Analysis of behavioral management for dental treatment in patients with dementia using the Korean National Health Insurance data

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Background: The global population is aging rapidly, and accordingly, the number of patients with dementia is increasing every year. Although the need for dental treatment increases for various reasons in patients with dementia, they cannot cooperate during dental treatment. Therefore, behavioral management, including sedation (SED) or general anesthesia (GA), is required for patients with dementia. Thus, this study aimed to investigate the trends and effects of SED or GA in patients with dementia undergoing dental treatment in South Korea based on the Korean National Health Insurance claims data.

Methods: This study utilized customized health information data provided by the Health Insurance Review and Assessment Service. Among patients with records of using sedative drugs during dental treatment from January 2007 to September 2019, patients with the International Classification of Diseases-10 code for dementia (F00, F01, F02, F03, and G30) were selected. We then analyzed the full insurance claims data for dental care. Age, sex, sedative use, and dental treatment of patients were analyzed yearly. In addition, the number of cases of GA or SED per year was analyzed, and changes in behavioral management methods with increasing age were investigated.

Results: Between January 2007 and September 2019, a total of 4,383 (male, 1,454; female, 2,929) patients with dementia received dental treatment under SED or GA. The total number of SED and GA cases were 1,515 (male, 528 ; female, 987) and 3,396 (male, 1,119 ; female, 2,277) cases, respectively. The total number of cases of dental treatment for 4,383 patients with dementia was 153,051 cases, of which 2.22% were under GA and 0.98% were under SED. Midazolam was the most commonly used drug for SED.

Conclusion: Although gingivitis and pulpitis were the most common reasons for patients with dementia to visit the dentist, GA or SED for patients with dementia was frequently used in oral and maxillofacial or periodontal surgery.

Keywords: Alzheimer Disease; Dementia; Dental Treatment; General Anesthesia; National Health Insurance; Sedation.

INTRODUCTION

The world's population is rapidly aging, and as a result, diseases caused by aging are also increasing. Dementia is a non-congenital cognitive disorder characterized by reduced memory, speaking difficulty, and disability in performing daily living activities, as well as loss of socio-occupational functions over time [1]. The most common cause of dementia is Alzheimer's disease (AD)

(60-80%), and other causes include vascular (10%), traumatic brain damage, and systemic diseases, such as Parkinson's disease [2]. AD is a neurodegenerative disease characterized by cognitive and functional deficits, as well as loss of functional independence and behavioral changes [3].

The prevalence of dementia in Korea increased significantly, with 176,746 and 530,269 dementia cases in 2008 and 2016, respectively. AD was the most common dementia subtype (65.4% and 86.1% in 2008 and 2016, respectively). As the population ages, the number of patients with dementia is increasing every year [4].

For various reasons, the need for dental treatment for patients with dementia increases, while patient cooperation becomes challenging to obtain (patients may exhibit aggressive behavior, cry, or be restless) [5]. Many symptoms caused by AD and the side effects of drugs used in treating AD aggravate the dental disease and make dental treatment difficult. Therefore, the demand for behavioral management such as sedation (SED) and general anesthesia (GA) for the dental treatment of patients with AD has also increased [6,7]. Based on actual claims data from the Korean National Health Insurance, we investigated the behavioral management trends of patients with dementia for dental treatment in South Korea.

METHODS

1. Study design

The study was approved by the Institutional Review Board of the Seoul National University School of Dentistry (IRB No. S-020200006). Before the start of the study, the Healthcare Insurance Review & Assessment Service in South Korea approved the use of customized health information (M20191014119) of the Healthcare Bigdata Hub (https://opendata.hira.or.kr/). As the data source for the subjects in this study, the National Health Insurance Service in South Korea's payment data during

the period from January 2007 to September 2019 were used. First, a request was made to the Healthcare Bigdata Hub for the payment data of patients at dental hospitals and dental clinics who made insurance claims for one of the following eight sedatives which can be used in dental SED: chloral hydrate, hydroxyzine, propofol, sevoflurane, midazolam, triazolam, N_2O, or dexmedetomidine. To analyze the medical history of each patient, general summary information (the 200 table), treatments (the 300 table), and diagnoses (the 400 table) were extracted from the data warehouse containing information about medical treatments carried out between January 2007 and September 2019 [8]. The International Classification of Diseases (ICD)-10 codes of the 400 table were searched, and patients with ICD-10 codes for dementia (F00, F01, F02, F03, and G30) were selected. We investigated the presence or absence of diseases such as brain disorder, cerebral palsy, epilepsy, genetic disorder, psychosis, intellectual disability, and anxiety disorder that accompany dementia using ICD-10 codes. The total number of dental treatments (the 200 table) for patients with dementia was 153,051 (Table 1).

2. Grouping of GA, SED, and No GA or SED cases

The GA code (L121) and N_2O behavioral management code (U237) were searched in the medical service item (DIV_CD; treatment, medical materials, and drugs) of the treatment table (the 300 table) for each of the 153,051 cases. Cases with GA code were classified as cases of GA. Cases with the N_2O behavioral management code rather than the GA code, or with one or more of the eight sedatives listed above as a named generic drug (GNL_CD) in the treatment table (the 300 table), were classified as SED cases. All others were classified as no GA or SED cases, where neither GA nor SED was performed for dental treatment.

3. Yearly trend of patients with dementia by dental treatment

GA and SED, sex, age, and claim date were used as the information found in the general summary

Table 1. Total number of dental treatments in patients with dementia

		Cases	(%)	Number of patients	(%)
No SED or GA	Male	49076	32.07	1454	33.17
	Female	99064	64.73	2929	66.82
	total	148140	96.79	4383	100.00
SED	Male	528	0.34	473	10.79
	Female	987	0.64	885	20.19
	total	1515	0.98	1358	30.98
GA	Male	1119	0.73	993	22.65
	Female	2277	1.49	2057	46.93
	total	3396	2.22	3050	69.58
Total		153051		4383	

GA, general anesthesia; SED, sedation.

information table (the 200 table). All cases of dental treatment from January 2007 to September 2019 were categorized into the GA, SED, and no GA or SED groups. Sex data were used to estimate the sex ratio. To determine the annual changes, the number of cases of dental treatment per year was estimated, as was the number of SED or GA cases per year. The age of patients with dementia receiving dental treatment was analyzed per year.

4. Grouping patients with dementia by dental diagnosis

The main diagnosis requiring dental treatment was analyzed using general summary information (the 200 table). The names of the dental diagnoses were categorized into 40 groups based on the ICD-10 codes, and the frequency of each group was analyzed. Diagnosis according to frequency was analyzed, while the number of SED or GA cases upon dental treatment was calculated for each diagnosis type, and the percentages are presented as tables.

RESULTS

1. Total cases of dental treatments of patients with dementia

Between January 2007 and September 2019, a total of 4,383 (male, 1,454; female, 2,929) patients with dementia received dental treatment under SED or GA. The total

number of SED and GA cases were 1,515 (male, 528 ; female, 987) and 3,396 (male, 1,119 ; female, 2,277) cases, respectively. Table 1 shows the number of dental treatments and the number of patients according to the type of dental anesthesia (no SED or GA/SED/GA). From January 2007 to 13 years, the total number of cases of dental treatment for 4,383 patients with dementia was 153,051 cases, of which 2.22% were under GA and 0.98% were under SED. As the study design investigated the total number of cases of dental treatment in patients with dementia for 13 years in the diagnoses table (the 400 table), dental treatment prior to the onset of dementia was also included. Regarding the accompanying diseases of patients with dementia, brain lesions such as stroke or Parkinson's disease were 46.2%, psychosis 24.3%, anxiety disorder 14.9%, and epilepsy 2%.

2. Yearly trend of patients with dementia by dental treatments, GA or SED cases

Fig. 1 shows the total number of cases of SED and GA, and the ratio of SED, and GA compared to the total number of treatments. Although the ratio of SED, and GA compared to the total number of treatments was not high, the ratio of SED decreased, while the ratio of GA tended to increase progressively.

3. Changes in dental treatment cases according to year and age

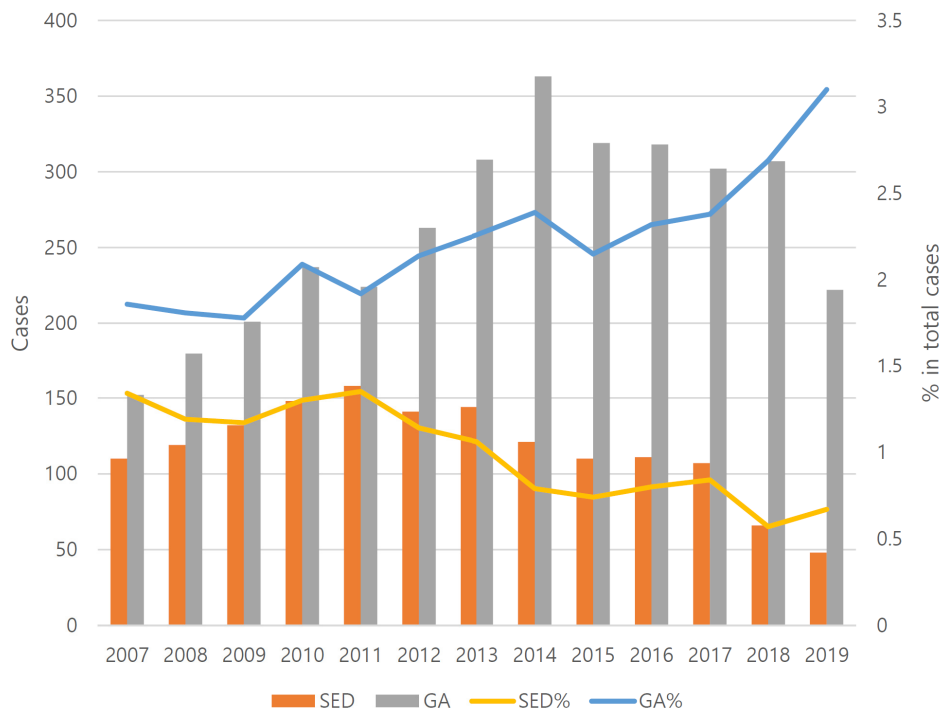Given that the age of the included patients increased

Fig. 1. Cases and percentage of dental treatments under GA for patients with dementia in each year show an increasing trend. However, SED cases show a decreasing trend. SED; sedation, GA; general anesthesia.

Table 2. Frequency of dental diagnosis in dementia patients

Diagnosis	No SED or GA		SED		GA		Total cases	
	Cases	(%)	Cases	(%)	Cases	(%)	Cases	% of total cases
Gingivitis	44146	98.9	279	0.6	202	0.4	44627	29.95
Pulpitis	32258	99	155	0.4	170	0.5	32583	21.86
Not specified	16101	90.1	388	2.1	1372	7.6	17861	11.99
Exfoliation of teeth	16218	98.8	112	0.6	73	0.4	16403	11.01
Dental caries	9908	98.4	62	0.6	94	0.9	10064	6.75
Stomatitis	4635	93.8	138	2.7	164	3.3	4937	3.31
Fracture of tooth	2673	86.1	51	1.6	377	12.1	3101	2.08
Abrasion of teeth	2980	99.2	9	0.2	14	0.4	3003	2.02
Malocclusion	2195	96.3	36	1.5	47	2	2278	1.53
Malignant neoplasm of cheek mucosa	1695	93.1	27	1.4	97	5.3	1819	1.22
Dental cyst	1461	87.9	36	2.1	164	9.8	1661	1.11
Malignant neoplasm of gum	1326	95.2	3	0.2	63	4.5	1392	0.93
Benign neoplasm of craniofacial bones	999	85.4	14	1.1	156	13.3	1169	0.78
Osteonecrosis due to drugs	1066	91.2	27	2.3	75	6.4	1168	0.78
Impacted teeth	962	96	17	1.6	23	2.2	1002	0.67
Gingival recession or enlargement	740	96.4	17	2.2	10	1.3	767	0.51
Malignant neoplasm of tongue	643	92.6	8	1.1	43	6.1	694	0.47
Chronic maxillary sinusitis	530	87.8	17	2.8	56	9.2	603	0.4
Benign neoplasm of other parts of oropharynx	480	86.6	30	5.4	44	7.9	554	0.37
Diseases of salivary glands	385	92.5	7	1.6	24	5.7	416	0.28

GA, general anesthesia; SED, sedation.

and the number of new patients that added every year was not large, the number of patients aged 60–70 years gradually decreased as the year increased, and the number of patients aged 70–80 years increased until 2014 and
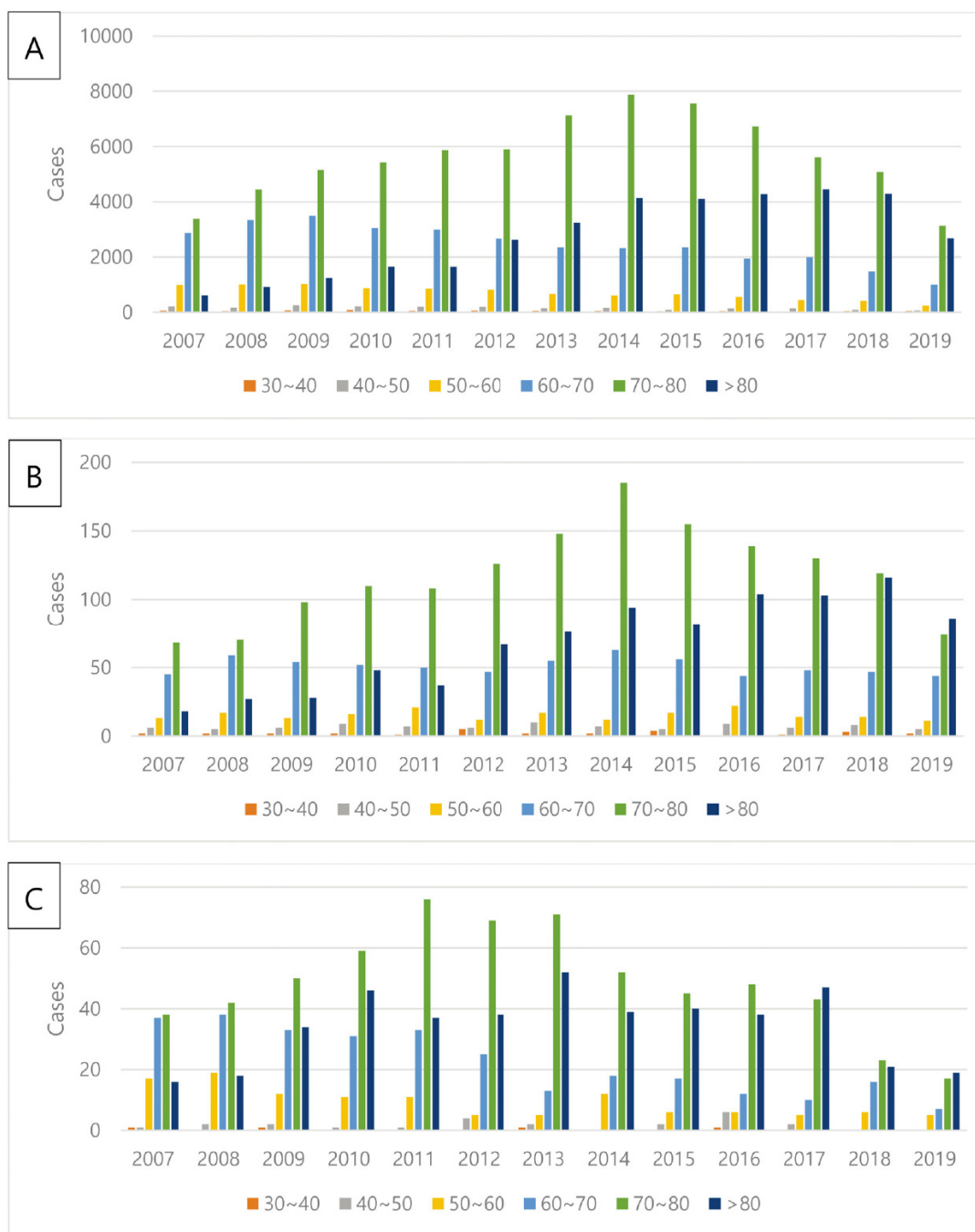
Fig. 2. Trend in dental treatment cases changes according to year and age. A: total cases, B: general anesthesia cases, C: sedation cases.

subsequently decreased, while the number of patients in the more than 80 years group showed an increasing trend (Fig. 2A). In cases under GA, there were several patients aged 70–80 years until 2014, but after that, the increase in patients aged over 80 years old was remarkable (Fig. 2B). The number of cases under SED has shown a decreasing trend since 2011 (Fig. 2C).

4. Frequency of dental diagnosis in patients with dementia

The most common reasons for visiting the dentist were gingivitis, pulpitis, exfoliation of teeth, and dental caries (Table 2). GA and SED have been widely used in oral and periodontal surgeries.
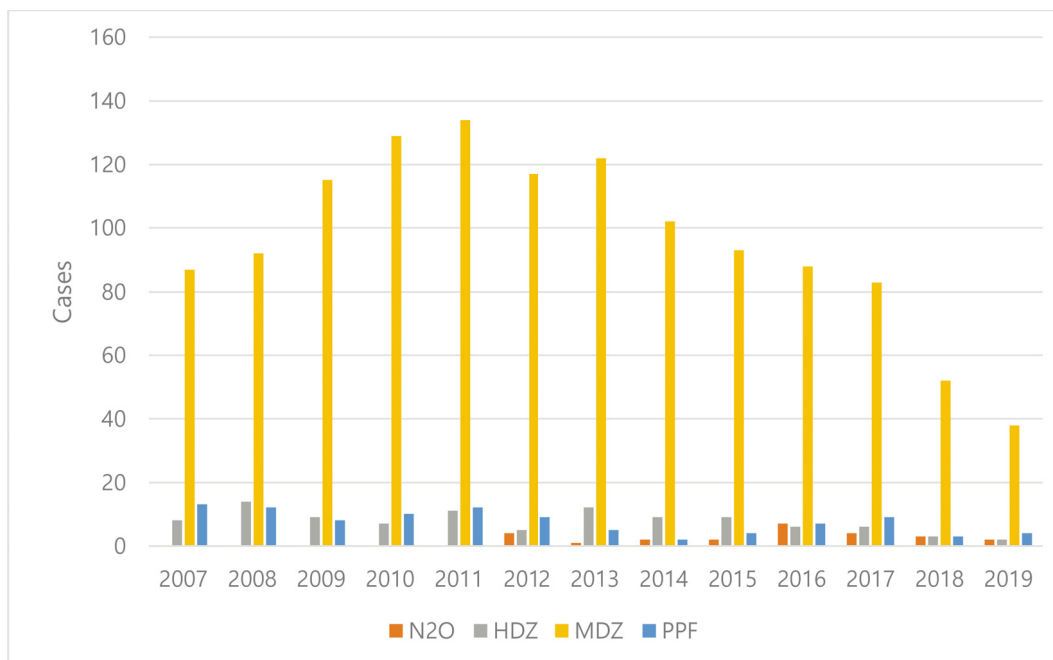
Fig. 3. Midazolam was the most commonly used for sedation. HDZ; hydroxyzine, MDZ; midazolam, N$_2$O; nitrous oxide, PPF; propofol.

5. Annual changes in sedative use and SED method

Midazolam is mainly used as a drug for SED, and the use of sedatives such as propofol and nitrous oxide (N$_2$O), which are generally used for dental treatment, is small. In addition, as the year increased, the application of the SED decreased (Fig. 3).

DISCUSSION

The prevalence of dementia is high in women, and two-thirds of all patients with dementia are women [4]. Regarding the dental claims data of patients with dementia, the proportion of women was twice that of men in almost all items (Table 1). Dementia is commonly attributed to AD (25%–75%), vascular dementia (20%–30%), frontotemporal dementia, and dementia with Lewy bodies (<5%) [9]. In this study, the dementia codes recorded in the diagnosis table (the 400 table) were searched including data for 13 years. Since one person has codes for various diseases and most of the codes for other accompanying brain diseases are included, it is difficult to determine the exact cause. According to a study on the hospital use of patients with dementia in Korea, 86.1% of patients who used the hospital for dementia in 2016 were reported to have AD [4]; therefore, it is reasonable to assume that more than 80% of the patients included in this study had AD.

AD mainly affects people over the age of 60 years, and its prevalence is known to increase with age, affecting 10% of people over 65 years and approximately 50% of people over 85 years [2]. Although it is rare, it can occur even at a young age due to genetic factors [3]. The number of patients started to increase after the age of 50 years, and the number of patients in their 70s was the highest (Fig. 2).

AD can be divided into seven stages according to severity. For example, a stage 5 patient cannot recognize or identify familiar objects such as toothbrushes and cannot skillfully and intentionally manipulate them [10]. Patients with stage 7 may have no or incomprehensible speech and may have dysphasia. Since this disease usually develops after the age of 60 years, most patients have other underlying diseases. As AD progresses, these underlying diseases progressively worsen and are

sometimes accompanied by aspiration pneumonia due to dysphagia. Xerostomia, dysphagia, and decreased interest in eating cause nutritional deficiencies in patients with AD. As AD progresses, the patient's cognitive abilities gradually decline. Therefore, oral care itself becomes impossible as the patient does not remove the dentures and does not brush their teeth [10].

It is well known that a decrease in salivation with increasing age is unfavorable for oral health management. However, in patients with AD, although the cause remains unclear, a decrease in salivation limited to the submandibular gland has been observed [11-13]. Hyposalivation in patients with AD can cause gingivitis, periodontal disease, and dental caries [14]. regarding the results of this study, the most common cause of dental treatment in patients with dementia visiting the dentist was gingivitis, followed by pulpitis, tooth loss, caries, and stomatitis (Table 2). Fracture of the tooth, which accounts for approximately 2%, may have occurred as a result of trauma caused by the patient's increased aggression and ataxia. Abrasion of the teeth and malocclusion are thought to be caused by tardive dyskinesia.

Several drugs used to treat AD can cause various adverse effects. Atypical antipsychotic agents (olanzapine, quetiapine, risperidone, ziprasidone) used to treat delusions, hallucinations, and agitation in patients with AD have anticholinergic effects that cause xerostomia, parageusia, and stomatitis [15]. In addition, these drugs tend to cause dysphagia. Carbamazepine and divalproex sodium are known to induce xerostomia and glossitis. Selective serotonin reuptake inhibitors antidepressants such as citalopram, fluoxetine, paroxetine, and sertraline are prescribed to improve mood and reduce agitation and aggression of the patient [16], These drugs also cause side effects such as tremor and dry mouth. Tricyclic antidepressants (TCAs), such as nortriptyline and desipramine, used for antianxiety effects also induce dry mouth as a peripheral anticholinergic side effect.

In patients with dementia, the longer the duration of illness, the more severe the level of disability, and the inability to perform sufficient oral hygiene on their own,

making them more susceptible to caries or periodontal disease [17]. In addition, when oral problems occur, it is difficult to complain of symptoms, and even if the patient visits the dentist, it is difficult to communicate properly with the dentist, making effective treatment challenging [18].

When the symptoms of patients with dementia become very severe that it is difficult to cooperate with the dentist, dental treatment under SED or GA is necessary for effective dental treatment [7, 19]. In the case of SED or GA, treatment is performed in a state in which the patient's movement is reduced or eliminated to ensure that high-quality dental treatment can be provided regardless of the patient's level of cooperation. In addition, since the treatment time per treatment is prolonged and the amount of treatment is relatively increased, the total number of visits can be reduced. Moreover, it helps to induce a positive attitude toward dental treatment in the future because treatment is carried out in a state where consciousness is suppressed, and thus, does not cause a bad experience [20].

As patients with dementia have many comorbidities in their old age, it can be a great challenge for anesthesiologists to perform GA in patients with dementia. In this study, GA cases tended to increase until about 2015; however, thereafter, the number of cases became stagnant (Fig. 2). This shows that dental treatment using GA and SED does not exceed 3%, and considering the results of other studies, dental treatment under GA or SED for patients with dementia is mainly focused on tooth extraction and caries treatment [7]. In the case of patients with attention deficit hyperactivity disorder (ADHD) published by the authors with the same study design as in this study, approximately 30% of the patients were treated for pulpitis using SED [8].

When using propofol in patients with dementia, it is difficult to use a lower concentration than in patients with other disabilities [21]. The use of dexmedetomidine in patients with dementia has also been reported to take a long time to recover, and complications such as hypoxia (SpO_2 <94%) 35%, apnea 7%, airway obstruction 5%

irrespective of the drug (propofol, midazolam, and dexmedetomidine) have also been reported [6]. Regarding the result of this study, midazolam was mostly used for SED because it can be used more safely than other drugs. However, it seems to be reluctant to use SED because of the high risk of complications, while it is difficult to obtain sufficient cooperation for the application to patients with dementia, and it can be observed that the use of GA during hospitalization is preferred.

In conclusion, the results of this study show the implementation trends of SED and GA in dental treatment for patients with dementia and can serve as basic data for future direction and research on dental treatment for patients with dementia.

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Seong In Chi: Writing – original draft
Hyuk Kim: Data curation, Resources
Kwang-Suk Seo: Conceptualization, Methodology, Writing – review & editing, Supervision

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