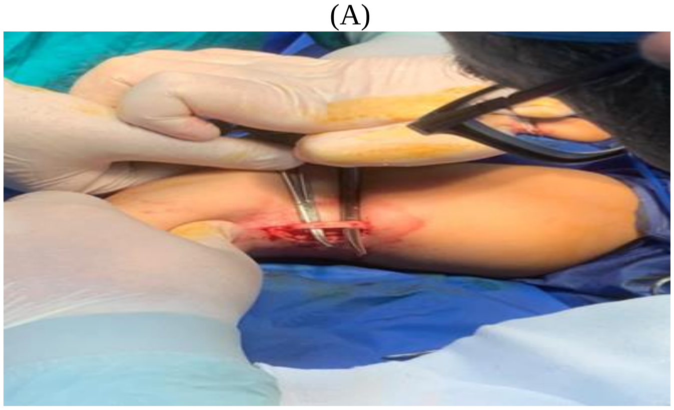
(D)



(E)

Figure 2: (A): Gender distribution, (B): Age distribution of children included in the study, (C): Type and involvement of cerebral palsy, (D): Classification of cases according to GMFCS, (E): Levels of release surgery done to the children


(A) (B)




(C) (D)

(E)

Figure 3: Case 1 (A): Preoperative limited range of motion, (B): Adductor muscle release (C): Medial hamstring release, (D): Bilateral above knee cast, (E): 2 years follow up range of motion

(A) (B)

(C) (D)

(E)

Figure 4: Case 2 (A): Preoperative limited range of motion, (B): Adductor muscle release (C): Medial hamstring release, (D): Tendon Achilles lengthening, (E): 2 years follow up range of motion.

Discussion

Movement or posture abnormalities are the result of a non-progressive injury that happens during a child's brain's formative years, making CP the most prevalent cause of physical disability in the pediatric population. There are few linked secondary conditions that may arise or change over time. In early childhood, hypotonia can be replaced by spasticity, and athetosis or a mixed variety comprising indications of both can become apparent. Awareness among parents of these children is growing in developing nations, and many cases are being seen in specialized tertiary centers at extremely young ages. Although many children start walking and standing by age 2, many cases of CP are not reported until the kid is older than 3 [10]. Static or dynamic deformity of the lower leg joints would have already occurred by this point in these circumstances. A single-stage multilevel corrective surgery with rehabilitation may be more rational than arranging multistage surgical treatments with physiotherapy when these non-ambulatory individuals with various static abnormalities are originally brought to a tertiary care hospital. As a result, people with spastic CP had better clinical and functional outcomes [6].

In this study, single event multi-level surgeries performed in the children with CP generated positive outcomes in the GMFM which changed significantly from (45.67±3.70) in the preoperative assessment to (52.63±3.34) in follow up after 2 years postoperative with p value<0.001.

This was also in agreement with Wood, et al. [11] who reported an increase of 2.18 (3.23%) in the GMFM between the preoperative (67.66±12.35) and the postoperative (69.86±15.24) assessments. Similar results also obtained in the prospective case controlled study conducted by Chang, et al. [12] which involved 25 children with spastic cerebral palsy and found that SEMLS had a favorable effect on the GMFM which increased significantly from (55.9±12) preoperatively to (57.5±12.1) six months post operatively with P value 0.005.

Increase in GMFM is also reported in two studies done by Buckon, et al. [13] But, no detectable changes in GMFM were observed in the prospective cohort study conducted by Gorton, et al. [14] and also the study done by Seniorou, et al. [15] which may be due to calculating GMFM score for two dimensions only not the full five dimensions.

The results of our study noted a marked improvement in the range of motion as determined by ROM score which changed from (44.67±8.67) preoperatively to (33.00±9.09) after 6 months with P value <0.001 which means significant improvement in the range of motion. This agrees with Chang, et al. [12] in which ROM score decreased from (39.1±9.1) preoperatively to (32.8±10.3) in the 2 years postoperative follow up with P value 0.001. Same results were also obtained in the studies conducted by Thomas, et al. [16], Zorer, et al. [17], Zwick, et al. [18], Dobson, et al. [19], Adolfsen, et al. [20], Gough, et al. [21] & Bernthal, et al. [22]

This was in disagreement with the study done by Rodda, et al. [23] in which they found that there was no significant improvement in the range of motion after multilevel release surgery in children with spastic diplegi. This may be related to very small sample size, late and irregular physiotherapy.

Chang, et al. [12] also declared improvement in the spasticity as noted from changes in the modified Ashworth score before and after single event multilevel release surgery as the mean score decreased from (18) preoperatively to (14) at six months postoperative with P value <0.001, the same as in our study in which spasticity score changed from (15.46±2.18) preoperatively to (10.71±2.29) postoperatively also with a P value <0.001.

Same results were also obtained in the study done by Putz, et al. [24] which found that modified Ashworth score declined from (15.9±4.6) to (11.4±3.1) in a duration of 6 months with a significant P value of 0.0001.

Also, Thomas, et al. [16] noted marked decrease in the muscle tone with decrease in the spasticity score after multilevel release surgery in a randomized controlled trial done to 25 children with spastic diplegia.

Our study's objective was to examine the efficacy of a single, multilayer surgical procedure in enhancing patients' gait and function who suffer from spastic cerebral palsy.

Thomason et al. [25] analysed data from a prospective cohort study of 19 children with bilateral spastic cerebral palsy who had participated in a randomised controlled trial and were followed for 5 years; the children had GMFCS levels II (14 children) or III (5 children), and their mean age was 9.7 years (range 7.7-12.2 years). The subjects were evaluated using the Gross Motor Function Measure (GMFM-66), the Functional Mobility Scale (FMS), the Gait Profile Score (GPS), and the Gait Deviation Index (GDI).

There have been 18 children who have completed follow-up at 1, 2, and 5 years after SEMLS, allowing for interval analysis. Because of neurological decline, one child was excluded from the study and given a new diagnosis of Hereditary Spastic Paraparesis (HSP). Five years after SEMLS, GPS accuracy increased by 5.29°, and GMFM66 improved by 3.3%. The stability of gait and gross motor function improvements over time was indicated by the lack of statistical significance between 1- and 5-year and 2- and 5-year outcome measures (except for GMFM66). They concluded that Improvements in gait and function following SEMLS in children with bilateral spastic cerebral palsy are both clinically and statistically significant, and they were maintained 5 years after surgery [25].

All reported gait enhancements after SEMLS were analysed in the outcome studies. They took readings both before and after the operation.

In United States of America, Oskoui, et al. [26] aimed to reduce the likelihood of complications from anaesthesia and other surgical hazards, most surgeries were recommended to be performed as SEMLS (single event, multiple level surgery). With this method, post-operative rehabilitation can be organized as well. This agreed with the guidelines for orthopedic management of spasticity in cerebral palsy published with Horstmann & Beck [27]. In Switzerland, a study conducted by Rutz, et al. [28] evaluated 14 children with spastic diplegia (ten boys and four girls). Ten of the studied cases were GMFCS II, three were GMFCS III but only one case was GMFCS I. All fourteen cases underwent single event multilevel soft tissue release surgery and results showed marked early improvement in function and gait as assessed by movement analysis profile and gross motor functional measures, but long term follow up revealed that to maintain the early improvements, two third of the patients required additional surgery due to relapses or new gait problems.

Thompson et al. [29] investigated the differences between conventional SEMLS methods and non-invasive SEMLS methods. The average age of the 10 children with spastic diplegic CP who had surgery was 10.6 years (7.11 to 13.9). Using the Gross Motor Functional Classification System (GMFCS), ten young diplegics (mean age at surgery, 11.4) were compared to ten healthy children who received conventional multi-level surgery on 20 limbs (7.9 to 14.4). There were no significant variations in pre-operative gait kinematics amongst the groups; however, the traditional multi-level group had considerably higher knee flexion during stance compared to the other groups. Post-operatively, both groups showed considerable improvements in sagittal and coronal plane gait metrics, including increased knee flexion in stance. In addition, there was a statistically significant increase in the Gillette Gait Index between the two groups ($p<0.001$) [29].

At 12 months, the strength of all lower-limb muscle groups in the conventional group was lower than it had been before surgery, with the exception of the hip abductors. The knee flexors were especially affected by this (p 0.001). There was a substantial decrease in knee flexor strength in the minimally invasive group at 12 months compared to pre-operatively (p 0.001), however there was an increase in hip abductor strength and knee extensor strength at 90 degrees and 30 degrees. This was especially true of the second set of muscles ($p = 0.01$). At 12 months after surgery, the minimally invasive group's knee flexor strength was considerably higher than that of the conventional group ($p = 0.048$) [29].

When comparing the minimally invasive group to the traditional multi-level group, the minimally invasive group had a shorter surgery time ($p = 0.013$), less blood loss ($p = 0.004$), and faster time to mobilisation (p 0.001). Neither group experienced any issues during or after surgery.

The results of the study showed that minimally invasive procedures can be used to successfully perform multi-level surgery, with the added bonuses of increased muscle strength, accelerated mobilization, and decreased operative time and blood loss [29].

There are few limitations to our study. The study's primary limitations include its limited sample size, which prohibited examination of the age effect at individual GMFCS levels, and its limited follow-up duration, which limited the study's ability to generalize to longer postoperative outcomes. Small age range of patients from 3 to 10 years didn't allow to study the effect of SEMLS on older children with spastic cerebral palsy. The GMFM change after the first 6 months requires further study. Certain complications like recurrence of deformities could not be detected in the present study. Also, because of non-availability of the equipment during that period, gait analysis was not performed. Also lack of control group is one of the drawbacks of this study. This information is helpful for parents and doctors as they prepare their CP children for a single event, multi-level orthopaedic surgery.

Conclusion

The results of SEMLS regarding deformity correction and quality of life improvement are considered satisfactory with minimal complications.

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Figure legends

Figure 1: (A): Hip reconstruction procedure, (A1): radiograph before surgery, (A2): varus derotation osteotomy of the femur and triple pelvic osteotomy were performed, (B): post operative distal femoral osteotomy, (C): post operative supramalleolar osteotomy.

Figure 2: (A): Gender distribution, (B): Age distribution of children included in the study, (C): Type and involvement of cerebral palsy, (D): Classification of cases according to GMFCS, (E): Levels of release surgery done to the children.

Figure 3: Case 1 (A): Preoperative limited range of motion, (B): Adductor muscle release (C): Medial hamstring release, (D): Bilateral above knee cast, (E): 2 years follow up range of motion.

Figure 4: Case 2 (A): Preoperative limited range of motion, (B): Adductor muscle release (C): Medial hamstring release, (D): Tendon Achilles lengthening, (E): 2 years follow up range of motion.

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