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Long-Term Outcome of Motor Functional Neurological Disorder After Rehabilitation

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Background and Purpose Functional neurological disorder (FND) is defined as the presence of neurological symptoms that are inconsistent with a neurological disease. We performed a single-center retrospective study aimed at determining the long-term outcome of FND patients receiving inpatient rehabilitation and the predictors of a good outcome.

Methods A multidisciplinary graded exercise program was provided with one or two daily physiotherapy and occupational therapy sessions on 5 days each week, as well as weekly psychological support. Outcome was assessed using the motor part of the Functional Independence Measure scale (FIM; maximum score of 91) at admission, discharge, and follow-up, with the last assessment performed by phone interview.

Results The 30 included patients were aged 43.6±14.7 years (mean±standard deviation), comprised 70% females, and received a mean of 4 weeks of rehabilitation. The admission FIM score (80.2±8.3) was significantly lower than the discharge FIM score (86.9±4.6; $p<0.001$, Wilcoxon signed-rank test). No notable difference was observed between discharge and follow-up FIM scores (85.5±8.5, $p=0.54$). The mean follow-up of the 36-month FIM scores at discharge and follow-up was dichotomized as a good outcome in cases where all items were scored ≥6 (functional independence). Binomial logistic regression showed that absence of a comorbid psychiatric disorder ($p=0.039$, odds ratio=10.7) was a predictive factor for a good outcome at follow-up. Other variables (e.g., sex and age) were not significant predictors of clinical outcome (all $p\geq0.058$).

Conclusions These results suggest inpatient intensive rehabilitation for motor FND is effective and produces favorable long-term results. Further studies with larger groups are warranted so that the management protocols can be standardized.

Keywords functional neurological disorder; conversion disorder; rehabilitation.

INTRODUCTION

Functional neurological disorder (FND) is defined as the presence of neurological symptoms that are inconsistent with a somatic neurological disease.[1] The presentation of FND can include motor and sensory symptoms, movement disorders, and psychogenic nonepileptic seizures (PNES). Among other terminologies, hysteria was used from antiquity to the 20th century,[2] and conversion disorder is currently used in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5).[3] FND is notable, with an annual incidence of 12 per 100,000 and a prevalence of 50 per 100,000. Onset can occur at any age, and there is a female predominance (60%–75%).[4] While these data are difficult to assess due to lack of high-quality studies, FND is among the main diagnoses in outpatient neurology consultations.[5] The onset and evolution of FND are characterized by distinguishing three types of factors: 1) risk factors such as a history of psychological stressor,

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with especially a history of emotional neglect appearing in over 50% of patients, as well as psychiatric disorders (e.g., depression or anxiety disorder);[6] 2) the occurrence of FND is often preceded by a particular event (precipitating factor), such as acute stress or structural injury;[6] and 3) perpetuating factors can be defined that influence the outcome and include misdiagnosis or lack of treatment.[6]

The clinical presentation of FND varies. DSM-5 criteria require the presence of altered voluntary motor or sensory function, in addition to evidence of incompatibility between the symptoms and a recognized neurological or medical condition.[7] The symptoms must not be better explained by another medical or mental disorder and cause significant distress.[7] The pathophysiology and pathogenesis of FND remain unclear, but neuroimaging data suggest contributions from alterations of the brain networks (especially limbic and sensorimotor circuits) involved in multimodal integration and attention.[8] Regarding motor FND, increased functional connectivity between the amygdala and motor control circuits has been observed,[8] especially in the supplementary motor area,[9] also with decreased activity in striato-thalamo-cortical networks during voluntary movement.[9]

Motor FND is managed using an integrated multidisciplinary approach based on a biopsychosocial model, but standardized and validated management protocols are currently lacking. There is no clear evidence that pharmacological therapy is beneficial, in particular regarding antidepressants (in the absence of depressive disorder).[10] Psychotherapeutic support with cognitive behavioral therapy or short-term psychodynamic therapy is recommended, possibly beginning in the early phase after diagnosis.[1,11-13] However, there is no evidence for the superiority of a specific psychotherapeutic model.[13] Promising therapeutic approaches include noninvasive brain stimulation. Transcranial magnetic stimulation, notably of the motor cortex, has shown long-term benefits for functional movement disorders and functional weakness, including for different stimulation protocols.[14-17]

Rehabilitation programs for motor FND have been proposed for more than 20 years, including a multidisciplinary approach with physical and occupational therapy, as well as psychotherapy.[18,19] Some centers apply inpatient rehabilitation for acute episodes of FND and as an elective admission in more-chronic situations.[20] Current recommendations for physical and occupational therapy are mostly based on expert consensus, and evidence-based standardized care is warranted.[21,22] Weakness secondary to defined neurological diseases and FND share clinical similarities, and so standard motor rehabilitation techniques can be applied. However, considering that patients with FND are intrinsically able to move a weak limb, therapies emphasize distraction techniques so that the patient does not focus on a weaker limb.[23] Graded exercise is also likely to be helpful.[24,25]

The long-term prognosis of FND is reportedly poor, and it differs with the clinical presentation. One study found that only 20% of patients exhibited complete remission during a long-term follow-up (FU) of motor FND, with 40% exhibiting partial recovery and 40% experiencing stabilization or worsening of symptoms.[26] That study also found that remission occurred in 33% of patients with PNES.

Based on these observations, the current single-center retrospective study aimed at determining the long-term outcome of patients with motor FND who benefited from inpatient rehabilitation.

METHODS

Our local Ethics Committee (Commission Cantonale d'Ethique de la Recherche, Switzerland) approved the research protocol (CCER 22-00669).

Participants gave oral or written informed consent for the use of their anonymized clinical data.

Study population

We identified all patients with motor FND who received multidisciplinary in-hospital rehabilitation at our Division of Neurorehabilitation, Department of Clinical Neurosciences, Geneva University Hospitals, Switzerland. The study period included all patients who were admitted between September 28, 2011 and July 22, 2022 for a first acute episode of FND (27 of the 30 included patients), with the remaining 3 patients admitted for FND relapse. Diagnosis was performed by our colleagues from the Division of Neurology, Geneva University Hospitals, and was confirmed upon admission at our division. Diagnostic criteria were based on the DSM-5 criteria for FND[3] and were applied retrospectively to previous patients (2011–2013) admitted before the publication of the DSM-5 criteria. Namely, included subjects had one or more symptoms that affected motor function and the symptom was found to be not due to a general medical condition. Included patients had a motor weakness causing limb impairment. Subjects with movement disorders and other symptoms (sensory symptoms or PNES) without motor weakness were not included. One or more diagnostic features were present that provided evidence of internal inconsistency or incongruity. The symptoms caused clinically significant distress or impairment in social or occupational areas of functioning.

Similar management protocols were applied to all patients based on personalized pre-established functional weekly objectives. The therapeutic program included two daily sessions of physiotherapy and one daily session of occupation-

al therapy (duration 30–45 minutes) on 5 days each week as well as a psychotherapy session once weekly. This intervention included psychoeducation, support therapy, and identification of provocative/perpetuating factors. In addition, at least one assessment by an experienced psychiatrist was performed for diagnosing psychiatric disorder according to DSM-5 criteria and for the management of psychiatric comorbidities. We retrospectively extracted hospitalization data from computerized patient files then contacted the patients to perform a telephone interview to assess FU outcomes.

Assessments

Functional motor outcomes were assessed using the Functional Independence Measure scale (FIM).[27] This scale comprises 18 items, each scored between 1 (worst) and 7 (best), grouped into a motor part (13 items, minimum score 13 and maximum score 91) and a cognitive part (5 items). For each item, the degree of dependency is divided into functional independence (scores of 6 and 7), modified dependence (scores of 3, 4, and 5), and complete dependence (scores of 1 and 2).[28] The motor and cognitive parts can be used independently.[28] We used the FIM since it is a widely used scale that can be applied in person or by telephone interview.[29] Since the patients included in the present study had only motor impairment, we considered that using only the motor part of the FIM would be more relevant to assessing their functional deficits.

Demographics and clinical data

The following data were extracted from the medical files: age, sex, marital status, education level (compulsory education, apprenticeship, and academic qualification), duration of hospitalization, type of motor deficit (monoparesis, hemiparesis, paraparesis, and tetraparesis), presence of another neurological deficit, presence of a comorbid psychiatric disorder (e.g., depressive disorder or personality disorder), professional-activity status before hospitalization, and motor FIM scores at admission (FIM_{adm}) and discharge (FIM_{dis}). During each telephone interview we assessed the motor FIM score at FU (FIM_{FU}) as well as the current work status and the occurrence of other disabling diseases since discharge.

Statistical analysis

Statistical analysis was performed using standard software (SPSS [Statistical Package for the Social Sciences], version 28.0; IBM Corp., Armonk, NY, USA). Continuous variables were assessed for normality using the Shapiro–Wilk test and plotted histograms. The Wilcoxon signed-rank test and *t*-test were used accordingly to identify significant differences. In addition, we dichotomized FIM scores into a good outcome when all items were scored ≥6 (which corresponds to a degree of functional independence for all items of the scale) and a poor outcome when at least one item was scored <6 (which corresponds modified or complete functional dependence). Binomial logistic regressions were performed using good/poor outcome as a dependent variable. We first assessed predictors of a better clinical outcome during hospitalization (FIM_{dis}–FIM_{adm}) using the following independent variables: age, sex, marital status, education level, duration of hospitalization, type of motor deficit, presence of another functional neurological deficit, presence of a comorbid psychiatric disorder, and professional-activity status before hospitalization. FIM_{dis} values were used to dichotomize the dependent variables. We then assessed predictors of a better clinical long-term outcome (FIM_{FU}–FIM_{dis}) using the same independent variables but with the professional-activity status adapted to the time of FU and by updating the appearance of another disabling disease since discharge. FIM_{FU} values were used to dichotomize the dependent variables. Statistical significance was set at $p<0.05$.

RESULTS

Forty participants were initially identified, with 10 of them not being included because they could not be reached (n=5), refused to participate (n=3), died (n=1), or had a change in diagnosis (n=1, final diagnosis of myasthenia gravis). Thus, 30 participants were finally included in our study. For three patients who had a second hospitalization after a relapse of FND, only data from the last hospitalization were used.

Hospitalization and outcomes characteristics are presented in Table 1, and the characteristics of the participants are also detailed in Table 1. Most of them were female (70.0%) and had another comorbid FND (83.3%), namely sensory impairment (n=18, 60.0%), movement disorder (n=4, 13.3%), dysarthria (n=2, 6.7%), or PNES (n=1, 3.3%). Among motor deficits, the 16 cases of hemiparesis (53.3%) comprised 9 on the right side and 7 on the left side. About half had a comorbid psychiatric disorder (56.7%), comprising depressive disorder, anxiety disorder, or personality disorder of mild-to-moderate severity. Moreover, the professional-activity status changed, with 17 (56.7%) working at discharge and only 12 (40.0%) working at FU. Those who did not work were receiving disability insurance payouts: 13 (43.3%) before hospitalization and 18 (60.0%) at FU. A disabling disease appeared after hospitalization in four participants (13.3%), and only three (10.0%) experienced significant relapse requiring a second hospitalization: one after 25 months, another after 27 months, and the third after 38 months. The outcome was good in 22 participants at discharge, with a degree of func-

Table 1. Characteristics and clinical deficits of patients, with hospitalization outcomes

Variable	Value (*n*=30)
Age (yr)	43.6±14.7 (18–76)
Sex	
Male	9 (30.0)
Female	21 (70.0)
Marital status	
Married	9 (30.0)
Single	10 (33.3)
Divorced	11 (36.7)
Education degree	
Compulsory education	7 (23.3)
Apprenticeship	16 (53.3)
Academics	7 (23.3)
Motor deficit	
Hemiparesis	16 (53.3)
Paraparesis	11 (36.7)
Tetraparesis	3 (10.0)
Another comorbid functional neurological disorder	
Yes	25 (83.3)
No	5 (16.7)
Comorbid psychiatric disorder	
Yes	17 (56.7)
No	13 (43.4)
Professional activity status (before hospitalization)	
Work	17 (56.7)
Unemployed	13 (43.3)
Professional activity status (at FU)	
Work	12 (40.0)
Unemployed	18 (60.0)
Duration of hospitalization (days)	30.8±15.1 (5–76)
Time between hospitalization and FU (months)	36.5±26.8 (0.8–128.4)
FIM_{adm}	80.2±8.3 (58–91)
FIM_{dis}	86.9±4.6 (68–91)
FIM_{FU}	85.5±8.5 (52–91)

Data are mean±standard deviation (range) or *n* (%) values.
FIM, Functional Independence Measure scale; FIM_{adm}, FIM scores at admission; FIM_{dis}, FIM score at discharge; FIM_{FU}, FIM score at FU; FU, follow-up.

tional independence for all motor FIM items, and in 21 at FU. Clinical characteristics and functional outcomes are compared between good outcome group and poor outcome group in Table 2 for discharge, and in Table 3 for FU. The rehabilitation program was applied for a mean of 4 weeks, and the mean duration of FU was 36 months.

We observed that FIM_{dis} (86.9±4.6, mean±standard deviation) was significantly higher than FIM_{adm} (80.2±8.3; $p<0.001$, Wilcoxon signed-rank test). No notable difference was observed between FIM_{dis} and FIM_{FU} (85.5±8.5; $p=0.54$, Wilcoxon signed-rank test) (Fig. 1).

Table 2. Comparison between good outcome group and poor outcome group at discharges

	Good outcome (*n*=22)	Poor outcome (*n*=8)
Age (yr)	43.4±16.7 (18–76)	42.2±7.9 (32–55)
Sex		
Male	8 (36.4)	1 (12.5)
Female	14 (63.6)	7 (87.5)
Marital status		
Divorced	6 (27.3)	5 (62.5)
Married	7 (31.8)	2 (25.0)
Single	9 (40.9)	1 (12.5)
Education level		
Compulsory education	4 (12.2)	3 (37.5)
Apprenticeship	12 (54.5)	4 (50.0)
Academic qualification	6 (27.3)	1 (12.5)
Type of motor deficit		
Hemiparesis	11 (50.0)	5 (62.5)
Paraparesis	9 (40.9)	2 (25.0)
Tetraparesis	2 (9.2)	1 (12.5)
Another comorbid FND		
Yes	18 (87.2)	7 (87.5)
No	4 (12.8)	1 (12.5)
Comorbid psychiatric disorder		
Yes	12 (54.5)	5 (62.5)
No	10 (45.5)	3 (37.5)
Professional-activity status before hospitalization		
Work	14 (63.6)	3 (37.5)
Unemployed	8 (36.4)	5 (62.5)
Duration of hospitalization (days)	29.9±12.8 (14–59)	33.2±21.1 (5–76)
FIM_{adm}	81.0±7.8 (59–91)	77.9±9.7 (58–88)
FIM_{dis}	88.7±2.1 (84–91)	82.2±6.3 (68–88)

Data are mean±standard deviation (range) or *n* (%) values.
FIM, Functional Independence Measure scale; FIM_{adm}, FIM scores at admission; FIM_{dis}, FIM score at discharge; FND, functional neurological disorder.

Binomial logistic regression ($\chi^2=6.4$, $p=0.04$, $R^2=0.28$) showed the absence of a comorbid psychiatric disorder ($p=0.039$) was a predictive factor for a good outcome at FU ($\chi^2=17.28$, $p=0.002$, $R^2=0.62$; odds ratio=10.7, 95% confidence interval=1.1–101.3). Other variables including sex and age were not significant predictors of clinical outcome ($p\geq0.058$). Predictive factors are presented in Tables 4 and 5.

DISCUSSION

This retrospective observational study found that the im-

provement in motor FIM scores after an average 4-week-long inpatient rehabilitation program was maintained over the longer term. This finding is consistent with previous observations suggesting that multidisciplinary rehabilitation programs for motor FND are beneficial.[24] Optimal rehabilitation programs for motor FND are still to be precisely characterized, such as in terms of the intensity, duration, and frequency of therapeutic sessions.[1,20,30] Our rehabilitation program involved administering physiotherapy and occupational therapy on 5 days each week as well as a psychological session once weekly.

We also found that the absence of a comorbid psychiatric disorder was a predictor of a good long-term prognosis. It is particularly noteworthy that the present study found that sex and age did not significantly affect the clinical outcome. Our study showed that FIM_{FU} remained stable in comparison to FIM_{dis} (p=0.54). This is consistent with Theuer et al.[31] finding that most patients (70%) exhibited good long-term recovery after multidisciplinary rehabilitation (median FU of 13 months), as assessed by neurological examinations. Saifee et al.[32] observed improvements after a 4-week multidisciplinary inpatient rehabilitation program (p=0.019) for patients with functional weakness or movement disorders,

Table 3. Comparison between good outcome group and poor outcome group at follow-up

	Good outcome (n=21)	Poor outcome (n=9)
Age (yr)	44.1±16.5 (18–76)	42.4±10.2 (21–55)
Sex		
Male	6 (28.6)	3 (33.3)
Female	15 (71.4)	6 (66.7)
Marital status		
Divorced	8 (38.1)	3 (33.3)
Married	6 (28.6)	3 (33.3)
Single	7 (33.3)	3 (33.3)
Education level		
Compulsory education	5 (23.8)	2 (22.2)
Apprenticeship	11 (52.4)	5 (55.6)
Academic qualification	5 (23.8)	2 (22.2)
Type of motor deficit		
Hemiparesis	11 (52.4)	5 (55.6)
Paraparesis	8 (38.1)	3 (33.3)
Tetraparesis	2 (9.5)	1 (11.1)
Another comorbid FND		
Yes	17 (81.0)	8 (88.9)
No	4 (19.0)	1 (11.1)
Comorbid psychiatric disorder		
Yes	9 (42.9)	8 (88.9)
No	12 (57.1)	1 (11.1)
Professional-activity status at FU		
Work	11 (52.4)	1 (11.1)
Unemployed	10 (47.6)	8 (88.9)
Time between hospitalization and FU (month)	39.7±36.7 (0.8–132.0)	29.3±15.3 (3.8–48.9)
FIM_{dis}	87.5±4.9 (68–91)	85.8±3.7 (81–91)
FIM_{FU}	89.6±1.2 (87–91)	75.9±10.5 (52–87)

Data are mean±standard deviation (range) or n (%) values.
FIM, Functional Independence Measure scale; FIM_{adm}, FIM scores at admission; FIM_{dis}, FIM score at discharge; FIM_{FU}, FIM score at FU; FND, functional neurological disorder; FU, follow-up.

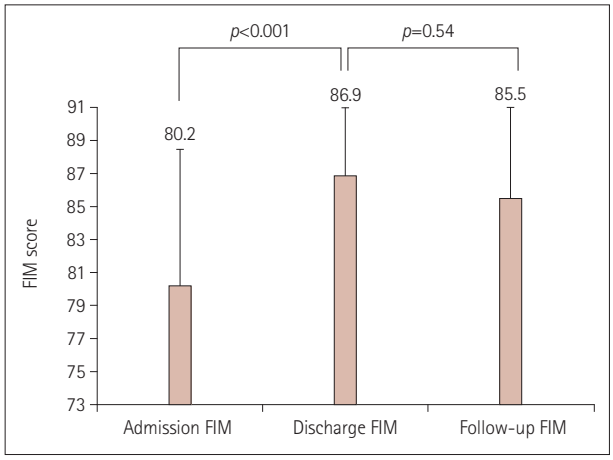

Fig. 1. Comparison beetwen FIM scales established at admission, discharge, and follow-up. Data are mean and standard deviation values. FIM, Functional Independence Measure scale.

Table 4. Predictive factors of better clinical outcome at discharge

	OR (95% CI)	p
Male sex (vs. female)	4.0 (0.4–38.7)	0.231
Marital status		0.212
Single	-	-
Divorced	0.1 (0.1–1.4)	0.097
Married	0.4 (0.1–5.2)	0.476
Education degree		0.490
Compulsory education	-	-
Apprenticeship	2.2 (0.3–14.7)	0.397
Academics	4.5 (0.3–60.1)	0.256
Motor deficit		0.730
Tetraparesis	-	-
Hemiparesis	1.1 (0.1–15.1)	0.943
Paraparesis	2.2 (0.1–38.8)	0.577
Another comorbid functional neurological disorder		
Yes (vs. no)	0.6 (0.1–6.8)	0.714
Comorbid psychiatric disorder		
No (vs. yes)	1.4 (0.3–7.3)	0.698
Professional activity status		
Work (vs. unemployed)	2.9 (0.6–15.6)	0.210

p value for binominal logistic regression.
CI, confidence interval; OR, odds ratio.

Table 5. Predictive factors of better clinical outcome at follow-up

	OR (95% CI)	*p*
Male sex (vs. female)	0.8 (0.1–4.3)	0.794
Marital status		0.958
Single	-	-
Divorced	1.1 (0.2–7.6)	0.890
Married	0.9 (0.1–6.0)	0.876
Education degree		0.987
Compulsory education	-	-
Apprenticeship	0.9 (0.1–6.2)	0.898
Academics	1.0 (0.1–10.1)	>0.999
Motor deficit		0.967
Tetraparesis	-	-
Hemiparesis	1.1 (0.1–15.2)	0.943
Paraparesis	1.3 (0.1–20.7)	0.837
Another comorbid functional neurological disorder		
Yes (vs. no)	0.5 (0.1–5.5)	0.597
Comorbid psychiatric disorder		
No (vs. yes)	10.7 (1.1–101.3)	0.039
Professional activity status		
Work (vs. unemployed)	8.8 (0.9–83.3)	0.058

p value for binominal logistic regression.
CI, confidence interval; OR, odds ratio.

with no significant difference between discharge and a median FU duration of 7 years (p=0.069). That previous study measured functional impact using questionnaires (visual analogue scales, the cause component of the Illness Perception Questionnaire, and the Work and Social Adjustment Scale). We found similar results for the same rehabilitation duration in a more-homogeneous population but a shorter FU. The randomized controlled trial of Jordbru et al.[25] evaluated patients with a psychogenic gait disorder who participated in a similar 3-week rehabilitation program using a cross-over design. They observed a sustained improvement after a 1-year FU (mean motor FIM score of 90.1 at discharge and 90.7 at FU). The prospective study of Speed[33] including patients with motor FND also used the FIM, but only its ambulation item, and found that most patients (78%) experienced complete recovery at a mean FU of 20 months. These last two studies also used the FIM but with different populations or shorter subscales than in the present study. Finally, the study of Couprie et al.[34] found favorable outcomes using the Oxford Handicap Scale, but details of the rehabilitation program were lacking and different types of FND were included.

The present study found that the absence of a comorbid psychiatric disorder did predict a good long-term outcome, which is consistent with the findings of Binzer and Kullgren.[35] In other words, the presence of a comorbid psychiatric disorder is associated with a worse long-term outcome. One explanation is that a psychiatric disorder adversely impacts the activities of daily living and the instrumental activities of daily living and hence also motor FIM scores. For example, a negative correlation between depression and the activities of daily living was demonstrated in a population with acquired brain injury.[36] Thus, psychiatric screening and care could improve long-term outcomes. Other predictors of a favorable outcome have been reported previously, such as a shorter duration of symptoms prior to diagnosis and a willingness to accept the potential reversibility of the symptoms.[37] In contrast, sex and age do not appear to significantly influence the prognosis of motor FND.[38]

The present study had several strengths. First, it used the motor part of the FIM, which is a standardized and reproducible clinical scale for assessing patient recovery according to their functional evolution. Second, patients participated in an adapted rehabilitation program comprising the same intensity of therapies and provided by therapists specialized in the rehabilitation of neurological conditions.

However, our study also had some limitations. Its retrospective design prevented more-specific aspects of motor functionality from being assessed. In addition, the sample was relatively small, including since long-term outcome data were not available for 10 of the 40 initially eligible patients. This study aimed at assessing an inpatient rehabilitation program, and therefore the findings cannot be applied to an outpatient setting, which is the main management setting for FND. It is worth mentioning that 3 of the 30 included patients experienced FND relapse, and for these cases only data from the last inpatient stay were used. Also, the FIM_{FU} score for all patients was obtained via telephone interviews during the same period, and so the FIM_{FU} score after a previous episode was not obtainable. We cannot exclude that this aspect may have influenced the study results somewhat. It should also be noted that the FIM scores were relatively high for the included FND patients, who mainly lost points for the transfers and locomotion items while preserving their abilities to perform daily care and sphincter control. This targeted motor impairment was significant enough to preclude their ability to return home and so required inpatient rehabilitation. Finally, applying an inpatient rehabilitation program represents a major commitment of staffing and financial resources, and so further studies are warranted to assess the clinical and economic benefits of providing inpatient rather than outpatient management.

In conclusion, intensive inpatient rehabilitation for motor FND is effective and produces favorable long-term results. The absence of a comorbid psychiatric condition is a predictor of a good long-term outcome. Further studies with larger

groups are warranted so that the management protocols can be standardized.

Availability of Data and Material

The datasets generated or analyzed during the study are available from the corresponding author on reasonable request.

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Conflicts of Interest

The authors have no potential conflicts of interest to disclose.

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None

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