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Original Article

Management for the patients with severe Parkinson's disease during dental treatments and tooth extractions: A retrospective observational study

Yoshinari Morimoto*†, Megumi Hayashi †, Yohei Tanaka †, Lou Mikuzuki, Hitomi Nishizaki

Department of Geriatric Dentistry, Kanagawa Dental University, Yokosuka, Kanagawa, Japan

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Abstract *Background/purpose:* When Parkinson's disease (PD) progresses, oral and swallowing functions decline, and special care is necessary when performing dental treatments. This study aimed to retrospectively investigate the records of patients with PD and analyze dental and general problems to establish countermeasures during dental treatments.
Materials and methods: We retrospectively examined the medical records of patients with PD to obtain data on dental treatments and management methods.
Results: Of the 27 patients, 40% had severe grade IV or higher Hoehn–Yale (HY) scores, and the wearing-off phenomenon was observed in those with grade III or higher. Additionally, 19% of the patients were receiving levodopa 500 mg/day or more. Intravenous sedation was administered 21 times (three patients) and general anesthesia eight times (three patients). Discontinuation of tooth extraction was observed in four patients: two with difficulty in opening the mouth, one with respiratory failure caused by the wearing-off phenomenon, and one with excessively elevated blood pressure due to the interaction between adrenaline in local anesthesia and the catechol-O-methyltransferase inhibitor. Tooth extraction was performed by adjusting the time of levodopa administration in two patients, under general anesthesia in one patient, and using adrenaline-free local anesthetics under intravenous sedation in one patient.
Conclusion: When PD progresses, oral and swallowing functions decline and body motor function deteriorates. Thus, the respiratory and circulatory conditions and the wearing-off phenomenon during dental treatments should be properly managed in patients with severe PD.

* Corresponding author. Department of Geriatric Dentistry, Kanagawa Dental University, 82, Inaoka-cho, Yokosuka, Kanagawa, Japan.
E-mail address: morimoto@kdu.ac.jp (Y. Morimoto).
† These authors contributed equally to this manuscript as the first author.

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Introduction

Parkinson's disease (PD) is caused by the degeneration and loss of dopaminergic neurons in the substantia nigra. The substantia nigra sends nerve fibers to the striatum in the basal ganglia, and dopamine is secreted from the nerve endings. It is believed that a decrease in dopaminergic neurons leads to a decrease in dopamine content in the striatum, resulting in various symptoms of PD.[1] PD is a progressive disease accompanied by resting tremors, akinesia or bradykinesia, muscle rigidity, and facial impassiveness. Simultaneously, mood disorder/fatigue is observed in approximately 40% of the patients and dementia in approximately 25%.[1] Oral and swallowing function may also decline, and when performing the dental treatments, measures must be taken according to the progression of the disease.[1,2] Regarding PD and dental practice, tremor affects tongue and lip motility and worsen oral hygiene.[1,2]

When the duration of PD is long and the administration of levodopa (L-dopa), a therapeutic drug, is prolonged, the drug effect time is shortened, the effect disappears several hours after L-dopa administration, and the symptoms of PD deteriorate (the wearing-off phenomenon). When this phenomenon occurs, motor function is severely impaired, and it is impossible to keep the mouth open or move the whole body during dental treatments.[3–5] Therefore, adequate appointments should be made to avoid wearing-off onset. To date, most reports on dental care for patients with PD have focused on oral care, periodontal disease, and denture management, with only a few detailed studies on risk management during dental treatments for patients with PD.[2,5–15]

This study aimed to retrospectively investigate the records of patients with PD and analyze dental and general problems to establish countermeasures during dental treatments.

Materials and methods

This retrospective observational study was conducted in accordance with the Declaration of Helsinki, and the study protocol was approved by the Kanagawa Dental University Ethics Review Board (approval number 633).

The participants were patients with PD who visited the Department of Geriatric Dentistry, Kanagawa Dental University Hospital, from November 2017 to March 2021. We retrospectively examined the medical records of these patients to obtain data on dental treatments and management methods. The survey items included sex; age; Hoehn–Yale (HY) score[16]; location for treatment (out-patient/home visit); medications, dental diseases; the number of remaining and healthy teeth; details of dental treatments (general dental treatments, tooth extraction, or dysphagia rehabilitation); management methods (monitoring, intravenous sedation, general anesthesia); complications during dental treatments; and other special considerations (presence of wearing-off, and history of pneumonia). Data were presented as medians (quartiles).

Results

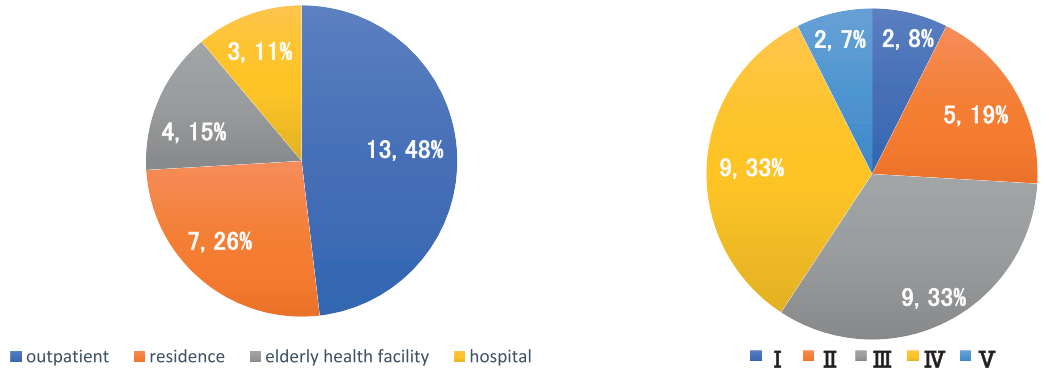
Patients' characteristics

The medical records of 27 patients with PD were surveyed. The patients' backgrounds and treatments (dental treatments or treatment for dysphagia) are shown in Table 1. A total of 48% were treated as out-patients and 52% in home visits (Fig. 1-A). In terms of the HY score, 40% were severe (IV, 33%; V, 7%) (Fig. 1-B). Regarding the medications taken, 81% of the patients received L-dopa at doses of 300 mg/day or less; however, 19% of the severe cases received doses of 500 mg/day or more (Fig. 2-A). Other agents for PD and donepezil hydrochloride for dementia were administered (Fig. 2-B). Additionally, two patients had long-term bed rest (HY score V), two underwent gastrointestinal nutrition management, one underwent deep brain stimulation (DBS), and levodopa/carbidopa combined intestinal gel (LCIG) continuous infusion therapy was performed in one patient. Five of the patients had a history of pneumonia. Nine patients recognized the wearing-off phenomenon daily, and their HY score was grade III or higher.

Table 1 Characteristics of the patients with Parkinson's disease.

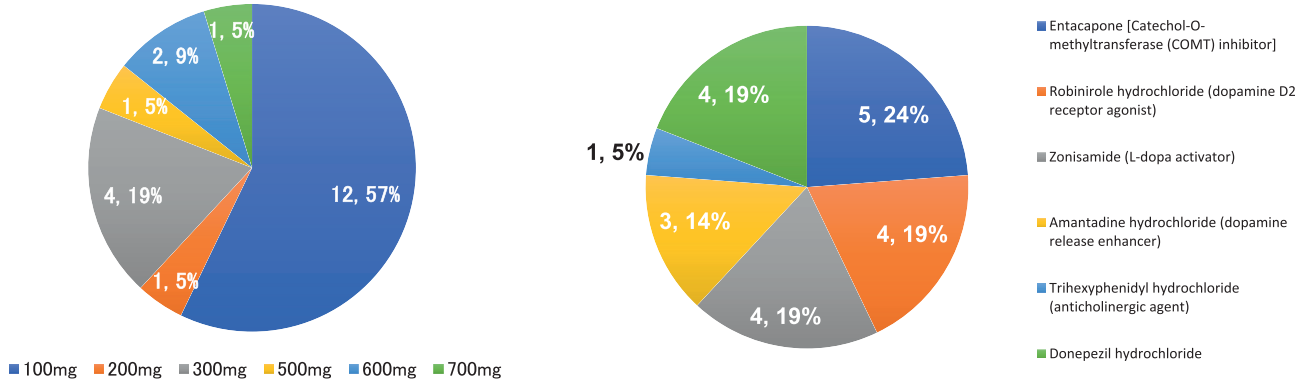
Characteristics of patients and number		
Age (years)		78 (75–82)
Gender (male/female)		13/14
Remaining teeth		22.5 (14.5–26.3)
Healthy teeth		8 (2.5–17)
Dental treatments		22
Dysphagia treatments		13
Tooth extraction cases		
Tooth extractions (occasion/patient)		1.5 (1–2)
Tooth extractions (tooth/patient)		4 (1.5–8)
Surgical extractions (tooth/patient)		1 (1–2)
Anesthetic management		
Intravenous sedation (occasion)		3 (3–12)
Dose of midazolam	maximum	2.5 (2.5–3)mg
	minimum	2 (1.5–2)mg
General anesthesia (occasion)		3 (1–4)

Data were presented as medians (quartiles).



(A) (B)

Figure 1 Location for treatment and Hoehn–Yale classification of the patients with Parkinson's disease. (A) Location for treatment (out-patient/home visit). A total of 48% were treated as outpatients and 52% in home visits. (B) Hoehn–Yale classification. Of the patients, 40% were severe (Hoehn–Yale classification IV, 33%; V, 7%).



(A) (B)

Figure 2 Levodopa dose and other medications for Parkinson's disease (A) Levodopa dose. Of the patients, 81% received L-dopa at doses of ≤300 mg/day; however, 19% of the severe cases received doses of ≥500 mg/day. (B) Other medications for Parkinson's disease. Other agents for Parkinson's disease and donepezil hydrochloride for dementia were administered.

The median number of remaining teeth was 22.5 (quartile 14.5–26.3), and number of healthy teeth was eight (2.5–17) (Table 1). According to the Eichner classification, group A accounted for 45%, group B for 47%, and group C for 8% (Fig. 3).

Tooth extraction cases

Tooth extraction was performed on 14 occasions (38 teeth) in nine patients (Table 2). The number of teeth extracted was four (median) per person, of which one (median) was surgically extracted. Considering the HY score, one patient grade II, three grade III; five grade IV; and seven daily wearing-off phenomena (2, grade III, 5 grade IV). Of these, two reported difficulty in opening their mouths during tooth extraction (cases 3 and 5), and one had respiratory insufficiency (SpO_2<80%) (case 7) due to wearing off. One patient who was taking a catechol-*O*-methyltransferase (COMT) inhibitor (Entacapone) experienced a significant increase in blood pressure (BP) (190/110 mmHg) after using a local anesthetic containing adrenaline (ORA® Injection: GC Showayakuhin Co., Tokyo) (case 4). In patients suggesting wearing-off, tooth extraction was discontinued, and the condition improved after L-dopa administration. Two patients underwent tooth extraction after adjusting the L-dopa dosing time (cases 5 and 7), and one patient was administered general anesthesia (case 3). For the abnormal increase in BP, tooth extraction was performed later using an adrenaline-free local anesthetic (3% prilocaine hydrochloride containing felypressin 0.54 mg/mL: Citanest-Octapressin®; Dentsply Sirona, Tokyo) under intravenous sedation (case 4) (Table 2).

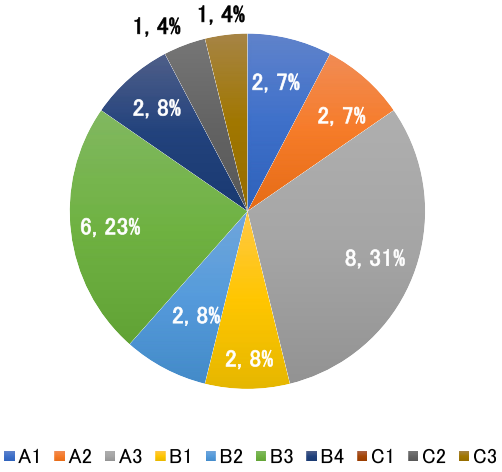


Figure 3 Eichner classification.Groups A, B, and C accounted for 45%, 47%, and 8%, respectively.

Sedation and anesthesia for dental treatments

All patients were monitored during dental treatments; intravenous sedation was performed 21 times (three patients), and general anesthesia was administered 8 times (three patients). For intravenous sedation, 2 or 2.5 mg of midazolam was used, and propofol was not administered. No decrease in BP (systolic BP [SBP], <80 mmHg) or percutaneous oxygen saturation (SpO_2 <93%) was observed (Table 1).

Among the tooth extraction cases, case 3 had a grade IV HY score, suggesting severe tremors, and walked using a cane or assistance. The wearing-off phenomenon occurred frequently, and L-dopa was administered approximately every 2 h (700 mg/day in total). Wearing off makes it impossible to open the mouth and causes severe motor impairment throughout the body. General anesthesia was administered three times, twice for tooth extractions and once for some other dental treatments. L-dopa was injected approximately every 3 h through a gastric tube during anesthesia.[3,17] No impairment of motor function was observed postoperatively (Table 3). Case 6 had a grade II HY score; however, the number of extracted teeth was 10; the patient also had a dental phobia, and general anesthesia was administered (Table 3). Case 9 had an HY score of grade IV, suggesting severe tremors, and had to walk with assistance or use a wheelchair. As wearing off causes severe motor impairment throughout the body and makes it impossible to move, L-dopa was administered in five divided doses (a total of 500 mg/day). General anesthesia was scheduled from 9:00 to 12:30 each time; therefore, the schedule of L-dopa intake on the day of surgery was modified to 1:00 100 mg/6:00 100 mg (generally 3:00)/14:00

Table 2 Management during tooth extraction of the patients with Parkinson's disease.

Case	Age (years)	Sex	Extracted tooth	Diagnosis	Hoehn—Yale Classification (wearing-off +/−)	Management during Dental Treatment
1	79	M	#38	C4	IV(+)	IVS
2	78	F	#46	P	III(+)	Monitor
3	69	M	#25,26,35,37	Per	IV(+)	Discontinuation due to trismus caused by wearing-off GA administration on another day
			#46	Per		GA
4	77	M	#14,17	Per	IV(+)	Discontinued due to hypertension (BP 190/110 mmHg) after LA IVS
			#32,36	Per		IVS
5	69	M	#44,45	Per	IV(+)	Discontinuation due to trismus caused by wearing-off Time adjustment of l-dopa
			#35	Per		Per Time adjustment of taking l-dopa
6	63	M	#11,12,13,21,23 #26,31,32,33,34	C4	II(−)	GA because of multiple tooth extractions and dental phobia
7	78	F	#16	P	IV(+)	Discontinued due to respiratory failure (SpO2<80%) due to wearing-off (rigidity of the respiratory muscles) Time adjustment of l-dopa
8	84	F	#16,44,45,47,48	Per	III(−)	IVS
			#41,42,43	C4		IVS
			#35	C4		IVS
9	68	F	#25,27,37,47	C4	IV(+)	GA because of severe tremor

M, male; F, female; C, dental caries; Per, periapical periodontitis; P, marginal periodontitis; L-dopa, levodopa; IVS, intravenous sedation; GA, general anesthesia; BP, blood pressure; SpO_2, oxygen saturation; LA, local anesthesia.

Table 3 Management of anesthesia cases of the patients with Parkinson's disease.

Case	Hoehn–Yale Classification (wearing-off +/−)	Induction		Maintenance		Treatment time	Anaesthesia time	Administration of L-dopa during anaesthesia	Use of vasopressor
3–1	IV(+)	M 3.0 mg	F 75μg	S 0.8–1.2%	R 0.1–0.12μg/kg/min	190 min	243 min	GT (1 time)	
3–2	IV(+)	M 2.5 mg	F 75μg	S 0.7–1.5%	R 0.05–0.1μg/kg/min	233 min	285 min	GT (2 times)	
3–3	IV(+)	M 2.0 mg	F 75μg	S 1.0–1.5%	R 0.05–0.15μg/kg/min	192 min	242 min	GT (1 time)	
6–1	II(−)	160 mg	F 100μg	S 1.0–1.5%	N_2O 3 L/min O_2 3 L/min	122 min	190 min	none	Phenylephrine
9–1	IV(+)	M 2.0 mg	R 0.2μg/kg/min	S 1.5%	R 0.1–0.15μg/kg/min	170 min	225 min	Time adjustment	
9–2	IV(+)	M 2.0 mg	R 0.2μg/kg/min	S 1.0–1.5%	R 0.07–0.15μg/kg/min	175 min	233 min	Time adjustment	Ephedrine
9–3[a]	IV(+)	M 2.0 mg	R 0.2μg/kg/min	S 1.0–1.5%	R 0.1–0.15μg/kg/min	150 min	195 min	Time adjustment	
9–4	IV(+)	M 2.0 mg	R 0.2μg/kg/min	S 1.0–1.5%	R 0.1–0.15μg/kg/min	145 min	180 min	GT (1 time)	Phenylephrine

M: midazolam, F: fentanyl, R: remifentanil, S: sevoflurane, P: propofol, N_2O: nitrous oxide, O_2: oxygen, GT: gastric tube.

[a] The wearing-off phenomenon was observed immediately after anesthesia.

100 mg (generally 11:00)/17:00 100 mg/22:00 100 mg. General anesthesia was administered a total of four times, including one tooth extraction and three dental treatments. L-dopa (14:00, 100 mg) was administered 1.5—2 h after the completion of anesthesia, and no impairment of motor function was observed postoperatively in the first and second anesthesia sessions. However, case 9 suffered from severe general malaise caused by the wearing-off phenomenon just after completion of the third anesthesia and was treated with L-dopa administration postoperatively. The patient reported that the action time of L-dopa was shorter than that in the past. L-dopa was administered through the gastric tube intraoperatively at the fourth anesthesia, and there were no complications upon awakening after the completion of the anesthesia (Table 3).

General anesthesia was induced using propofol and fentanyl in case 6 (HY score II). However, in cases 3 and 9 (HY score IV), propofol was not used because dehydration and autonomic nervous system abnormalities were associated with hypotension. Instead, anesthesia was induced with midazolam (2 mg) and small doses of fentanyl (75—100 mg) or remifentanil (0.2 mg/kg/min). Anesthesia was maintained with air (5L/min), oxygen (1L/min), sevoflurane (0.7—1.5%), and remifentanil (0.05—0.15 mg/kg/min). Vasopressors were used in two patients for lower SBP (<80 mmHg).

Discussion

We retrospectively examined the management of patients with PD during dental treatments. Of the 27 patients, 40% had severe cases of grade IV or higher HY score, and wearing-off was observed in those with grade III or higher. Additionally, 19% of the patients received L-dopa 500 mg/day or more. Intravenous sedation was administered 21 times (three patients), and general anesthesia was administered 8 times (three patients). Discontinuation of tooth extraction was observed in four patients: two patients with difficulty in opening the mouth, one with respiratory failure due to the wearing-off phenomenon, and one with abnormally elevated BP due to the interaction between adrenaline in local anesthesia and a COMT inhibitor. Tooth extraction was performed by adjusting the time of L-dopa administration in three patients, under general anesthesia in one patient, and using adrenaline-free local anesthetics under intravenous sedation in one patient.

The Ministry of Health, Labor, and Welfare defines an HY score of III or higher as severe.[16] In total, 73% of the patients with PD treated in our clinic were classified as having an HY score of III or higher. Additionally, 19% of the severe cases received more than 500 mg/day of L-dopa. Other drugs were administered to more than half of the patients. In severe cases, DBS and LCIG continuous infusion therapy were administered, along with long-term bed rest and nutritional management via a gastric fistula. LCIG is continuously delivered via a portable infusion pump to the proximal small intestine through a percutaneous endoscopic gastrostomy with jejunal extension, and levodopa and carbidopa preparations are continuously administered to maintain a constant blood concentration.[17] This is expected to improve severe wearing-off symptoms. In this study, nine patients experienced wearing-off daily, and it was adopted in one patient.

Dental findings showed that there were 22 remaining teeth (median), of which only 8 were healthy (median). The incidence of group A (contact with the opposing teeth in all four support areas), according to the Eichner classification, was less than half (45%), and more than half of the cases were in groups B and C. In particular, B3 (one support area in contact with the opposite tooth) accounted for 23%, which was the highest number among groups B and C, suggesting poor occlusal support. In reports on PD and dental practice, tremor affects tongue and lip movements, resulting in the deterioration of oral functions, such as chewing, swallowing, and speaking.[5,6] Additionally, those with HY scores II or higher have a small number of remaining teeth, a large number of DMF teeth, a large amount of plaque and deep periodontal pockets, and low levels of interest in oral health.[7—10] Muller et al. also reported that patients with PD had fewer daily brushings and dental visits.[11] From the above, it is shown that patients with PD have movement disorders, such as tremors, and the progression of dental caries and periodontal disease is owing to the difficulty in oral cleaning. The present study revealed similar dental findings.

An adequate suction should be performed during the dental treatments of patients with PD, owing to the risk of aspiration, and possible orthostatic hypotension. Caution, such as carefully changing the sitting position of the dental chair, should be exercised.[1] In this study, BP, heart rate, and SpO_2 were monitored in all patients during dental treatments. Additionally, many patients experienced wearing off; therefore, appointments were made during the drug effect.

Tooth extraction was discontinued in three patients because of wearing off. Tooth extraction can be time-consuming and often causes more instances of wearing off than general dental treatments. It is difficult to maintain the mouth open for a long time when wearing off occurs. It is important to discontinue treatment and stabilize the neuromuscular activity using L-dopa. Eventually, the three patients (cases 1, 4, and 8) underwent tooth extraction under intravenous sedation, and three patients (cases 3, 6, and 9) underwent tooth extraction under general anesthesia. Mostly, these patients had severe HY (grades III and IV). Intravenous sedation was performed using 2 or 2.5 mg of midazolam (without propofol). Propofol has a strong vasodilating effect and is likely to cause hypotension in older PD patients with dehydration and abnormalities of the autonomic nervous system.[3—5,18,19] In patients with PD, low doses of midazolam induce sufficient sedation levels; therefore, it was considered appropriate owing to concerns of hypotension. In case 4, the interaction between the use of a COMT inhibitor and adrenaline-containing local anesthetics can increase BP excessively; therefore, it is recommended to limit the amount of adrenaline used to 36 μg or to use adrenaline-free local anesthetics.[1] Intravenous sedation was also considered appropriate because BP can also increase with psychological strain and painful stimuli.

In patients with PD undergoing general anesthesia, attention should be paid to preoperative cognitive function, respiratory function, the recent history of pneumonia,

swallowing function, orthostatic hypotension, and hypotension due to dehydration. In the three patients who underwent general anesthesia in this study, only orthostatic hypotension was observed when L-dopa was effective. Case 6 showed normal data on preoperative spirometry examination, case 3 showed restrictive respiratory disturbance (vital capacity: 66.9%), and case 9 could not be performed because the mouthpiece could not be held appropriately in the oral cavity due to tremors. Other preoperative examinations revealed nearly normal ranges of values.

In the selection of general anesthetics for patients with PD, propofol is recommended because it is short-acting and nonprotracted despite the risk of dyskinesia. Although thiopental inhibits dopamine release, and ketamine induces an increase in oral secretions and hypertension, neither is recommended. Volatile anesthetics inhibit synaptic dopamine uptake and increase postoperative stiffness. However, sevoflurane has few adverse effects and can be used safely. Benzodiazepine sedatives have been shown to reduce tremors; however, cause postoperative delirium in patients with cognitive decline. The prolonged use of narcotics also poses the problem of suppressing respiratory function.[3—5,18,19] Therefore, in general anesthesia cases (HY score IV) in this study, 1) because L-dopa has a short half-life of 1—2 h, it should be administered appropriately pre-, peri-, and postoperatively, and the wearing-off condition was avoided to maintain motor function postoperatively. L-dopa was administered by adjusting the time or gastric tube pre- and postoperatively or every several hours intraoperatively, respectively.[2,19] However, as the efficacy of L-dopa can decrease gradually; therefore, appropriate dosing regimens should always be considered in each anesthesia. 2) Since there is a possibility of hypotension due to dehydration, and there were no patients with severe cognitive impairment, anesthesia was induced with small doses of midazolam, fentanyl, or remifentanil, followed by maintenance with a low dose of sevoflurane and remifentanil. The BIS value was generally maintained at 40—60, and vasopressors were used only three times if the SBP was $<$80 mmHg. Since the anesthesia time was $>$3 h, we did not antagonize the muscle relaxant; however, there were no postoperative anesthetic or narcotic protractions and other complications.

In conclusion, we retrospectively examined the management of patients with severe PD who underwent dental treatments. As PD progresses, oral, swallowing, and body motor functions decline. It is important to properly manage the respiratory and circulatory conditions and wearing-off phenomenon during the dental treatments of patients with severe PD.

Declaration of competing interest

The authors declare no conflicts of interest with respective to the research and publication of this article.

Acknowledgments

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