The Functional Mobility Scale (FMS)

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Abstract: We devised a new Functional Mobility Scale (FMS) to describe functional mobility in children with cerebral palsy, as an aid to communication between orthopaedic surgeons and health professionals. The unique feature of the FMS is the freedom to score functional mobility over three distinct distances, chosen to represent mobility in the home, at school and in the wider community. We examined the construct, content, and concurrent validity of the FMS in a cohort of 310 children with cerebral palsy by comparing the FMS to existing scales and to instrumented measures of physical function. We demonstrated the scale to be both valid and reliable in a consecutive population sample of 310 children with cerebral palsy seen in our tertiary referral center. The FMS was useful for discriminating between large groups of children with varying levels of disabilities and functional mobility and sensitive to detect change after operative intervention.

Key Words: functional mobility, disability, limitations, ICF, NCMRR, cerebral palsy, spastic diplegia, energy expenditure, uptime, activity monitoring, outcomes

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Deformity, impaired function, and limitations in mobility are key features of many of the common conditions affecting children, which lead to referral to an orthopedic surgeon.[1,24,30] Functional limitation, activity, and participation are central concepts in the models of disablement developed by the National Center for Medical Rehabilitation Research in the United States[14] and the more recent International Classification of Functioning, Disability and Health (ICF) of the World Health Organization[29] (World Health Organization, 2001). The ICF emphasizes participation restriction and activity limitations rather than handicap and disability.[1,29] A key area of global health status is physical function, defined as the ability to use the musculoskeletal system to interact with the environment in a purposeful way.[30] In turn, a key area of physical function is functional mobility, defined as the means by which an individual moves within the environment to achieve day-to-day interaction with family and society. For the purposes of this research, we define functional mobility as including all the means by which an individual moves to interact within the environment, from independent walking to using a powered wheelchair.

The link between deformity and physical function is not always clear, and, until recently, the measurement of physical function has not received adequate attention in the orthopaedic literature.[7,13,26,30] Measuring physical function is more difficult than measuring deformity and measures of deformity are often used as surrogate measures for function. Young and Wright reviewed many of the scales of physical function, which were in use in 1995.[30] Since their review, a number of new instruments have been introduced including the Gross Motor Function Classification System (GMFCS),[16] the Pediatric Outcome Data Collection Instrument (PODCI),[4,27] the Child Health Questionnaire (CHQ),[9,10,11,28] and the Functional Assessment Questionnaire (FAQ)[15,24] among others.

Traditionally, orthopedic surgeons have classified function according to the scale reported by Hoffer and colleagues from the Rancho Los Amigos hospital.[8] Although the Rancho Scale was originally designed to describe walking ability in the myelomeningocele population, it has been applied to children with other disabilities.[23] It was published in 1973 and has not been formally evaluated in terms of validity and reliability.[8] Functional mobility should be considered to be a complex spectrum for children with moderate and severe disabilities and defies simple ordinal classification. A child who walks independently at home may use crutches at school and a wheelchair in the community.[16] None of the existing scales fully address the difficulty in describing functional mobility in children who use a range of assistive devices and mobility aids in their daily lives.[15,16] In keeping with the World Health Organization's disability paradigm, we constructed a scale to classify functional mobility, which takes into account both self-initiated movement as well as assisted movement and passive mobility in a powered wheelchair.[29] The scale is used to rate walking ability at three specific distances, 5, 50, and 500 me-

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ters or 5, 50, and 500 yards (Table 1). The target age range was age 6 years to skeletal maturity, the age range when most reconstructive surgery is practiced. We excluded younger age groups, when rapid changes in functional mobility are more likely to be the result of developmental changes and the effects of musculoskeletal deformity are less important.[16,21] The scale was designed to be completed by a physician or therapist but may also be completed by the parent with very careful instruction. The rater is asked to rate the usual walking ability of the child at three distances according to the need for assistive devices, such as walking sticks, or crutches or mobility aids, such as a wheelchair. A specific example is a child, aged 8 years, who has severe spastic diplegia. The child walks independently in the home but uses Canadian crutches in the school playground and a wheelchair for long family walks or school outings. This child, according to the Functional Mobility Scale, would be scored as 5, 3, and 1 indicating at a glance the level of walking ability at 5, 50, and 500 meters respectively. In this study we aimed to establish the validity and reliability of the FMS and its ability to detect postoperative change in children with cerebral palsy.

TABLE 1. The Functional Mobility Scale (FMS)

Please rate the child's usual walking ability for each of the distances listed below. Please write, in the space provided, the number that best describes the child's ability or need for assistance, at each of the distances listed.

1. Uses wheelchair, stroller or buggy: May stand for transfers and may do some stepping supported by another person or using a walker/frame
2. Uses K-Walker or other walking frame: without help from another person
3. Uses two crutches: without help from another person
4. Uses one crutch or two sticks: without help from another person
5. Independent on level surfaces: does not use walking aids or need help from another person. If uses furniture, walls, fences, shop fronts for support please use 4 as the appropriate description
6. Independent on all surfaces: does not use any walking aids or need any help from another person when walking, running, climbing and climbing stairs.

Walking Distance	Rating (1–6)
Walking 5 Meters (eg, in bedroom or other room)	
Walking 50 Meters (eg, at school, in the classroom and playground)	
Walking 500 Meters (eg, in shopping mall or street)	

MATERIALS AND METHODS

Population Sample

The parents of 311 consecutive children attending an orthopaedic clinic for children and adolescents with cerebral palsy were invited to participate. Ethical approval was obtained prior to the commencement of the study from our Institutional Ethics Committee. Written, informed consent was obtained from parents, and there was only one refusal to participate. All parents were asked to complete the FMS in the outpatient clinic. They were also asked to complete a Rancho Scale (RS),[8] a Child Health Questionnaire–Australian CHQ PF-50 (CHQ),[28] and a Pediatric Outcomes Data Collection Instrument (PODCI)–version 2[4] appropriate for the age of the child. These were scored, and the physical functioning domain of the CHQ and the physical function and sports domains of the PODCI were used for further analysis. For the purposes of the analysis, the ratings on the Rancho Scale were converted to numerical ratings with community ambulators scored as 1, household ambulators as 2, nonfunctional ambulators as 3, and nonambulators as 4. The attending orthopedic surgeons (HKG and GRN) and the research fellow also completed the FMS, a short demographic questionnaire, and a RS rating for each child during their clinic appointment.

Functional activity in the community was also directly measured using a remote activity monitor, the PAL1, Positional Activity Logger, also known as an "Up-timer" (National Aging Research Institute of Melbourne, Melbourne, Australia) (UT).[5,6,18,25] This measured "uptime" (UT) defined as the time that the child spent in the upright position as compared with the time that the child spent in the supine position.[5] The validity, reliability, and normative values for this instrument have been established in previous studies.[6,18] Energy Expenditure (EE) was measured during a 10-minute walk at self-selected speed, with the Cosmed K4 apparatus (Cosmed, Rome, Italy) as described previously.[2]

Sensitivity to Change After Gait Correction Surgery

The same instruments were used in the surgical study, with identical protocols to those described earlier and in previous studies. It is our standard practice to conduct an evaluation of all children every 3 months after gait correction surgery, in the gait laboratory, for a video recording of gait, a physical examination, and a check on the fit and function of orthoses. The parents completed the questionnaires during their child's gait laboratory evaluation, and the gait laboratory staff conducted the measurements of Energy Expenditure. The last author attended all of these evaluations, to distribute and collect the questionnaires and the Uptimers and to be available to answer questions. The test schedule was according to the following timetable:

- Baseline: FMS, RS, Uptime, CHQ, PODCI, and EE.
- 3 months: FMS, RS, and Uptime.
- 6 months: FMS, RS, Uptime, CHQ, and PODCI.
- 9 months: FMS, RS, and Uptime.
- 12 months: FMS, RS, Uptime, CHQ, PODCI, and EE.

Statistical Analysis

The CHQ, PODCI, RS, UT, and EE were used as the validity criteria. Content and concurrent validity of the FMS was assessed using Spearman rank correlation. Correlation coefficients for each of the individual sections of the FMS were calculated. Chi-square and Fisher exact test tests were used to analyze the significance of any detected differences in the performance of the scales. Construct validity was measured in two ways. The first was the performance of the scale to differentiate between different walking abilities in the children from the population-based study. The ability of the FMS to detect individual differences in the walking abilities of the children was assessed with Spearman rank correlations. The second was the ability to detect change during the postoperative rehabilitation period in the cohort of children who had multilevel surgery. Multiple signed rank comparisons were made between the preoperative and the 3-, 6-, 9-, and 12-month postoperative measurements. The validity of this change was assessed using Spearman rank correlation to compare the FMS to UT at 3-month intervals, the PODCI and CHQ at 6-month intervals, and the EE at the 12-month postoperative mark. Interrater reliability was assessed using intraclass correlation coefficients (ICC), Cronbach's α, and concordance correlation coefficients (CCC).

RESULTS

Demographics and Motor Distribution

Three hundred ten consecutive families enrolled in the study, with only one refusal. All children had cerebral palsy, which was predominantly spastic in motor type. The age-sex distribution and topographical description of the children with cerebral palsy is found in Table 2. The response rate was excellent with 87% returning the questionnaire in the allotted time, increasing to 100% with a telephone reminder.

The more severely involved children had a lower grading on each of the three sections of the FMS (Table 3). Age and gender did not significantly influence this finding. As expected, the use of assistive devices increased with greater walking distances, reflected by lower FMS scores, in the more severely involved children. Modal scores for children with hemiplegia decreased from a score of 6 at 5 meters to a modal score of 5 at 500 meters. Those with diplegia decreased from a modal score of 5 at 5 meters to 4 at 500 meters, with many requiring some form of assistive device at these longer distances.

Children with spastic quadriplegia had a modal score of 3 at 5 meters and only 1 at 500 meters, indicating their complete dependence on a wheelchair for longer distances. Five children with severe spastic quadriplegia required a wheelchair at 5 meters with an FMS rating of 1. At 50 meters the number requiring a wheelchair had increased to 30 (42%). At 5 and 50 meters, no children with either spastic hemiplegia or diplegia were using wheelchairs. In children with spastic diplegia, at 5 meters 19% required the assistance of a walking aid and at 50 meters 42% required some form of assistance, 21% used sticks, and 16% required crutches. At the 500 meter distance 8% required a wheelchair for functional mobility (Table 3).

There was no significant age-related variation in either CHQ or PODCI scores within the cohort with analysis of variance testing. However, there was a significant age-related variation in uptime between children aged less than 10 years and those aged greater than 10 years (3.3 ± 0.9 hours versus 2.5 ± 0.7 hours, respectively, $P < 0.01$). Fisher exact test testing also demonstrated that the younger children had higher rating for all three sections of the FMS than the older children ($P < 0.05$, $P < 0.01$, and $P < 0.001$ respectively).

Concurrent and Content Validity

Using Spearman rank correlations, the FMS had strong correlations with all of the outcome tools except oxygen cost (Table 4). The highest observed correlations were with the UT and PODCI. The energy expenditure assessment had poor correlations with all of the outcome tools.

TABLE 2. Motor Pattern, Age, and Sex Distribution of the Main Study Cohort, 310 Children With Spastic Cerebral Palsy

	Number		Age (years)		Σ	
Motor Pattern	Male	Female	Male	Female	Number	Age
Spastic hemiplegia	55	59	11 ± 3.5	12 ± 4.1	114	12 ± 3.6
Spastic diplegia	56	68	12 ± 4.2	11 ± 3.9	124	12 ± 4.0
Spastic quadriplegia	38	34	10 ± 3.4	10 ± 3.9	72	10 ± 3.7
Σ	149	161	11 ± 3.6	11 ± 4.0	310	11 ± 3.7

TABLE 3. Summary Mean Scores for Each of the Outcome Tools by FMS Score and Motor Pattern, 310 Children With Spastic Cerebral Palsy

		N (n = 310)			PODCI (n = 310)			CHQ (n = 310)			E (n = 73)			RS (n = 310)			UT (n = 300)		
Scale	**Rating**	**H**	**D**	**Q**	**H**	**D**	**Q**	**H**	**D**	**Q**	**H**	**D**	**Q**	**H**	**D**	**Q**	**H**	**D**	**Q**
FMS-5	1			5			14			15						3.1			0.3
	2			16			17			22						2.8			0.4
	3		4	23		42	20		48	25		0.40	0.39		1.6	2.4			0.6
	4		20	15		49	25		50	30		0.40	0.39		1.4	2.3		1.7	0.9
	5	25	55	7	75	54	32	81	53	34	0.26	0.36	0.36	1.4	1.4	2.3	4.3	2.0	1.3
	6	89	45	6	82	58	40	90	56	38	0.25	0.35	0.35	1.2	1.2	2.1	5.1	2.4	1.5
FMS-50	1			30			26			31			0.40			3.2			0.6
	2		6	37		41	35		47	40		0.39	0.40		1.6	2.5		1.2	1.1
	3		20	5		45	48		52	52		0.36	0.37		1.6	1.5		1.6	1.8
	4		26			50			56			0.35	0.37		1.4			1.9	
	5	54	38		82	56		87	61		0.25	0.35	0.36	1.2	1.2		4.5	2.2	
	6	60	34		84	60		92	65		0.25	0.34	0.34	1.1	1.1		5.5	2.7	
FMS-500	1		10	60		40	35		42	38		0.39	0.40		2.1	3.7		1.2	0.9
	2		15	10		52	42		55	45		0.36	0.38		1.6	2.9		1.5	1.3
	3		21	2		56	51		63	55		0.36	0.32		1.4	1.4		1.8	1.9
	4	13*	35		69	65		73	70		0.26	0.35		1.2	1.1		4.9	2.1	
	5	53	25		86	72		85	75		0.25	0.34		1.1	1.0		5.4	2.5	
	6	48	18		94	81		92	85		0.23	0.32		1.0	1.0		5.8	2.9	

H, spastic hemiplegia; D, spastic diplegia; Q, spastic quadriplegia. *Requiring occasional external support, not using crutches.

The FMS also differentiated children with varying degrees of walking ability that would have been grouped under the same functional category using the Rancho Scale. The Rancho grading system tended to overestimate the ability of some of the children rated as community ambulators as many required the use of walking aids. This was evident across all motor patterns. The Rancho Scale rated all children with spastic hemiplegia as community ambulators, despite some children scoring 4 on the FMS-500 scale, indicating occasional need for external support such as leaning against a shop window in the street. Of the children with spastic diplegia rated as community ambulators, 24% required the use of assistive devices at 500 meters, 13% at 50 meters, and 5% at 5 meters. The Rancho Scale performed best with the more severely involved children with spastic quadriplegia. The children rated as nonambulators all required wheelchairs at 500 meters, 77% re-

TABLE 4. Spearman Correlation Coefficient Matrix

	FMS-5	**FMS-50**	**FMS-500**	**PODCI**	**CHQ**	**E**	**RS**	**UT**
FMS-5	1.00			0.89*	0.78*	0.51‡	0.78*	0.87*
FMS-50		1.00		0.84*	0.82*	0.52‡	0.72*	0.83*
FMS-500			1.00	0.82*	0.81*	0.55‡	0.71*	0.84*
PODCI				1.00	0.75†	0.53	0.80‡	0.79*
CHQ					1.00	0.54	0.74‡	0.81*
EE						1.00	0.54‡	0.61
RS							1.00	0.78†
UT								1.00

*$P < 0.001$.
†$P < 0.01$.
‡$P < 0.05$.

quired wheelchairs at 50 meters, and 69% at 5 meters. A small number could take some steps with the use of a K-walker, crutches, or walking sticks.

Reliability

The FMS had high interrater reliability with high intraclass correlation coefficients, a high Cronbach α score, and a high concordance correlation coefficient for each of the sections (Table 5).

Interrater Reliability

Bland and Altman analysis of limits of agreement demonstrated that the mean difference between ratings was close to zero indicating very little bias between occasions for each of the sections of the scale. Furthermore, the absence of a significant relationship between the differences and the means of the ratings showed that there was no tendency for bias along the length of the scale. The intraclass correlation coefficients for both attending surgeon and research fellow's ratings for each of the categories were exceptionally high. This reliability was not affected by age, gender, or motor pattern of involvement of the child.

Construct Validity

The FMS was able to detect differences in walking ability in the population sample (see Table 6). The scale could also detect change following surgical intervention in the subsample of 35 children. This cohort of children with spastic diplegia had a mean age of 10.5 ± 2.3 years. There were 17 boys with an average age of 10.3 ± 2.4 years and 18 girls with an average age of 10.6 ± 2.8. The FMS demonstrated an excellent ability to demonstrate a difference between pre- and postoperative state and to detect improvement and deterioration in walking ability during the rehabilitation phase (see Table 6). At the 3-month postoperative mark, the children's walking ability was significantly reduced and this gradually improved with continuing rehabilitation. This was not affected by the age or gender of the children. These changes correlated well with changes in the other outcome measures (see Table 7).

TABLE 6. FMS Ratings After Multilevel Orthopaedic Surgery, in 35 Children With Spastic Diplegia

	Score	Preop	3/12 Postop	6/12 Postop	9/12 Postop	12/12 Postop
FMS-5	Mean	5.8	1.8‡	3.6*	5.5	5.9*
	Median	5	2‡	4*	5	6*
	Range	4–6	1–3	2–5	4–6	4–6
FMS-50	Mean	4.2	1.1‡	2.3‡	3.5†	4.9†
	Median	4	1‡	2‡	3†	5†
	Range	3–5	1–2	1–3	2–5	3–6
FMS-500	Mean	3.9	1.1‡	1.5‡	3.0*	5.1‡
	Median	4	1‡	2‡	3*	5‡
	Range	3–5	1–2	1–3	2–4	4–6

All comparisons are with the preoperative rating, of the respective section of the scale.
*$P < 0.01$.
†$P < 0.05$.
‡$P < 0.001$.

The strongest correlation for the FMS was with Uptime (see Table 7). Uptime was very sensitive to change in the postoperative period, and changes in rating in the FMS correlated strongly with the changes in Uptime. The FMS had strong correlations with the physical functioning domains of the PODCI and CHQ; however, these correlations were weaker than with Uptime (Table 7). The strength of these correlations was not influenced by the age or gender of the child.

Oxygen cost showed the weakest correlation with postoperative recovery as detected by the FMS and was not improved by stratification by age, gender, height, weight, or body surface area.

TABLE 5. Intraclass Correlation Coefficient, Cronbach's α, and Concordance Correlation Coefficient, With 95% Confidence Intervals in Brackets, for the Assessment of Interrater Reliability, 310 Children With Spastic Cerebral Palsy

	ICC	Cronbach's α	CCC
FMS-5			
Surgeon* vs research fellow†	0.95 (0.88–0.98)	0.95 (0.86–0.98)	0.97 (0.94–0.99)
FMS-50			
Surgeon* vs research fellow†	0.94 (0.88–0.97)	0.94 (0.87–0.99)	0.96 (0.93–0.99)
FMS-500			
Surgeon* vs research fellow†	0.95 (0.89–0.99)	0.96 (0.89–0.99)	0.98 (0.93–0.99)

ICC, intraclass correlation coefficient; CCC, concordance correlation coefficient.
*HKG, GRN.
†MP.

TABLE 7. Spearman Correlation Coefficient Matrix for the Change in Ratings Between Each Section of the FMS and the Other Outcome Tools at 6 and 12 Months Postoperatively, in 35 Children With Spastic Diplegia

	PODCI	CHQ	E	UT
6 months				
FMS-5	0.78*	0.77‡	0.53*	0.86‡
FMS-50	0.82*	0.80*	0.59*	0.84‡
FMS-500	0.81‡	0.80‡	0.52*	0.85‡
PODCI	1.00	0.78†	0.51*	0.81‡
CHQ		1.00	0.53*	0.82‡
E			1.00	0.62*
UT				1.00
12 months				
FMS-5	0.79*	0.75‡	0.54*	0.78‡
FMS-50	0.81‡	0.82*	0.55*	0.85‡
FMS-500	0.80‡	0.83‡	0.53*	0.89‡
PODCI	1.00	0.81†	0.55*	0.84‡
CHQ		1.00	0.56*	0.81‡
E			1.00	0.60*
UT				1.00

*$P < 0.05$.
†$P < 0.01$.
‡$P < 0.01$.

DISCUSSION

Many instruments for the assessment of quality of life, health status, physical function, and mobility in children with physical disabilities are now available.[2–4,6–9,12,15–17,19–21,26,30] The instruments which would appear to hold the most promise for self-reported assessment of general health, musculoskeletal health and physical function are the Child Health Questionnaire (CHQ)[9–11,27,28] and the Pediatric Outcome Data Collection Instrument (PODCI).[4,27] However, both the PODCI and CHQ are time consuming to administer and to analyze. We believe there is a need for a simple tool to describe the more narrow issue of functional mobility, in children with disabilities, as evidenced by the popularity of the Rancho Scales (four groups)[8] and the more recently introduced Gross Motor Function Classification Measure (GMFCS 5 levels)[16] and the Functional Assessment Questionnaire (FAQ 10 levels).[15] The Rancho groups are too few and too broad to be helpful in discriminating between children with widely differing functional mobility and the scale is unresponsive to change, as demonstrated in this study. The mean preoperative Rancho Score for the whole population was between 3.7 and 3.8, and most of the children in the surgical cohort were graded as four preoperatively. When this was analyzed further with the FMS, it was found that the Rancho Scale tended to overrate good mobility and underrate poor mobility in many children. Children with a dependence on walking aids were often rated as community ambulators, while children with the ability to walk very small distances around the house with walking aids were rated as nonambulators.

The GMFCS and the FAQ are both very useful scales but suffer from ambiguity particularly in the large group of children who require a range of assistive devices and mobility aids for daily functioning. Parents and therapists frequently express difficulty in using both the GMFCS and FAQ when children use crutches and a wheelchair, at different times and for different distances. According to the GMFCS, children at Level III primarily use assistive mobility but children at Level IV also have self-mobility with limitations. With respect to distance and duration parameters, the GMFCS includes terms such as "long distances," "short distances," and "frequently" with no numerical or graphic guide to interpretation.[16] In addition, the generic term "assistive mobility device" is used with no attempt made to differentiate various levels of support.[16] The FAQ specifies distances such as 15 to 50 feet but includes less precise terms such as "community distances."[15]

There is also a tendency for parents and children to default to the highest level of function when faced with the dilemma of choosing a single response to a question regarding function. This can have serious effects on the interpretation of outcome studies because the parents may choose different responses, at different time intervals, when there has been little real change in function. The FMS is similar to the GMFCS with an emphasis on the need for assistive devices and mobility aids. With the FMS, these are listed in descending order of support, ranging from a wheelchair to no aid of any kind (Table 1). The unique feature of the FMS is the freedom to score functional mobility over three distinct distances, chosen to represent mobility in the home, at school, and in the shopping mall. We believe that this extends the scale to the complexities of functional mobility in the real world and allows the selection of a series of responses instead of choosing highest function. We resolved the issue of ambiguity by using one scale but applying it over three key distances.

We tested the FMS in a large population study of children with cerebral palsy, and the response rate was excellent ensuring excellent internal validity. The cohort was representative of the referral pattern to this clinic for children with cerebral palsy in a tertiary referral center. Concurrent validity was established by the excellent correlations with the PODCI, CHQ, and Uptime. The PODCI and Uptime had the stronger correlation with walking ability. The PODCI has been shown to be a more sensitive indicator of physical impairment than the CHQ.[4,27] Uptime is a new tool in pediatrics rehabilitation studies but has a good track record in adult medicine.[22,25] Validity, reliability, and normative data have been established in recent studies.[6,18,25] We think that it is critical to validate functional mobility scales by comparison to an instrumented measure of physical activity.

The FMS was very sensitive at detecting change in children with spastic diplegia after gait correction surgery, as demonstrated by recorded changes in rating. Furthermore, these changes were valid as there was good correlation with Uptime, PODCI, and CHQ scores. The 5-meter section picked up changes that most strongly correlated with changes in uptime in the first 6 months after which the correlation decreased in magnitude. This may have been because most of the children had improved to their full possible score on the scale during the initial 6-month period. The 50- and 500-meter sections continued to show strong correlation with uptime of improvement detected at all postoperative reviews.

Oxygen cost had the poorest correlation with the FMS, compared with the other instruments and was not improved by stratification of the data. Energy expenditure may be related to walking ability in a more complex manner than a direct relation between oxygen cost and walking ability.[2,17–20] The interrater reliability of the scale was also high. All three measures of agreement demonstrated a high reliability between attending surgeon and research fellow ratings.

We use the CHQ and PODCI questionnaires as outcome measures in many of our studies in children with cerebral palsy and other disabilities. However, the FMS is useful for discriminating between large groups of children with varying levels of disabilities and functional mobility. It is very useful for monitoring change and has the sensitivity both to detect the initial deterioration in mobility after gait correction surgery as well as the ultimate improvement in function. An improved understanding of the relationship between the progression of deformity and functional mobility may help refine thinking as to the most appropriate forms of management.

We have used the FMS successfully in assessing children with other disabilities, including children with myelomeningocele. We think that there may be a role for this scale in many of the conditions, which present to pediatric orthopaedists. Further condition specific, reliability, and validity studies will be required.

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