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The EXCITE Trial: Predicting a Clinically Meaningful Motor Activity Log Outcome

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Abstract

Background and Objective—This study determined which baseline clinical measurements best predicted a predefined clinically meaningful outcome on the Motor Activity Log (MAL) and developed a predictive multivariate model to determine outcome after 2 weeks of constraint-induced movement therapy (CIMT) and 12 months later using the database from participants in the Extremity Constraint Induced Therapy Evaluation (EXCITE) Trial.

Methods—A clinically meaningful CIMT outcome was defined as achieving higher than 3 on the MAL Quality of Movement (QOM) scale. Predictive variables included baseline MAL, Wolf Motor Function Test (WMFT), the sensory and motor portion of the Fugl-Meyer Assessment (FMA), spasticity, visual perception, age, gender, type of stroke, concordance, and time after stroke. Significant predictors identified by univariate analysis were used to develop the multivariate model. Predictive equations were generated and odds ratios for predictors were calculated from the multivariate model.

Results—Pretreatment motor function measured by MAL QOM, WMFT, and FMA were significantly associated with outcome immediately after CIMT. Pretreatment MAL QOM, WMFT, proprioception, and age were significantly associated with outcome after 12 months. Each unit of higher pretreatment MAL QOM score and each unit of faster pretreatment WMFT log mean time improved the probability of achieving a clinically meaningful outcome by 7 and 3 times at posttreatment, and 5 and 2 times after 12 months, respectively. Patients with impaired proprioception had a 20% probability of achieving a clinically meaningful outcome compared with those with intact proprioception.

Conclusions—Baseline clinical measures of motor and sensory function can be used to predict a clinically meaningful outcome after CIMT.

Keywords

Stroke; Rehabilitation; Outcome; Prediction

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Constraint-induced movement therapy (CIMT)[1,2] is a promising neurorehabilitation technique developed in the past decades. Recently, a multicenter randomized clinical trial evaluated the efficacy of CIMT in patients who were 3 to 9 months poststroke. The Extremity Constraint Induced Therapy Evaluation (EXCITE) trial[3] is the first national, randomized, singleblind study to systematically test the effects of CIMT among poststroke hemiparetic patients in the subacute to chronic stage. CIMT produced significant improvements in arm motor function as well as functional usage of the paretic arm, which persisted for at least 1 year.[4]

Despite this promising result, there are barriers to the adoption of CIMT in clinical practice. The signature CIMT protocol used in the EXCITE trial is labor intensive and expensive, and is applied for at least 2 weeks. Such intensity is usually not possible in most clinical settings[5]; therefore, implementing the signature CIMT protocol in clinical practice may be somewhat remote from the realities of clinical practice. The feasibility of using a CIMT protocol, considering the amount and duration of therapy, and the criteria for selection of the best candidates, those expected to benefit most, are as yet to be determined.[6]

In this retrospective study, the EXCITE trial data were analyzed to determine the factors most predictive of a clinically meaningful outcome defined by the Motor Activity Log (MAL) Quality of Movement scale (QOM). The primary outcome measures of the EXCITE trial were the performance-based Wolf Motor Function Test (WMFT),[7] which objectively measures arm and hand function in 17 tasks administered in the laboratory, and the patient self-report MAL,[8,9] a structured interview that measures the amount (Amount of Use scale, AOU) and quality (QOM) of the more affected arm use for 30 items of daily life. Defining a clinically meaningful outcome is a challenging task for any study. Attempts have been made to find predictive factors for CIMT outcomes, including the WMFT. However, to define a meaningful outcome that makes sense to both clinicians and patients, the MAL was chosen as a criterion in this study. The MAL includes a rank order scale (0–5) originally developed to evaluate the effect of CIMT, for many real-world functional activities such as “turning on a light switch” and “washing your hands.” The purpose of this study is (1) to determine predictors among baseline clinical measures that are associated with a clinically meaningful outcome on the MAL following 2 weeks of CIMT and at the 12-month follow-up, and (2) to develop a predictive model using clinical parameters to predict the probability of achieving a clinically meaningful outcome after CIMT in stroke patients 3 to 9 months poststroke.

METHODS

Subjects

Data from all participants who were enrolled in the EXCITE trial were included. Details of the EXCITE protocol are described elsewhere; however, they are summarized here for clarity.[3] Inclusion criteria were (1) participants with hemiparesis between 3 and 9 months poststroke; (2) active wrist extension of 10°, 10° abduction/extension of the thumb, and at least 2 additional digits; (3) adequate balance and safety; and (4) adequate communication ability. Exclusion criteria were (1) structural or biomechanical restrictions to active motion of the more affected upper extremity; (2) less than 24 on the Mini Mental State Examination; (3) major medical problems, excessive pain, insufficient endurance and stamina that would interfere with participation; (4) younger than 18 years of age; and (5) baseline score of greater than 2.5 on the MAL AOU scale.

The EXCITE trial used a randomized controlled crossover design. Participants were assigned to either treatment (immediate) group or control (delayed) group. A total of 222 participants were enrolled using an adaptive randomization procedure,[3] with 106 assigned to the treatment group and 116 to the control group. Participants were stratified by gender,

dominant side, side of stroke, and functional level. Functional level denotes 2 categories (high or low) according to the level of paretic arm function. High functional level indicates the ability to extend the wrist at least 20° and each metacarpophalangeal and interphalangeal joint at least 10°, whereas low functional level indicates the ability to extend the wrist at least 10°, abduct the thumb at least 10°, and extend 2 additional digits at least 10°. After the 12-month follow-up, the control group received the same treatment as the immediate group. Clinical evaluations were performed at baseline, immediately after CIMT, and again 4, 8, and 12 months later. The same evaluation protocol was applied for the second year (ie, 12–24 months). Clinical data measured at baseline; at 2 weeks, during which the treatment (immediate) group received CIMT whereas the delayed group served as control; and at 12 months were used in this study. All 222 participants were included in the analysis.

Intervention

CIMT was administered using the signature protocol for 2 weeks. Participants were instructed to wear an instrumented mitt, which contained a conductancesensitive transducer to monitor mitt compliance, on the less affected hand during 90% of waking hours over the treatment period. They also received individual treatment that consisted of shaping and repetitive task practice of the paretic limb for up to 6 hours a day for 10 weekdays during the 2-week duration.

Clinical Variables (Predictors)

To build a predictive model, clinically relevant variables, considered relevant to motor recovery after stroke,[10–12] were chosen as potential predictors. The clinical data used for analysis were obtained from the baseline evaluations of EXCITE. These variables included age and gender; type of stroke; side of stroke; concordance; time after stroke (in days) at baseline; pretreatment MAL (both AOU and QOM scores); pretreatment WMFT; motor and sensory function measured by the Fugl-Meyer test; spasticity of elbow flexors, forearm pronators, and wrist flexors, measured by the modified Ashworth scale; and visual perception measured by the Clock Drawing Test.

Outcome Measure (Dependent Variable)

The average score for the MAL QOM scale measured immediately after CIMT and at 12 months was dichotomized and used as the dependent variable. The MAL consists of 30 ADL items, and each item has 11 scales from 0 (no use) to 5 (normal). Validity and reliability of the MAL has been established,[9,13] and the QOM scale was recently found to be more reliable than the AOU scale.[8] A clinically meaningful outcome after CIMT was explicitly defined as an average score of ≥3,[4] which indicates that the participant scored his or her ability to use the paretic arm and hand without any assistance by the less affected side in each of the tasks probed in the MAL (Table 1).

Statistical Analysis

Univariate logistic regression was performed to identify significant predictors of a clinically meaningful outcome. All stratified variables as well as group assignment (treatment or control) were included in the models. In the multiple logistic regression, all significant variables identified by univariate analysis were included, and then each variable was removed from the model one by one and tested by the likelihood ratio test. Collinearity was examined by calculating the variance inflation factor (VIF). Interactions between variables were assessed by the likelihood ratio test comparing the full model containing interaction terms and the original model. For univariate and multivariate regression analysis, significance level was set at $P < .10$. SAS 9.1 (SAS Institute Inc, Cary, North Carolina) statistical software was used for all statistical analysis.

RESULTS

In the treatment group, 31/106 participants (29.3%) and 33/106 participants (31.1%) achieved a clinically meaningful outcome at immediate posttreatment and after 12 months, respectively. In the control group, 18/116 participants (15.5%) at 2 weeks and 21/116 participants (18.1%) at 12 months achieved a clinically meaningful outcome (Table 2).

There were 21 missing MAL QOM scores at 2 weeks (8 from the treatment, 13 from the control) and 56 at the 12 months (26 from the treatment, 30 from the control). All participants with missing MAL QOM outcome values were regarded as not having reached a clinically meaningful outcome and included in the analysis.

Clinical Predictors Associated With the Outcome at 2 Weeks (Immediately After CIMT)

From the univariate regression analysis, the MAL (both AOU and QOM), WMFT (both time and functional ability scale), Fugl-Meyer upper extremity motor portion, sensory impairment (light touch), time after stroke, functional level, and group assignment were identified as significantly associated with posttreatment outcomes (Table 3).

The multivariate analysis identified pretreatment mean MAL QOM, log mean WMFT time, and FMA motor score as significant predictors. The VIF values calculated for each variable were less than 10 and did not indicate strong collinearity between variables. The likelihood ratio test revealed no significant interactions between treatment and baseline clinical measures. In the final model, pretreatment mean MAL QOM score, log mean WMFT time, FMA motor score, and design variables were included as predictive variables (Table 4). The final logistic regression equation is as follows:

$$\text{Logit } P(\text{posttreatment mean MAL QOM} \geq 3) = -7.6668 + 0.1739 \times (\text{female}) - 0.3743 \times (\text{left side dominant}) - 0.3307 \times (\text{left hemiparesis}) + 0.9311 \times (\text{high functional level}) + 2.4704 \times (\text{CIMT}) + 1.9039 \times (\text{pretreatment mean MAL QOM}) - 1.1863 \times (\text{pretreatment log mean WMFT time}) + 0.0722 \times (\text{pretreatment FMA motor}).$$

This model indicates that individuals who received CIMT have an 11.8 times higher probability of achieving a clinically meaningful outcome immediately after treatment than those who did not. A 1-unit increase in pretreatment mean MAL QOM score and a 1-unit decrease in pretreatment log mean WMFT time led to a 6.7 and 3.2 times higher probability of achieving a clinically meaningful outcome, respectively. An increased FMA score of 1 unit enhanced the probability by 8%. For continuous variables, such as mean MAL QOM score, log mean WMFT time, and FMA motor score, participants were divided into groups according to MAL score categories (<1, 1–2,≥2) and WMFT and FMA quartiles determined by their baseline values.

Odds ratios between groups were calculated. According to these estimates, participants whose mean baseline MAL QOM was ≥2 had a 19.6 times higher probability of success compared to those who had a mean MAL QOM of ≤1. Participants whose mean baseline WMFT time was ≥5.10 seconds had an 11.2 times higher probability of success compared to those with ≥14.15 seconds mean WMFT time. No participant who had ≥36.97 seconds mean WMFT time achieved a clinically meaningful outcome. Participants whose baseline FMA motor score was ≥52 had a 15.8 times higher probability of success compared to those who had a FMA motor score of less than 32 (Table 5).

Clinical Predictors Associated With Outcome at 12 Months

Univariate analysis identified MAL (both AOU and QOM scale), WMFT (both time and functional ability scale), Fugl-Meyer upper extremity motor portion, sensory impairment

(proprioception), time after stroke, age, functional level, and group assignment as variables significantly associated with outcomes at 12 months (Table 3).

In multivariate analysis, pretreatment mean MAL QOM score, log mean WMFT time, sensory impairment (proprioception), and age were identified as significant variables. Testing collinearity and interaction did not remove or add any variables. These variables and design variables were included as predictors in the final model (Table 4). The final logistic regression equation is as follows:

$$\text{Logit P (12 month mean MAL QOM} \geq 3) = -0.7780 - 0.0331 \times (\text{age}) + 0.1088 \times (\text{female}) + 0.3300 \times (\text{left side dominant}) - 0.3682 \times (\text{left hemiparesis}) - 0.0167 \times (\text{high functional level}) + 1.2770 \times (\text{CIMT}) + 1.6442 \times (\text{pretreatment mean MAL QOM}) - 0.5758 \times (\text{pretreatment log mean WMFT time}) - 1.6322 \times (\text{impaired proprioception}).$$

This model indicates that participants who received CIMT have a 3.6 times higher probability of achieving the clinically meaningful outcome 12 months after treatment than those individuals who had usual and customary care (control participants). One unit increase in the baseline mean MAL QOM score and a 1 unit decrease in log mean WMFT time led to 5.2 and 1.8 times higher probability, respectively, of achieving the clinically meaningful outcome after 12 months. Continuous variables were converted to dichotomous variables by the same method as used for 2-week analysis. According to these estimates, participants whose mean baseline MAL QOM is ≥2 have a 21.8 times higher probability of success compared to those who have a mean MAL QOM of less than 1. Participants whose mean baseline WMFT time was ≤5.10 seconds have a 12 times higher probability of success compared to those with ≥36.97 seconds of mean WMFT time. Participants with impaired proprioception had a 20% probability of success compared with those with intact proprioception. One year increase in age reduced the probability of success by 3% (Table 5).

DISCUSSION

Results from this study indicate that baseline clinical measures of motor and sensory function can be used as predictors to determine which patients with subacute stroke may achieve a clinically meaningful outcome after CIMT. Defining success for a rehabilitation intervention is a challenging task. An important rehabilitation goal is to achieve some level of independence among persons with disabilities. Commonly used rehabilitation outcome measures, such as the Functional Independence Measure[14] and the Barthel index,[15] do not measure change in impairment level within the paretic arm. CIMT is a therapeutic intervention primarily focused on regaining the functional use of the hemiparetic arm. The MAL is a measurement tool developed to specifically address the effect of CIMT[9] on impaired limb use and reflects the patient's perspective on both amount and quality of paretic arm use in selected ADLs. Moreover, its association with subjective perception of recovery is significant.[16] Defining a clinically meaningful result as differences between before and after treatment[17] may also be a good approach, but its pitfall is that the same difference in a continuous scale does not reflect the same amount of improvement. Because the MAL is a continuous scale, having a metric to define a clinically relevant change is useful. A rating of ≥3 on the MAL QOM scale indicates a perceived level of qualitatively independent use of the impaired arm in ADL (the task can be successfully completed without assistance from the less affected arm) and thus may be a criterion for ascertaining a clinically meaningful outcome in terms of both subjective patient perception and objective goal of rehabilitation.[4]

Developing predictive models for CIMT outcome has been attempted by other investigators.[11,16,18] In a model to predict WMFT after CIMT, finger extension was the only significant predictor for both posttreatment and follow-up WMFT.[18] In our study, the

functional level of the paretic arm, which basically measured the ability to extend the wrist and fingers, was a significant predictor for MAL in the univariate analysis, but not in the multivariate analysis, since other objective motor function measures were included in that model. In another model that included descriptive characteristics to predict CIMT outcome, age was the only predictor for MAL AOU.[11] Recently, Fritz et al[16] used the perceived recovery section of the Stroke Impact Scale as the outcome variable for important improvement after CIMT. They suggested that the follow-up scores of MAL AOU and WMFT would predict the participants' perception of recovery, and reported that follow-up MAL AOU < 1.15 or WMFT > 34.0 seconds are predictive of perceived recovery <50%. Those findings cannot be directly compared with our results, as they did not use baseline data for predictor variables, and the predictive models developed in our study could not determine cutoff scores of each scale because each model contains many predictors. However, our finding that baseline MAL QOM < 1 or WMFT > 37 seconds predicts a significantly lower probability of success than those with baseline MAL QOM ≥ 2 or WMFT ≤ 5 seconds is comparable to Fritz et al.[16] According to our predictive model, a 60-year-old man with right hemiparesis secondary to stroke, whose dominant side is right, functional level is high, mean MAL QOM score is 2, mean WMFT is 5 seconds, FMA score is 52, and proprioception is not impaired, has an 80% chance of achieving ≥3 on the MAL QOM score after CIMT, and 70% after 12 months. For women with the same scores, there is an 83% and 73% chance of achieving ≥3 after CIMT and 12 months, respectively. On the contrary, for both men and women, if the functional level is low, mean MAL QOM score is 1, mean WMFT is 14 seconds, FMA score is 32, and proprioception is impaired, there is only a 2% chance of achieving ≥3 on the MAL QOM score after CIMT, and 5% after 12 months. Likewise, the same male patient would have only a 0.1% chance of achieving ≥3 on the MAL QOM if not treated; for women, this chance is 0.2% without treatment.

Our results suggest that the immediate posttreatment outcome is predictable mainly from pretreatment motor functional variables, whereas sensory function and age are also predictive factors for long-term (12 month) outcome. The CIMT intervention dramatically increases the probability of getting a score of 3 or higher in the mean MAL QOM scale immediately after treatment. However, its impact is much less after 12 months, reflecting the fact that the participants in the control group who received usual care also showed significant improvement during their first year of the trial.[4] The influence of motor function on the outcome is also slightly less evident at 12 months than immediately posttreatment.

The role of sensory function in CIMT has not been fully evaluated previously. Our findings indicate that impaired light touch sensation is not an independent factor affecting the immediate benefits of CIMT. However, impaired proprioception appears to significantly impede the long-term effect of CIMT. Rijntjes et al[12] found that sensory impairment is inversely related to post-CIMT WMFT time. Van der Lee et al[17] reported that CIMT is more beneficial than bimanual training in patients with sensory disorders. Our finding does not necessarily contradict those observations. However, a cutoff point of 3 on the MAL QOM scale can hardly be maintained in patients with impaired proprioception. In a subgroup analysis for 30 participants with impaired proprioception (data not presented), 5 of these participants who received CIMT achieved a clinically meaningful outcome immediately after treatment, but only 1 of those 5 participants could maintain that outcome at 12 months. This finding suggests that a 2-week intervention may not be sufficient for patients with persistent proprioceptive impairment, and continuous supplementary and/or booster intervention may be needed. This impaired persistence is consistent with the long-term effects of deafferentation in primates.[19]

Fritz et al[11] reported that age was a significant predictor of CIMT outcome at 4 to 6 months follow-up. Our results also indicate that age is inversely related to 12-month outcome,

though its contribution is relatively small (odds ratio = 0.97). Spasticity was not associated with outcome, which is consistent with other reports.[12] However, it should be noted that those with severe spasticity were likely to be excluded in the trial.

Our predictive models have a more comprehensive set of clinical predictors than previous studies, including motor, sensory, and perceptual function. Nevertheless, other potential factors not addressed in this study (for example, behavioral variables, such as depression, lesion location, family support) might also affect outcome. One important limitation of this study is that our predictive models need to be validated by applying them to a separate set of data.

In summary, this study suggests that baseline clinical measures of motor and sensory function are associated with outcomes measured immediately after CIMT and at 12 months in patients with subacute stroke. These baseline measures can be used to predict a clinically meaningful MAL outcome, defined here as a score of 3 or higher rating of the mean MAL QOM scale. The MAL QOM scale as well as the WMFT are useful measures to predict both short-term and long-term outcomes. The role of sensory function in motor recovery after CIMT needs further investigation.

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Table 1

Motor Activity Log Quality of Movement Scale Scoring

Score	Description
0	My weaker arm was not used at all for that activity (of no use)
0.5	
1	My weaker arm was moved during that activity but was not helpful (very poor)
1.5	
2	My weaker arm was of some use during that activity but needed some help from the stronger arm or moved very slowly or with difficulty (poor)
2.5	
3	My weaker arm was used for that activity but the movements were slow or were made only with some effort (fair)
3.5	
4	The movements made by my weaker arm for that activity were almost normal but not quite as fast or accurate as normal (almost normal)
4.5	
5	The ability to use my weaker arm for that activity was as good as before the stroke (normal)

Table 2

Descriptive Characteristics of Participants

	No. of Participants (%) / Mean ± SD		
Baseline Characteristics	**Treatment**	**Control**	**Total**
Age	61.0 ± 13.5	63.3 ± 12.6	62.2 ± 13.0
Gender (female)	37 (34.9)	43 (37.1)	80 (36.0)
Type of stroke (ischemic)	97 (91.5)	98 (84.5)	195 (87.8)
Side of stroke (left)	58 (54.7)	62 (53.5)	120 (54.1)
Concordance	50 (47.2)	60 (51.7)	110 (49.6)
Time after stroke (days)	179.8 ± 66.1	187.7 ± 70.8	182.5 ± 65.9
Functional level (high)	83 (78.3)	94 (81.0)	177 (79.7)
Mean MAL AOU	1.36 ± 0.91	1.39 ± 0.92	1.38 ± 0.91
Mean MAL QOM	1.44 ± 0.90	1.46 ± 0.91	1.45 ± 0.90
Mean WMFT FAS	2.55 ± 0.51	2.50 ± 0.66	2.52 ± 0.59
Log mean WMFT time	2.68 ± 1.02	2.66 ± 1.21	2.67 ± 1.12
FMA motor	42.5 ± 11.7	41.1 ± 12.9	41.8 ± 12.3
Spasticity: elbow flexors	69 (67.7)	75 (66.4)	144 (67.0)
Spasticity: forearm pronators	63 (61.8)	74 (65.5)	137 (63.7)
Spasticity: wrist flexors	65 (63.7)	74 (65.5)	139 (64.7)
Sensory impairment (light touch)	44 (41.5)	52 (44.8)	96 (43.2)
Sensory impairment (proprioception)	30 (28.3)	37 (31.9)	67 (30.2)
Impaired visual perception	53 (50.0)	62 (53.5)	115 (51.8)
Outcomes			
2 week mean MAL QOM	2.48 ± 1.00	1.77 ± 1.11	2.12 ± 1.11
2 week mean MAL QOM ≥3	31 (29.3)	18 (15.5)	49 (22.1)
12 month mean MAL QOM	2.64 ± 1.06	2.06 ± 1.30	2.34 ± 1.22
12 month mean MAL QOM ≥3	33 (31.1)	21 (18.1)	54 (24.3)

MAL = Motor Activity Log; AOU = Amount of Use; QOM = Quality of Movement; WMFT = Wolf Motor Function Test; FAS = functional ability scale; FMA = Fugl-Meyer Assessment.

Table 3

Univariate Logistic Regression Analysis for Clinically Meaningful Outcome Represented by Mean MAL QOM Scale (≥3)

	At 2 Weeks (Immediate Posttreatment)				At 12 Months			
Variables	**Estimate (β)**	**Standard Error**	**Wald Chi-Square**	***P* Value**	**Estimate (β)**	**Standard Error**	**Wald Chi-Square**	***P* Va l ue**
Group (1 = treatment)	0.946	0.352	7.226	.007	0.799	0.332	5.790	.016
Age	−0.009	0.014	0.383	.536	−0.022	0.013	2.988	.084
Gender (1 = female)	−0.495	0.373	1.759	.185	−0.545	0.356	2.334	.127
Type of stroke	−0.289	0.555	0.270	.603	−0.423	0.547	0.594	.441
Side of stroke (1 = left)	−0.644	0.349	3.406	.065	−0.572	0.331	2.983	.084
Concordance	−0.136	0.642	0.045	.833	−0.360	0.604	0.356	.551
Time after stroke (days)	−0.006	0.003	3.636	.057	−0.006	0.003	3.890	.049
Functional level (1 = high)	2.947	1.033	8.133	.004	1.473	0.560	6.919	.009
Pretreatment mean MAL AOU	1.946	0.320	37.108	<.0001	1.465	0.251	34.046	<.0001
Pretreatment mean MAL QOM	2.380	0.392	36.936	<.0001	1.774	0.294	36.474	<.0001
Pretreatment mean WMFT FAS	3.597	0.677	28.229	<.0001	2.265	0.481	22.170	<.0001
Pretreatment log mean WMFT time	−1.934	0.327	34.905	<.0001	−1.357	0.243	31.132	<.0001
Pretreatment FMA motor	0.123	0.024	26.514	<.0001	0.050	0.017	8.993	.003
Spasticity: elbow flexors	−0.080	0.368	0.047	.829	−0.026	0.352	0.006	.941
Spasticity: forearm pronators	−0.517	0.362	2.041	.153	−0.083	0.346	0.057	.811
Spasticity: wrist flexors	−0.640	0.359	3.175	.075	−0.113	0.345	0.107	.743
Sensory impairment (light touch)	−0.756	0.370	4.184	.041	−0.538	0.345	2.425	.119
Sensory impairment (proprioception)	−0.708	0.431	2.702	.100	−1.430	0.478	8.931	.003
Impaired visual perception	−0.398	0.349	1.299	.255	−0.179	0.331	0.292	.589

MAL = Motor Activity Log; QOM = Quality of Movement; AOU = Amount of Use; WMFT = Wolf Motor Function Test; FAS = functional ability scale; FMA = Fugl-Meyer Assessment.

Table 4

Multivariate Logistic Regression Analysis for Clinically Meaningful Outcome Represented by Mean MAL QOM Scale (≥3)

	At 2 Weeks (Immediate Posttreatment)				At 12 Months			
Variables	**Estimate (β)**	**Standard Error**	**Wald Chi-Square**	***P* Value**	**Estimate (β)**	**Standard Error**	**Wald Chi-Square**	***P* Value**
Age	NS				−0.0331	0.0171	3.7311	.0534
Gender (1 = female)	0.1739	0.5363	0.1052	.7457	0.1088	0.4642	0.0549	.8147
Dominant side (1 = left)	−0.3743	0.7951	0.2216	.6378	0.3300	0.7241	0.2077	.6486
Side of stroke (1 = left)	−0.3307	0.5291	0.3906	.5320	−0.3682	0.4336	0.7211	.3958
Functional level (1 = high)	0.9311	1.2428	0.5612	.4538	−0.0167	0.7254	0.0005	.9817
Group (1 = treatment)	2.4704	0.6283	15.4616	<.0001	1.2770	0.4688	7.4211	.0064
Pretreatment mean MAL QOM	1.9039	0.4267	19.9087	<.0001	1.6442	0.3602	20.8349	<.0001
Pretreatment log mean WMFT time	−1.1863	0.3844	9.5250	.0020	−0.5758	0.2941	3.8322	.0503
Pretreatment FMA motor	0.0722	0.0306	5.5758	.0182	NS			
Sensory impairment (proprioception)	NS				−1.6322	0.5658	8.3226	.0039
Intercept	−7.6668	2.4259	9.9878	.0016	−0.7780	1.4947	0.2709	.6027
−2 Log Likelihood	106.440				145.941			
Hosmer & Lemeshow Goodness-of-Fit	Chi-Square 8 *df* = 8.9196, *P* = .3491				Chi-Square 8 *df* = 14.8659, *P* = .0618			

MAL QOM = Motor Activity Log Quality of Movement; WMFT = Wolf Motor Function Test; FMA = Fugl-Meyer Assessment.

Odds Ratio Estimates of Predictors for Clinically Meaningful Outcome Represented by Mean MAL QOM Scale (≥3)

	At 2 Weeks (Immediate Posttreatment)		At 12 Months	
Predictor	**Odds Ratio Estimates**	**95% CI**	**Odds Ratio Estimates**	**95% CI**
Constraint-induced therapy	11.83	3.45–40.52	3.59	1.43–8.99
Pretreatment mean MAL QOM				
Per 1 unit increase of MAL QOM score	6.71	2.91–15.49	5.18	2.56–10.49
MAL QOM ≥ 2 vs MAL QOM < 1	19.63	3.32–116.29	21.76	4.65–101.71
1 ≤ MAL QOM < 2 vs MAL QOM < 1	1.72	0.31–9.47	3.7	0.90–15.22
Pretreatment mean WMFT time				
Per 1 unit increase of log mean time	0.31	0.14–0.65	0.56	0.32–1.00
WMFT ≤ 5.10s vs WMFT > 14.15s	11.22	2.50–50.33		
5.10s < WMFT ≤ 14.15s vs WMFT > 14.15s	2.05	0.51–8.25		
WMFT ≤ 5.10s vs WMFT > 36.97s			11.98	1.09–132.31
5.10 < WMFT ≤ 14.15s vs WMFT > 36.97s			7.66	0.77–76.10
14.15 < WMFT ≤ 36.97s vs WMFT > 36.97s			5.35	0.55–52.24
Pretreatment FMA motor score			NA	
Per 1 unit increase of FMA score	1.08	1.01–1.14		
FMA ≥ 52 vs FMA < 32	15.82	1.50–167.06		
42 ≤ FMA < 52 vs FMA < 32	4.62	0.46–46.89		
32 ≤ FMA < 42 vs FMA < 32	4.27	0.35–52.47		
Sensory impairment (proprioception)	NA		0.2	0.06–0.59
Age	NA		0.97	0.94–1.00

MAL QOM = Motor Activity Log Quality of Movement; WMFT = Wolf Motor Function Test; FMA = Fugl-Meyer Assessment.