

Indonesian Journal of Medicine (2017), 2(2): 100-106
<https://doi.org/10.26911/theijmed.2017.02.02.04>

The Result of Functional Mobility Scale (FMS) on Cerebral Palsy Spastic Diplegic that treated by SEMLS (Single Event Multi Level Surgery) method in Orthopaedic Hospital Prof. Dr. R. Soeharso, Surakarta

Seti Aji Hadinoto, Anung Budi Satriadi, Hari Wujoso

Masters Program of Family Medicine, Sebelas Maret University

ABSTRACT

Background: Cerebral Palsy is a permanent non-progressive brain disorders that occur in early childhood where abnormalities in the brain due to damage on immature brain can cause movement disorders and postural dysfunction. Nowadays, the treatment of choice for CP Spastic diplegic is using SEMLS (Single Event Multi Level Surgery). There was many scoring to evaluate outcome of SEMLS, but only a few scoring system that can evaluate changing after SEMLS. Functional Mobility Scale (FMS) is an outcome measure designed to evaluate mobility of children with cerebral palsy (CP). FMS has been shown to detect both improvement and deterioration in mobility status during the rehabilitation period following multilevel orthopaedic surgery in children with spastic diplegic

Subjects and Method: This was a cross sectional observational study. The sample are obtained by sensus from January 1st 2014 until March 1st 2015. The patient's characteristic that we include in this study are gender, age when the patient had a surgery, and where the contracture are involved. We evaluate the outcome using FMS before operation, 3 month, 6 month, 9 month, and 12 month after operation on three different distance (5, 50, 500 meter) that represent home, school, and community. After that we analyze the result using regression logistic model to better understands about changes and time of changes on patient after SEMLS procedure. We also analyze the correlation between age, sex, and location of contracture with the outcome after SEMLS procedure

Result : 51 patients were reviewed and identified, there were 31 males (61%) and 20 females (39%), mean age when the patient was operated was 8.07 years old, with the most common cases are CP Spastic Diplegic with hip, knee, ankle contracture bilateral about 41 patient (80.3%), knee ankle bilateral about 7 patient (13.2%), and hip ankle bilateral about 3 patient (5.88%). From evaluation of FMS scoring, we found most patient had an improvement on their mobility after SEMLS procedure (OR > 1), with the time changes for 5 and 50 meters distance is at six months (OR : 1.52) and (OR= 1.47), and 500 meters is at 12 months (OR= 3.45). We also found no significant relationships (p value > 0.05) between age (p value= 0.632), sex (p value= 0.576) and location of contracture (p value= 0.222) with the outcome of the FMS after SEMLS

Conclusion: We found that SEMLS gives a good result to increased mobility of patient with CP Spastic Diplegic. FMS Score were able to asses the outcome of SEMLS procedure, and also responsive to change that occur after SEMLS. Age, sex, and contracture's location were not significantly influence the FMS outcome after SEMLS

Keywords: CP Spastic Diplegic, SEMLS (Single Event Muti Level Surgery), FMS (Functional Mobility Scale).

Correspondence:

Seti Aji Hadinoto. Masters Program of Family Medicine, Sebelas Maret University, Jl. Ir. Sutami 36 A, Surakarta 57126, Central Java.

BACKGROUND

Cerebral Palsy is a permanent non-progressive brain disorders that occur in early childhood where abnormalities in the brain due to damage on immature brain can cause movement disorders and postural dysfunction O'shea M (2011).

From a recent study, the prevalence of Cerebral Palsy (CP) was estimated between 2.4 and 2.7 out of 1000 live births Herring J (2008). Increased incidence of CP supposedly correlates with increased survival rates of premature or low birth weight children Cerebral Palsy most commonly experienced by male infants. In a study conducted by Johnstone and Hagberg (2007); Jarvis et al., (2005) CP cases is more commonly observed in male gender as much as 30% when compared with female gender.

CP management is divided into non operative and operative actions. Non operative CP management include medication, splinting, bracing, physical rehabilitation therapy or other adjunctive therapy (e.g. neurodevelopmental therapy, serial cast correction, antispastic oral medication, and injections for focal spastic) (Sawyer, 2007).

Operative CP management is indicated when contracture or deformities have a big impact on limb function, causing pain or interfere with daily activities. This is the most effective management to treat fixed contracture (Sawyer, 2007).

Single-event multi-level surgery (SEMLS) is a corrective surgery that correct all orthopedic deformities at the same time, with soft tissue and bone surgery at two or more different anatomical locations for rehabilitation syndrome at a time so as to prevent birthday syndrome (Graham and Harvey, 2007; Harvey et al., 2007). The goal of SEMLS is to improve gait (Thomson et al., 2011). According to study conducted by Rang et al., they reported that walking will

reach its peak at the age of 7 years, so it is advisable to do SEMLS surgery when the child is 7 years old (O'shea, 2011; Khwaja and Volpe, 2008).

There are various scoring methods that have been developed to analyze the ability and limitation of functional activity of children with CP, both before and after the surgery such as Gross Motor Functional Classification Score (GMFCS), Functional Mobility Scale (FMS), Functional Assessment Questionnaire (FAQ), Children Health Questionnaire (CHQ), and Pediatric Outcomes Data Collection Instrument (PODCI) (Harvey and Morris, 2008).

The aims of this study is to evaluate the success rate of SEMLS on spastic diplegic CP patients that conducted in Paediatric Clinic Prof. Dr. R. Soeharso, Surakarta Orthopedic Hospital and to determine whether there is an influence between age, gender, and number of surgical procedures performed on patients with the success rate SEMLS. Success rate is measured using FMS.

SUBJECTS AND METHOD

This was an analytic observational study with cross-sectional design. The study was conducted at the Paediatrics' Outpatient Department of Prof. Dr. R. Soeharso, Surakarta Orthopedic Hospital from January 1, 2014 to March 1, 2015.

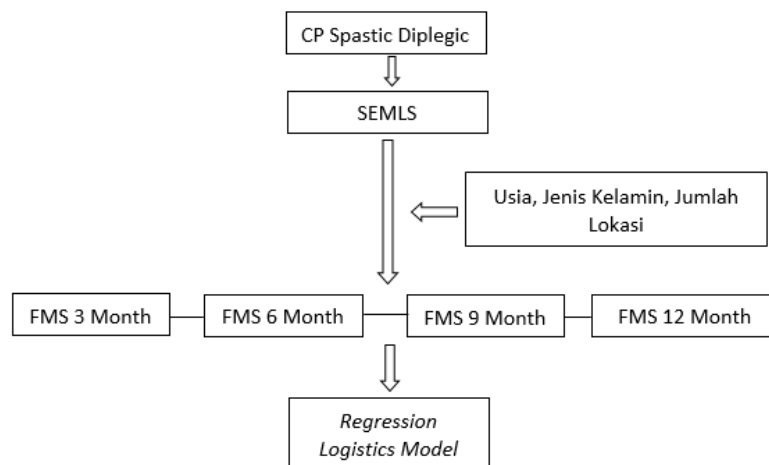
The population were all patients with Spastic diplegic Cerebral Palsy in Paediatric Clinic Prof. Dr. R. Soeharso, Surakarta Orthopedic Hospital that have been performed SEMLS.

The samples used were patients with Spastic diplegic Cerebral Palsy in Paediatric Clinic Prof. Dr. R. Soeharso Surakarta Orthopedic Hospital that have been performed SEMLS that fulfill inclusion criteria

All the samples are then evaluated using FMS questionnaire to their parents or the patients themselves. Outcome expressed by FMS score changes at different evaluation time i.e before operation, 3 month, 6 month, 9 month and 12 month after operation.

Regression logistics model is used to evaluate the correlation between SEMLS

with therapy outcome (significance level: $p < 0.05$). Odds Ratio (OR) < 1 means the child is experiencing deterioration. Odds Ratio (OR) > 1 means the child is experiencing improvement after operation. Correlation between ages, gender, and locations of surgery with SEMLS outcome is assessed by correlation method.



Picture 1. Conceptual Framework

Introduction

The Functional Mobility Scale (FMS) has been constructed to classify functional mobility in children, taking into account the usage of assistive devices a child might use.

The scale can be used to classify children's functional mobility, document change over time in the same child and to document change soon following interventions, for example orthopedic surgery or selective dorsal rhizotomy.







The FMS rates walking ability at three specific distances, 5, 50 and 500 metres, for 5, 50, 500 yards. This represents the child's mobility in the home, at school and in the community setting. It therefore accounts for different assistive devices used by the same child in different environments.

Assessment is by the clinician on the basis of questions asked of the child/parent (not direct observation). The walking ability of the child is rated at each of the three distances according to the need for assistive devices such as crutches, walkers or wheelchair frames which are regularly used should be included for the rating.

The FMS is a performance measure. It is important to note what the child actually does at this point in time, not what they can do or used to be able to do.

Developed by the Hugh Williamson Gait Laboratory, The Royal Children's Hospital, Melbourne, Australia. Part of the Gold CCC.

www.rch.org.au/gait

Rating 6	<p>Independent on all surfaces: does not use any walking aids or need any help from another person when walking over all surfaces including uneven ground, curbs etc, and in a crowded environment.</p> 	Rating 3	<p>Uses crutches: without help from another person.</p> 								
Rating 5	<p>Independent on level surfaces: Does not use walking aids or need help from another person. Requires a rail for stairs.</p> <p><small>*If also handles, walls, fences, shop fronts for support, please use 4 as the appropriate description.</small></p> 	Rating 2	<p>Uses a walker or frame: Without help from another person.</p> 								
Rating 4	<p>Uses sticks (one or two): Without help from another person.</p> 	Rating 1	<p>Uses wheelchair: May stand for transfers, may do some stepping supported by another person or using a walker/frame.</p> 								
<table border="1"> <thead> <tr> <th>Walking distance</th> <th>Rating: select the number (from 1-6) which best describes current function</th> </tr> </thead> <tbody> <tr> <td>5 metres (yards)</td> <td></td> </tr> <tr> <td>50 metres (yards)</td> <td></td> </tr> <tr> <td>500 metres (yards)</td> <td></td> </tr> </tbody> </table>		Walking distance	Rating: select the number (from 1-6) which best describes current function	5 metres (yards)		50 metres (yards)		500 metres (yards)		Rating C	<p>Crawling: child crawls for mobility at home (m).</p>
Walking distance	Rating: select the number (from 1-6) which best describes current function										
5 metres (yards)											
50 metres (yards)											
500 metres (yards)											
		Rating N	<p>N = does not apply: For example child does not complete the distance (500 m).</p>								

Questions

To obtain answers that reflect performance, the manner in which the questions are asked of the child/parent is important. The questions we use to obtain the appropriate responses are:

- How does your child move around for short distances in the house? (m)
- How does your child move around in and between classes at school? (cm)
- How does your child move around for long distances such as at the shopping centre? (500m)

The distances are a guide. It is the environment that is most relevant.

Qualifiers

The difference between 1-4 is self-explanatory, however the difference between 5 and 6 is less clear:

- 5 metres: children who require a rail for stairs would be rated as 5 and children who do not require a rail or help would be rated as 6.
- 50 metres: children who can walk on all surfaces including uneven surfaces and steps, particularly at school are rated as 6 and children that require help on these surfaces but can walk on level surfaces without help are rated as 5.
- 500 metres: children who can walk on all surfaces including rough ground, curbs, steps and in crowded environments in the community without help are rated as 6 and children who walk long distances only on level surfaces and have difficulty walking in crowds are rated as 5.

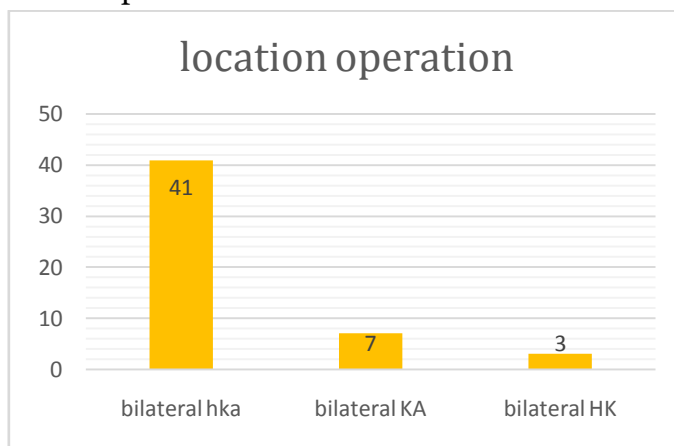
Picture 2. FMS Questionnaire

RESULTS

From studies that have been carried out from January, 2014 to March, 2015 we collect 51 patients as a sample. 31 patients (61%) are male and 20 patients (39%) are female.

From the location operation, there are 41 patients with bilateral hip-knee-ankle

surgery, 7 patients with knee-ankle surgery, and 3 patients with hip-knee surgery. The youngest patient was 3 years old and the oldest 15 years old with a mean age of 8.07 years. Surgery is performed before 7 years old in 23 patients and after 7 years old in 28 patients.



Picture 3. Patient distribution of location operation

Preoperative mobility status assessed using FMS revealed that most of the patients (38 patients) mobility status was crawled or non-walker (FMS: Crawling score) at 5, 50, and 500m. while the remaining 13 patients (25.4%) had varying mobility at range of 5, 50, and 500m. 1 FMS score (wheelchair or standing with assistance) was obtained at 5m by 5 patients, 50m by 8 patients and 500m by 12 patients. 2 FMS scores (using walker / frame without assistance) was obtained at

5m by 7 patients, 50m by 4 patients and 500m by 2 patients. 3 FMS scores (using crutches unassisted) was obtained at 5, 50, and 500m only by 1 patient.

From evaluation of FMS scoring, we found most patient had an improvement on their mobility after SEMLS procedure (OR >1), with the time changes for 5 and 50 meters distance is at six months (OR= 1.52) and (OR= 1.47), and 500 meters is at 12 months (OR= 3.45).

Month	5 meter			50 meter			500 meter		
	OR	P value	Ket	OR	P value	Ket	OR	P value	Ket
3 month	0,639	0,048	< 0,050	0,893	0,998	> 0,050	0,329	0,998	> 0,050
6 month	1,519	0,040	< 0,050	1,470	0,035	< 0,050	0,739	0,998	> 0,050
9 month	2,639	0,047	< 0,050	3,893	0,048	< 0,050	0,970	0,090	> 0,050
12 month	4,639	0,007	< 0,050	5,439	0,020	< 0,050	3,450	0,043	< 0,050

Worsening in mobility if OR < 1
Improvement in mobility if OR > 1

We also found no significant relationships between age ($r = -0.09$; $p = 0.632$), sex ($r = -0.10$; $p = 0.576$) and location of contracture ($r = -0.22$; $p = 0.222$) with the outcome of the FMS after SEMLS.

DISCUSSION

In our study, the number of male and female patients were 31 (61%) and 20 (39%) respectively. This number is consistent with study conducted by A. Chounti et al., (2013) and Jarvis et al., (2004) where in their study they reported there was a male predominance in all types of CP cases and found more severe cases in male infants (Jarvis et al., 2005; Chounti et al., 2013).

In our study, the average age of patients was 8.07 years and most of the patients fall into non walker category with crawling FMS score. This finding was consistent with the research conducted by Khan et al., (2007) in which they reported that most of CP cases in developing country is delayedly diagnosed with the average age of 8.5 years and cannot walk (non walker) at the time SEMLS was performed (Khan, 2007).

Decreased patient's mobility in the first 3 months post-surgery can be caused by many things. Høiness et al., (2014) suggested a few problems that arise after SEMLS procedure is postoperative pain, discomfort and psychosocial problems.

There is no significant relationship between gender and SEMLS outcome indicated by FMS score ($p = 0.576$). This finding is consistent with the result from a study conducted by Chounti et al., (2013) in which involving 590 children with CP in Sweden and found no significant relationship between gender and patient's mobility (Chounti et al., 2013).

There is no significant relationship between number of sites in which SEMLS was performed and SEMLS outcome

indicated by FMS score ($p = 0.222$). This finding is consistent with the result from a study conducted by Svehlik et al., (2011) that showed no significant relationship between number of operated sites and surgery outcome.

In this study SEMLS resulted in a significant improvement of patient's mobility status indicated by FMS score despite of the average age of patients was 8.07 years and most of the patients fall into non walker category preoperatively. This finding is consistent with the result from a study conducted by Khan et al., (2007) that report SEMLS outcome in developing countries. They reported that Spastic Diplegic CP patients who have not been able to walk until the age of 7 - 8 years can still benefit from SEMLS surgery, if the patient can sit independently at 4 - 5 years, and good post-operative habilitation care (Khan, 2007).

Based on the result of this study we conclude that:

1. Most CP patients who come at Paediatric Clinic Prof. Dr. R. Soeharso, Surakarta Orthopedic Hospital is male with mean age of 8.07 years old and most of them are not yet able to walk (74.5% with FMS score: Crawling)
2. SEMLS surgery performed in Prof. Dr. R. Soeharso Surakarta Orthopedic Hospital to Spastic Diplegic CP patients gave a good results and improve the patient's mobility status as indicated by FMS score, regardless of age at which surgery is performed and patient's mobility status before surgery.
3. FMS can be used to assess SEMLS outcomes and very responsive to changes that occur and may point the time of change
4. Age, gender, and number of sites in which SEMLS was performed have no significant effect on the SEMLS outcome as indicated by FMS score.

REFERENCE

- Abdel H. Cerebral Palsy. <http://emedicine.medscape.com/article/1179555-overview#a4>.
- Adair B, Said C, Rodda J, et al., (2012). Psychometric properties of functional mobility tools in hereditary spastic paraplegia and other childhood neurological conditions. *Developmental Medicine & Child Neurology*, 596 – 605.
- Bache E, Selber P, Graham HK (2013). The management of spastic diplegia. 88-104. *Current Orthopaedics*. Elsevier Science Ltd.
- Bax M, Goldstein M, Rosenbaum P, Leviton A, Paneth N, Dan B, Jacobsson B, Damiano D (2005). Executive Committee for the Definition of Cerebral Palsy. Proposed definition and classification of cerebral palsy. *Dev Med Child Neurol*, 47: 571–576.
- Bell KJ, Ounpuu S, DeLuca PA, Romness MJ (2002). Natural progression of gait in children with cerebral palsy. *J Pediatr Orthop*, 22(5): 677-82.
- Berker N, Yalcin L (2010). *The Help Guide To Cerebral Palsy: Second edition*. Global Help.
- Bleck EE (1987). *Orthopaedic Management in Cerebral Palsy 2nd ed*, Michigan: Mac Keith.
- Chounti A, Heagglund G, Wagner P, et al., (2013). Sex differences in cerebral palsy incidence and functional ability: a total population study. *Acta Paediatrica*: 712–717
- Graham HK, Harvey A (2007). Assessment of Mobility after Multi – Level Surgery for Cerebral Palsy. *J Bone Joint Surg [Br]*, 89-B:993-4.
- Harvey A, Baker R, Morris M, et al., (2009). Does parent report measure performance? A study of the construct validity of the Functional Mobility Scale. *Developmental Medicine & Child Neurology*: 181 – 185.
- Harvey A, Morris M (2008). Systematic review of measures of activity limitation for children with cerebral palsy. *Developmental Medicine & Child Neurology*, 50: 190–198.
- Harvey A, Graham HK, Morris M (2007). The Functional Mobility Scale: ability to detect change following single event multilevel surgery. *Developmental Medicine and Child Neurology*, 49: 603.
- _____ (2010). Reliability of the Functional Mobility Scale for Children with Cerebral Palsy. *Physical & Occupational Therapy in Pediatrics*, 30(2).
- Harvey A, Rosenbaum P, Hanna S, et al., (2012). Longitudinal Changes in Mobility Following Single-Event Multilevel Surgery in Ambulatory Children with Cerebral Palsy. *J Rehabil Med*, 44: 137–143.
- Herring J (2008). Disorders of the Brain In. *Tachdjian's Pediatric Orthopaedics*, 4th Edition, Philadelphia: Saunders Elsevier, 1277 – 1382.
- Hoiness P, Capjon H, Lofterød B (2014). Pain and rehabilitation problems after single-event multi-level surgery including bony foot surgery in cerebral palsy: A series of 7 children. *Acta Orthopaedica*; 85(6): 646–651.
- Jarvis S, Glinianaia SV, Arnaud C, et al (2005). Case gender and severity in cerebral palsy varies with intrauterine growth. *Arch Dis Child*, 90: 474–479.
- Johnston M, Hagberg H (2007). Sex and the pathogenesis of cerebral palsy. *Developmental Medicine & Child Neurology*, 49: 74–78.
- Khan M (2007). Outcome of single-event multilevel surgery in untreated cerebral palsy in a developing country. *J Bone Joint Surg Br*, 89.

- Khwaja O, Volpe JJ (2008). Pathogenesis of cerebral white matter injury of prematurity. *Arch Dis Child Fetal Neonatal Ed.* 93(2):F153-61.
- Marret S, Vanhulle C, Laquerriere A (2013). Pathophysiology of Cerebral Palsy. In *Handbook of Clinical Neurology, Vol. 111 (3rd series) Pediatric Neurology Part I.* Philadelphia: Mosby Elsevier, 169 – 175.
- Novacheck TF, Stout JL, Tervo R (2000). Reliability and validity of the Gillette Functional Assessment Questionnaire as an outcome measure in children with walking disabilities. *J Pediatr Orthop*, 20(1):75-81.
- O'shea M (2011). Diagnosis, Treatment, and Prevention of Cerebral Palsy in Near-Term/Term Infants. *Clin Obstet Gynecol.* NIHPA.
- Palisano R, Tieman B, et al (2003). Effect of environmental setting on mobility methods of children with cerebral palsy. *Dev Med Child Neurol*, 45(2): 113-20.
- Reiss AL, Kesler SR, Vohr B, Duncan CC, et al., (2004). Sex differences in cerebral volumes of 8-year-olds born preterm. *J Pediatr.* 145: 242–249.
- Rethlefsen S, Ryan DD, Kay R (2010). Classification System in Cerebral Palsy. *Orthop Clin N Am* 41: 457–467.
- Sawyer J (2007). Cerebral Palsy In. *Campbell's Operative Orthopaedic* 11th ed. Philadelphia: Mosby Elsevier, 1202 – 1250.
- Svehlik M, Steinwender G, et al (2011). The influence of age at single-event multilevel surgery on outcome in children with cerebral palsy who walk with flexed knee gait. *Developmental Medicine & Child Neurology*: 730 – 735.
- Thomason P, Baker R, Dodd K (2011). Single-Event Multilevel Surgery in Children with Spastic Diplegia. *J Bone Joint Surg Am.* 93:451-60.