

原 著

Influence of Freezing of Gait on Quality of Life in Patients with Parkinson's disease

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Abstract

Purpose

Coping with distress in daily life due to freezing of gait (FOG) is one of the unmet needs for patients with Parkinson's disease (PD). We aimed to investigate the effect of several assessment aspects of FOG on the quality of life (QOL) of these patients.

Methods

We included 28 patients with PD in the study. FOG was assessed using the following criteria: (1) FOG questionnaire (FOGQ) items 3 and 4, (2) Gait and Falls Questionnaire (GFQ) item 14, and (3) Movement Disorder Society- Unified PD rating scale (MDS-UPDRS) Part II item 13 and Part III item 11. We also investigated the presence of FOG in common situations of actual daily living. Patients were classified into two groups based on the results of each FOG assessment. We compared the total score and values of 10 sub-items of mobility dimensions in the PD questionnaire-39 (PDQ-39) between the groups.

Results

In the total score of PDQ-39, there were significant differences between the groups classified by FOGQ item 3, GFQ item 14, and MDS-UPDRS Part II item 13 and Part III item 11 but not between the groups classified by FOGQ item 4. Strong associations between the PDQ-39 sub-items (6 and 7) and the GFQ item 14 were found. Moreover, there were strong associations between the total score of PDQ-39 and the presence of FOG in common situations, such as being in crowded and cluttered places, crossing roads, and entering automatic doors.

Conclusion

FOG has significant impacts on mobility-related QOL. In particular, frequency of falls due to FOG may be the major predictor of QOL. In addition, assessing the FOG occurrence in actual daily living may be valuable in promoting social participation.

Key words: Parkinson's disease, freezing of gait, quality of life

Introduction

Freezing of gait (FOG) is an episodic inability of effective stepping despite the intention to walk ^{1,2)}. FOG occurs during cognitively challenging and complex situations that require flexible adaptation to transient changes in the surrounding environment ^{3,4)}. However, the precise neural mechanism underlying FOG is yet to be elucidated.

As Parkinson's disease (PD) progresses, FOG becomes unresponsive to L-DOPA ⁵⁾. It is hypothesized that the unpredictable nature of FOG episodes and the helpless situation of the patient when confronting FOG during "on" medication cycle can have psychosocial impacts and increase the risk of falls ⁶⁾. Therefore, coping with distress in daily life due to FOG is one of the unmet needs for patients with PD. A holistic rehabilitation approach to promote social participation is required ⁷⁾.

FOG has been assessed using several aspects. In the Movement Disorder Society-Unified PD rating scale (MDS-UPDRS) Part II (Motor Aspects of Experiences of Daily Living) item 13, patients are assessed for the need of assistance during FOG. In the MDS-UPDRS Part III (Motor Examination) item 11, patients are assessed for the presence of FOG episodes while starting, turning, walking through a doorway, or straight walking (MDS-UPDRS grade 0=Normal, 1=Slight, 2=Mild, 3=Moderate, 4=Severe) ⁸⁾. In the FOG questionnaire (FOGQ) item 3, patients are graded based on the frequency of FOG (0=Never, 1=Very rarely-about once a month, 2=Rarely-about once a week, 3=Often-about once a day, 4=Always-whenever walking). In FOGQ item 4, patients are graded based on the duration of FOG (0=Never happened, 1=1-2 seconds, 2=3-10 seconds, 3=11-30 seconds, 4=More than 30 seconds) ⁹⁾. In the Gait and Falls Questionnaire (GFQ) item 14, patients are assessed for the frequency of falls due to FOG (0=Never, 1=Once or twice, 2=3-12 times in the last 6 months, 3=More than once a week, 4=Whenever trying to walk) ⁹⁾. Although the significant

impacts of FOG on the quality of life (QOL) of patients with PD have been reported^{6, 7, 10, 11)}, the contribution of the differential aspects of FOG assessments has been poorly investigated. On the other hands, common FOG situations in actual daily living are well-known^{7, 12, 13)}. However, the association between QOL and the triggering circumstances of FOG in actual daily living has not yet been investigated.

In the management of patients with FOG, it remains unclear which strategy is best to preserve a high QOL. Therefore, we aimed to investigate the effect of several assessment aspects of FOG on the QOL in patients with PD.

Methods

Subjects

Twenty-eight patients with PD (14 males and 14 females) were included in the study. Their age ranged from 58 to 85 years, with a mean age of 70.1 years [standard deviation (SD), 7.4 years]. The mean duration of illness was 12.1 (SD, 7.5) years. According to the Hoehn and Yahr stage, 14 patients were classified as grade 3 and 14 as grade 4.

Ethical approval was obtained from the Research Ethics and Governance Panel of Bukkyo University (Approval number: H28-53). All patients were informed about the details of the study, and they agreed to participate and provided written informed consent.

We included only patients with FOG as defined by FOGQ item 3 and MDS-UPDRS Part II item 13 (freezing) and Part III item 11(FOG).

Procedure

FOG was assessed using the following criteria: (1) MDS-UPDRS Part II item 13 and Part III item 11, (2) FOGQ items 3 and 4, and (3) GFQ item 14. Each test was graded on a 5-point scale, from 0 to 4. We also investigated the presence of FOG in common situations of actual daily living. We assessed QOL using 10 sub-items of mobility dimensions in the PD questionnaire-39 (PDQ-39)¹⁴⁾. The sub-items of PDQ-39 mobility dimensions were rated as 0 = Never, 1 = Occasionally, 2 = Sometimes, 3 = Often, and 4 = Always or Cannot do at all. High total scores reflected poor QOL (range, 0–40).

The patients were classified into two groups based on the results of each FOG assessment. Cut-off criteria were the following: frequent (multiple times in a day) FOG episodes, lasting of a FOG episode for more than 10 s, increased falls due to FOG more than once a month, need of assistance or walking aids during a FOG episode, and the

presence of FOG during straight walking (**Table 1**). We also classified patients into two groups based on the presence of FOG in common situations of actual daily living. Statistical analyses were performed using the SPSS version 23.0 for Windows. We used the unpaired *t* test, Mann–Whitney U test, and chi square test to compare the total scores and the values of sub-items of mobility dimensions in PDQ-39 between the groups. The critical value for statistical significance was set at $P < 0.05$. Effect sizes were calculated to investigate the strength of association.

Results

In the total score of mobility dimensions in PDQ-39, there were significant differences between the groups classified by FOGQ item 3, GFQ item 14, and MDS-UPDRS Part II item 13 and Part III item 11 but not between the groups classified by FOGQ item 4 (**Table 2**). Effect sizes (*d*) of FOGQ item 3, GFQ item 14, and MDS-UPDRS Part II item 13 and Part III item 11 were large. Effect size of FOGQ item 4 was medium.

The results of sub-items of mobility dimensions in PDQ-39 varied depending on the method of FOG assessments (**Table 3**). In the groups classified by FOGQ item 3, there were significant differences among sub-items 1, 3, 4, 6, and 9. Effect sizes (*r*) of these items were medium (range, 0.43–0.48). In FOGQ item 4, there was no significant difference among all sub-items. However, in GFQ item 14, there were significant differences among sub-items 2, 5, 6, and 7; their effect sizes ranged from 0.38 to 0.58. In particular, the strength of association was large between sub-items 6 and 7. In MDS-UPDRS Part II item 13, there was a significant difference between sub-items 1 and 2. Effect sizes of sub-items 1

Table 1. Group classification

	Low score group	High score group	Criteria of High score group
FOGQ item 3	Less than grade 3 (N=15)	Grade 4 (N=13)	Freeze multiple times in a day
FOGQ item 4	Less than grade 2 (N=18)	More than grade 3 (N=10)	Lasting of freezing episode more than 10 sec
GFQ item 14	Less than grade 1 (N=17)	More than grade 2 (N=11)	Fall because of FOG more than once a month
MDS-UPDRS Part II item 13	Less than grade 2 (N=21)	More than grade 3 (N=7)	Need someone's help or walking aids when freeze
MDS-UPDRS Part III item 11	Less than grade 2 (N=21)	More than grade 3 (N=7)	Freeze during not only starting, turning or walking through doorway but also straight walking

FOGQ; Freezing of gait questionnaire

GFQ; Gait and Falls Questionnaire

MDS-UPDRS; Movement disorder society-Unified Parkinson's disease rating scale

Table 2. Comparison of total score of PDQ-39 mobility dimensions between the groups classified by each FOG assessments

	95% CI		P value	Effect size (<i>d</i>)	1- β
	Low score group	High score group			
FOGQ item 3	5.47 - 17.20	16.34 - 30.28	0.008	1.09*	0.62
FOGQ item 4	8.38 - 20.40	12.58 - 30.22	0.156	0.58	0.78
GFQ item 14	7.22 - 16.07	16.01 - 33.99	0.003	1.25*	0.59
MDS-UPDRS Part II item 13	9.09 - 18.43	13.01 - 39.56	0.018	1.10*	0.62
MDS-UPDRS Part III item 11	9.18 - 19.21	12.33 - 37.67	0.044	0.92*	0.63

Unpaired-T test

Effect size (*d*): Small 0.20, Midium 0.50, Large 0.80 *

95% CI; 95% confidence interval

Table 3. Comparison of sub items of PDQ-39 mobility dimensions between the groups classified by each FOG assessments

Sub-item of PDQ-39	FOGQ item 3		FOGQ item 4		GFQ item 14		MDS-UPDRS Part II item 13		MDS-UPDRS Part III item 11	
	P value	Effect size	P value	Effect size	P value	Effect size	P value	Effect size	P value	Effect size
	1 Had difficulty doing the leisure activities which you would like to do?	0.015	0.46	0.141	0.29	0.091	0.33	0.007	0.50	0.101
2 Had difficulty looking after your home, e.g. DIY, housework, cooking?	0.217	0.24	0.068	0.35	0.047	0.38	0.014	0.46	0.126	0.30
3 Had difficulty carrying bags of shopping?	0.013	0.48	0.263	0.22	0.011	0.50	0.062	0.37	0.348	0.19
4 Had problems walking half a mile?	0.015	0.48	1	0.01	0.191	0.26	0.101	0.33	0.376	0.18
5 Had problems walking 100 yards?	0.13	0.33	0.468	0.16	0.037	0.45	0.228	0.26	0.042	0.44
6 Had problems getting around the house as easily as you would like?	0.015	0.47	0.054	0.38	0.002	0.58*	0.272	0.22	0.189	0.27
7 Had difficulty getting around in public?	0.201	0.25	0.142	0.29	0.002	0.58*	0.348	0.19	0.155	0.28
8 Needed someone else to accompany you when you went out?	0.058	0.38	0.595	0.11	0.161	0.29	0.101	0.33	0.113	0.33
9 Felt frightened or worried about falling over in public?	0.037	0.43	0.595	0.11	0.1	0.34	0.155	0.30	0.126	0.31
10 Been confined to the house more than you would like?	0.217	0.25	0.383	0.18	0.122	0.31	0.296	0.22	0.071	0.36

Grade of sub item in PDQ-39; 0:Never 1:Occasionally 2:Sometimes 3:Often 4:Always or cannot do at all
Mann-Whitney U test

Effect size (*r*): Small 0.10, Medium 0.30, Large 0.50*

and 2 were 0.46 and 0.50, respectively. In MDS-UPDRS Part III item 11, there was a significant difference in only sub-item 5 (effect size, 0.44).

There were strong associations between the total score of PDQ-39 and the presence of FOG in common situations such as being in crowded and cluttered places, crossing roads, and entering automatic doors (**Table 4**). In sub-item 9, strong associations were found between the groups in the following situations: change in the walking surface, being in cluttered places, being in unfamiliar places, crossing roads, and unintended thoughts while walking. In unfamiliar places, there was a significant difference between sub-items 8 and 9, whereas in cluttered places, there were significant differences among sub-items 3, 6, and 9 (**Table 5, 6**).

Discussion

The present study demonstrated that FOG is a significant symptom affecting QOL of patients with PD. FOGQ item 3, GFQ item 14, and MDS-UPDRS Part II item 13 and Part III item 11 may affect QOL at least with respect to mobility dimension (**Table 2**). However, the duration of FOG was poorly associated with QOL despite duration being considered as an important factor in FOG severity ¹⁵⁾ (**Table 2**). Even though short durations of FOG, QOL of patients can be significantly affected by falls or psychosocial impacts, such as fear, anxiety, embarrassment, helplessness, despair, and inability to perform a social role.

The results of sub-items of mobility dimensions in PDQ-39 suggest that difficult social situations for patients may vary according to the aspects of FOG assessment. Patients who

Table 4. Comparison of total score of PDQ-39 mobility dimensions between the groups classified by the presence of FOG in daily situations

Situations	95% CI		P value	effect size (<i>r</i>)
	FOG absence	FOG presence		
Change in the walking surface	8.11-19.37	14.45-32.66	0.028	0.41
Being in crowded places	3.09-11.66	14.85-26.55	0.002	0.55*
Being in cluttered (scattered) places	5.58-15.75	16.81-31.34	0.002	0.58*
In unfamiliar places	5.63-20.94	14.26-26.74	0.024	0.42
Getting on/off a public transport	5.76-19.95	14.24-27.62	0.031	0.41
Crossing roads	7.14-17.09	16.86-34.14	0.003	0.55*
Entering an elevator or automatic door	4.00-14.61	17.11-29.83	0.001	0.63*
When trying to hurry to the toilet	3.24-13.91	13.80-25.53	0.036	0.39
Unintended thoughts while walking	8.31-19.37	13.73-32.93	0.042	0.39

Mann-Whitney U test

Effect size (*r*): Small 0.10, Medium 0.30, Large 0.50*

Table 5. Comparison of sub items of PDQ-39 mobility dimensions between the groups classified by the presence of FOG in daily situations - 1 (p value)

PDQ-39 Sub-item No.	1 Leisure activities	2 Housework	3 Shopping	4 Long walking	5 Short walking	6 Getting around the house	7 Getting around in public	8 Needed accompany when went out	9 Frightened about falling in public	10 Been confined to the house
Situations										
Change in the walking surface	0.583	0.802	0.157	0.41	0.352	0.329	0.102	0.306	0.032	0.481
Being in crowded places	0.042	0.078	0.368	0.046	0.386	0.478	0.582	0.078	0.064	0.546
Being in cluttered (scattered) places	0.22	0.208	0.035	0.229	0.224	0.046	0.223	0.091	0.036	0.561
In unfamiliar places	0.25	0.797	0.507	0.552	0.526	0.092	0.277	0.027	0.042	0.8
Getting on/off a public transport	0.05	0.225	0.403	0.838	0.786	0.159	0.57	0.176	0.554	0.431
Crossing roads	0.065	0.183	0.582	0.27	0.075	0.143	0.074	0.09	0.018	0.055
Entering an elevator or automatic door	0.014	0.042	0.302	0.087	0.052	0.005	0.115	0.091	0.052	0.037
When trying to hurry to the toilet	0.261	0.216	0.287	0.038	0.51	0.231	0.339	0.025	0.125	0.937
Unintended thoughts while walking	0.198	0.595	0.323	0.042	0.512	0.28	0.503	0.306	0.032	0.187

Chi square test

Table 6. Comparison of sub items of PDQ-39 mobility dimensions between the groups classified by the presence of FOG in daily situations -2 (effect size)

PDQ-39 Sub-item No.	1 Leisure activities	2 Housework	3 Shopping	4 Long walking	5 Short walking	6 Getting around the house	7 Getting around in public	8 Needed accompany when went out	9 Frightened about falling in public	10 Been confined to the house
Situations										
Change in the walking surface	0.32	0.24	0.49	0.38	0.40	0.41	0.53*	0.42	0.61*	0.35
Being in crowded places	0.60*	0.55*	0.39	0.59*	0.39	0.35	0.32	0.55*	0.56*	0.33
Being in cluttered (scattered) places	0.45	0.46	0.61*	0.45	0.45	0.59*	0.45	0.54*	0.61*	0.33
In unfamiliar places	0.44	0.24	0.34	0.33	0.33	0.54	0.43	0.63*	0.59*	0.24
Getting on/off a public transport	0.58*	0.45	0.38	0.23	0.25	0.49	0.32	0.48	0.33	0.37
Crossing roads	0.56*	0.47	0.32	0.43	0.55*	0.50	0.55*	0.54*	0.65*	0.58*
Entering an elevator or automatic door	0.67*	0.60*	0.42	0.54*	0.58*	0.73*	0.52*	0.54*	0.58*	0.60*
When trying to hurry to the toilet	0.43	0.45	0.42	0.60*	0.34	0.45	0.4	0.63*	0.51*	0.17
Unintended thoughts while walking	0.46	0.32	0.41	0.60*	0.34	0.43	0.35	0.42	0.61*	0.47

Chi square test

Effect size (Cramer's V): Small 0.10, Medium 0.30, Large 0.50*

experience falling more than once a month exhibit significantly increased difficulty in navigating a house or a public place (**Table 3**, PDQ-39 sub-items 6 and 7). This means the following: (1) distress in performing activities of daily living and social roles at home and (2) embarrassment in public situations and avoidance of social interactions. GFQ item 14 as an assessment for frequency of falls due to FOG may be a major predictor of QOL. Special attention must be given to strategies for preventing falls in navigating a house and public places in order to promote social participation in patients with PD.

The grade of MDS-UPDRS Part III item 11 reflects loss of automaticity as a primary impairment. In this study, the effect size in the groups classified by MDS-UPDRS Part III item 11 was small compared with that of FOGQ item 3 and GFQ item 14 (**Table 2**). Our results suggest that QOL may be associated with increased frequency of FOG and falls due to FOG rather than impaired automaticity. This may indicate that FOG and falls are elicited not only by the loss of automaticity but also by various internal (personal) or external (environmental) factors ¹⁶⁾. In other words, this indicates that the restriction of social participation in patients with PD experiencing FOG results from a complex interaction of various factors. Various internal or external factors contribute to the episodic nature of FOG. In fact, there were patients who had disturbed QOL despite mild impaired automaticity and preserved QOL despite severe loss of automaticity (**Table 3**). The former indicates the following as barriers to social participation: (1) internal factors such as emotion or fatigue and (2) external factors such as physical environment. The latter factor is speculated the following as facilitators: (1) the reliance on cognitive function to compensate for the loss of automaticity ¹⁷⁾ and (2) environmental modification.

We also found an association between QOL and the presence of FOG in actual daily living. Therefore, assessing FOG occurrence in actual daily living may be valuable in preserving QOL. Emotional consequences of FOG have often been overlooked ⁷⁾. Fear of falling may be largely associated with QOL. The present study may indicate that fear or anxiety is an emotional consequence of psychological impact caused by the presence of FOG in actual daily situations (**Table 5, 6**). The presence of FOG in common situations such as changes in the walking surface, being in cluttered places, being in unfamiliar places, crossing roads, and unintended thoughts while walking may reflect fear of falling. Alternatively, this result may indicate the cause of FOG. It is well known that emotional stimuli can elicit FOG ^{7, 12, 13)}. Fear or anxiety in social situations may become a potential trigger for FOG, such as expected anxiety by a past FOG experience while crossing roads.

A study reported that when patients encounter an unfamiliar environment, FOG is

associated with deficiency in information processing from the temporoparietal cortex to the frontal cortex (frontoparietal network)¹⁸⁾. We found that this situation may have a strong association with the need of assistance when go out and the fear of falling. Thus, perceptual malfunction in PD may have a significant impact on social life. The present study also demonstrated that the presence of FOG while shopping and walking in a house may be influenced by cluttered places. This indicated that environmental modification is needed in these situations.

This is the first report to evaluate the effect of the aspects of FOG assessments on QOL of patients with PD. As mentioned above, the associations between PDQ-39 and several FOG assessments may have implications for the clinical management of FOG in patients with PD. However, our study has several limitations. First, we used a small sample size; further studies with a larger sample size of patients with PD are needed. Second, as MDS-UPDRS Part III item 11 was assessed through a single tasking, it cannot provide sufficient information on the degree of less automaticity. It is necessary to employ other FOG assessments such as a FOG score comprising four circumstances (gait initiation, clockwise and counter clockwise turn, and narrow space) combined with dual tasking¹⁹⁾. Third, PDQ-39 mobility dimensions may be inadequate to understand the psychosocial impact caused by FOG. The effect of FOG on psychosocial aspects appears to be as important as the contributions of mobility problems. Therefore, in clinical practice, a careful interview using open-ended questions is needed to identify distress in actual social life. Finally, future research analyzing the complex interactions of various triggering factors in actual FOG situations is needed.

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2017年9月7日受理