



# Trends in behavioral management techniques for dental treatment of patients with autism spectrum disorder: a 10-year retrospective analysis

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**Background:** Patients with autism spectrum disorder (ASD) present challenges in dental treatment cooperation owing to deficits in communication skills and social interaction. Behavioral guidance, sedation, and general anesthesia may be employed to ensure the quality of dental care for individuals with ASD. This study aimed to examine the trends in dental treatment for patients with ASD who visited the Department of Pediatric Dentistry at Dankook University Jukjeon Dental Hospital, an oral health center for the disabled in the Gyeonggi region, over the past 10 years.

**Methods:** This study utilized the order communication system to gather data on sex, age, cooperation level, number of quadrants treated, and administration of sedation or general anesthesia for patients with ASD who visited the Department of Pediatric Dentistry at Dankook University Jukjeon Dental Hospital between January 2013 and December 2022.

**Results:** The total number of patients with ASD increased annually, possibly due to an increase in ASD prevalence and the hospital's designation as a center for disabled oral health. General anesthesia was predominant before 2017, with a shift towards N<sub>2</sub>O-O<sub>2</sub> sedation. The most common age group for sedation or general anesthesia was 6–9 years, with a higher prevalence in males than in females. Notably, N<sub>2</sub>O-O<sub>2</sub> and midazolam sedation resulted in better cooperation and fewer treated teeth than general anesthesia.

**Conclusion:** This study highlights the evolving trends in dental treatment for individuals with ASD, indicating a shift towards outpatient methods, particularly N<sub>2</sub>O-O<sub>2</sub> sedation. The sex distribution aligns with national statistics, emphasizing a higher prevalence of ASD in males than in females. These findings underscore the need for further research to establish evidence-based guidelines for optimal dental care strategies tailored to the unique needs of individuals with ASD.

**Keywords:** Autism Spectrum Disorder; General Anesthesia; Pediatric Dentistry; Sedation.



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## INTRODUCTION

Autism spectrum disorder (ASD) is a neurodevelopmental condition that emerges within the first 3 years of life and is characterized by social interaction, communication

deficits, and restricted and repetitive behaviors [1]. Associated features include high sensitivity to stimuli, intellectual disabilities, and challenges in abstract thinking, language, and social understanding. Their communication skills are notably lower than those of their intellectual peers, with social proficiency below expectations.

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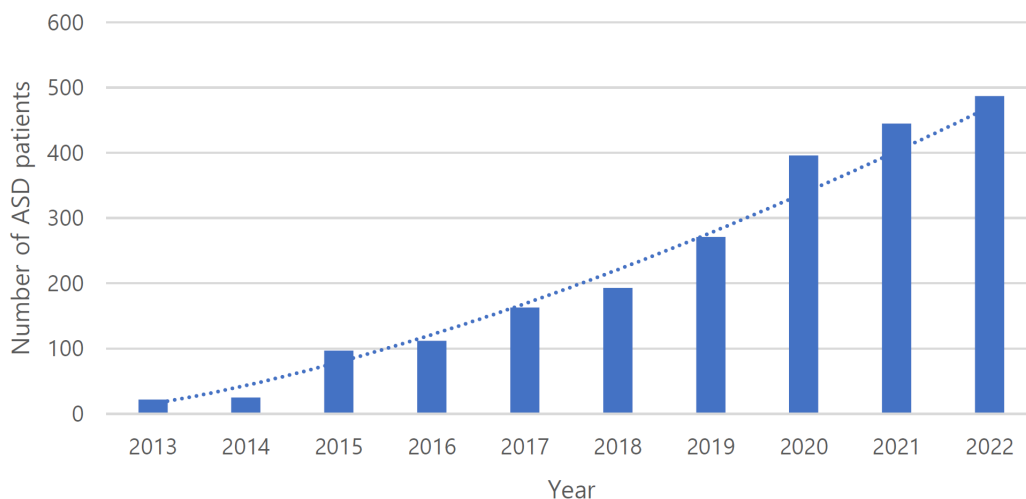


Fig. 1. Number of autism spectrum disorder patients by year

Individuals with ASD often exhibit limited interest in their social environment and may display tantrums, hyperactivity, aggression, and self-injurious behavior [2]. A previous study also reported the common comorbidities of epilepsy [3].

Individuals with ASD but without other developmental disorders tend to experience nonspecific oral symptoms. However, they may demonstrate self-injurious behaviors, such as gum picking or lip biting, and habitual oral damage, such as tooth grinding or object chewing [4]. Atypical oral habits and poor hand movements contribute to the challenges in maintaining good tooth brushing, which is often indicative of poor oral hygiene [5].

Owing to deficits in social interaction and communication skills, patients with ASD cooperate poorly during dental care. Thus, to ensure quality dental care, dental practitioners frequently employ behavioral guidance, sedation medications, and, in severe cases, general anesthesia [6]. However, only few studies have explored the use of sedation and general anesthesia in the dental care of patients with ASD. Thus, this study aimed to examine trends in the dental treatment of patients with ASD who visited the Department of Pediatric Dentistry at Dankook University Jukjeon Dental Hospital, an oral care center for people with disabilities in the Gyeonggi region, over the past 10 years.

## METHODS

This study was approved by the Institutional Review Board (IRB) of Dankook University Jukjeon Dental Hospital (IRB No. DKUJDH IRB 2402-001-001). Using a comprehensive medical information system (order communication system), this study included patients with ASD who visited the pediatric dentistry department of Jukjeon Dental Hospital, Dankook University College of Dentistry, between January 2013 and December 2022. Patient data, including sex, age, cooperation level, number of quadrants treated, and use of sedation or general anesthesia, were collected from patient charts. Patient cooperation was classified using Frankl's Behavior Rating Scale. Data were analyzed according to the number of procedures performed. The collected data were analyzed using Microsoft Excel 2010 (Microsoft Corp., Redmond, WA, USA).

## RESULTS

The number of visits per year by patients with ASD is shown in Figure 1. From 2013 to 2022, 2,211 patients visited the pediatric dentistry department at the Dankook University College of Dentistry Jukjeon Dental Hospital,

**Table 1.** Distribution of treatment for ASD patients by year

BM \ Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Total
General Anesthesia	8 (50%)	8 (38.1%)	10 (90.9%)	18 (94.7%)	16 (48.5%)	13 (30.2%)	33 (36.7%)	36 (42.8%)	36 (54.6%)	32 (45.7%)	210 (46.4%)
N <sub>2</sub> O-O <sub>2</sub>	0 (0.0%)	0 (0.0%)	1 (9.1%)	1 (5.3%)	17 (51.5%)	30 (69.8%)	48 (53.3%)	44 (52.4%)	29 (43.9%)	35 (50%)	205 (45.2%)
midazolam	8 (50%)	13 (61.9%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	9 (10%)	4 (4.8%)	1 (1.5%)	3 (4.3%)	38 (8.4%)
Total	16 (100%)	21 (100%)	11 (100%)	19 (100%)	33 (100%)	43 (100%)	90 (100%)	84 (100%)	66 (100%)	70 (100%)	453 (100%)

Abbreviations: ASD, autism spectrum disorder; BM, Behavior management; N<sub>2</sub>O-O<sub>2</sub>, Nitrous oxide/oxygen.

**Table 2.** Distribution of treatment by ASD patients' behavior

BM \ FBRs	1(-)	2(-)	3(+)	4(++)	Total
General Anesthesia	163 (77.6%)	40 (19.1%)	4 (1.9%)	3 (1.4%)	210 (100%)
N <sub>2</sub> O-O <sub>2</sub>	103 (50.2%)	66 (32.2%)	34 (16.6%)	2 (1.0%)	205 (100%)
midazolam	14 (36.9%)	17 (44.7%)	7 (18.4%)	0 (0.0%)	38 (100%)

Abbreviations: ASD, autism spectrum disorder; BM, Behavior management; FBRs, Frankl's behavior rating scale; N<sub>2</sub>O-O<sub>2</sub>, Nitrous oxide/oxygen.

1(-): Definitely negative by Frankl's behavior rating scale

2(-): Negative by Frankl's behavior rating scale

3(+): Positive by Frankl's behavior rating scale

4(++): Definitely positive by Frankl's behavior rating scale

**Table 3.** Distribution of treatment for ASD patients by age

BM \ Age	< 6 years	6-9 years	≥ 9 years	Total
General Anesthesia	37 (17.6%)	123 (58.6%)	50 (23.8%)	210 (100%)
N <sub>2</sub> O-O <sub>2</sub>	27 (13.2%)	135 (65.8%)	43 (21.0%)	205 (100%)
midazolam	22 (57.9%)	12 (31.6%)	4 (10.5%)	38 (100%)
Total	86 (19%)	270 (59.6%)	97 (21.4%)	453 (100%)

Abbreviations: ASD, autism spectrum disorder; BM, Behavior management; N<sub>2</sub>O-O<sub>2</sub>, Nitrous oxide/oxygen.

showing an increasing trend annually.

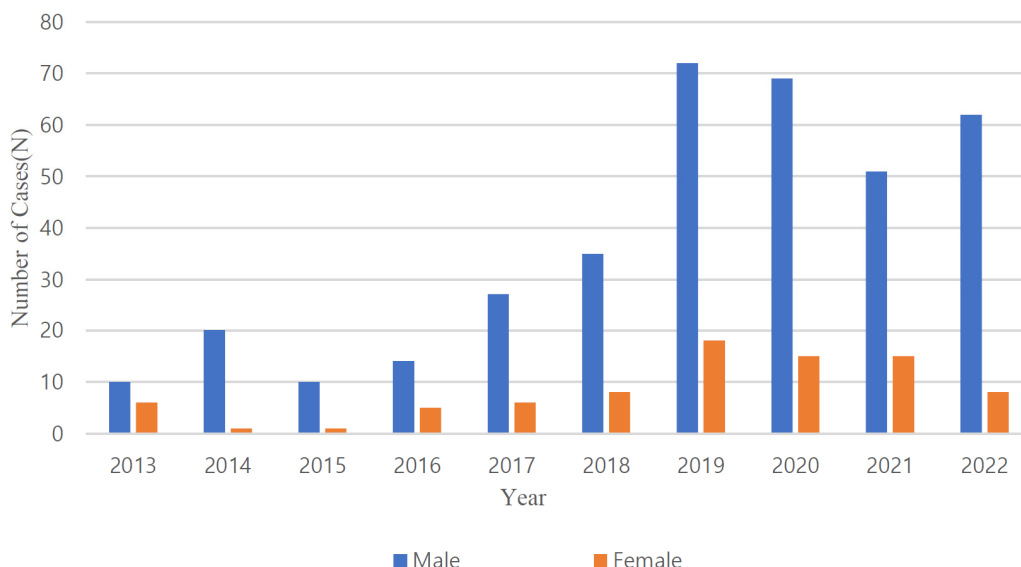
For the behavioral control of patients with ASD, the methods used by the Department of Pediatric Dentistry at the study hospital were mainly divided into outpatient methods and general anesthesia. Outpatient behavioral control methods included physical behavioral control using pedi-wrap, nitrous oxide/oxygen (N<sub>2</sub>O-O<sub>2</sub>) inhalation sedation, and intramuscular sedation with midazolam. The distribution of treatments by year for patients with ASD is shown in Table 1. In 2013, an even

distribution was observed between cases conducted under general anesthesia (50%, n = 8) and those conducted under midazolam sedation (50%, n = 8), whereas no instances (0%) utilized N<sub>2</sub>O-O<sub>2</sub> sedation. In 2014, a notable change occurred with the prevalence of midazolam sedation, surpassing that of general anesthesia. Specifically, 38.1% (n = 8) of the procedures were performed under general anesthesia, whereas the majority (n = 13, 61.9%) opted for midazolam sedation. Notably, N<sub>2</sub>O-O<sub>2</sub> sedation was not used in either year.

**Table 4.** Distribution of treatment for ASD patients by quadrant

BM	Quadrant				Total
	1/4 quadrant	2/4 quadrant	3/4 quadrant	4/4 quadrant	
General Anesthesia	15 (7.1%)	15 (7.1%)	16 (7.7%)	164 (78.1%)	210 (100%)
N <sub>2</sub> O-O <sub>2</sub>	143 (69.8%)	48 (23.4%)	12 (5.8%)	2 (1.0%)	205 (100%)
midazolam	9 (23.6%)	24 (63.2%)	5 (13.2%)	0 (0.0%)	38 (100%)

Abbreviations: ASD, autism spectrum disorder; BM, Behavior management; N<sub>2</sub>O-O<sub>2</sub>, Nitrous oxide/oxygen.

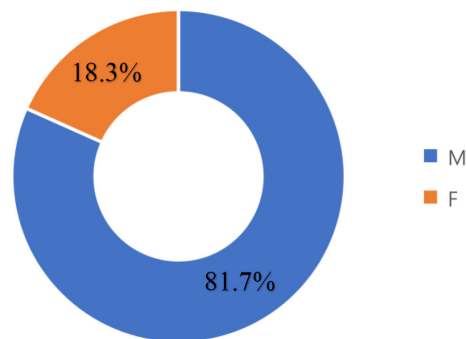


**Fig. 2.** Gender distribution of autism spectrum disorder patients by year

In 2015 and 2016, the rate of general anesthesia was the highest, and from 2017 onward, except for 2021, N<sub>2</sub>O-O<sub>2</sub> sedation accounted for more than half of the cases.

The distribution of treatments based on the behavioral rating scale for patients with ASD is presented in Table 2. Among the patients treated under general anesthesia, 77.6% of those with a Frankl’s behavior rating of grade 1 demonstrated the highest level of cooperation. For patients treated under N<sub>2</sub>O-O<sub>2</sub> sedation, 50.2% of those with Frankl’s behavior rating of grade 1 had the highest cooperation level, followed by those with grades 2, 3, and 4, in descending order. Among patients treated under midazolam sedation, 44.7% of those with Frankl’s behavior rating of grade 2 had the highest cooperation levels, with grade 1 closely following at 36.9%.

The distribution of treatments for patients with ASD according to age is shown in Table 3. In all cases, the



**Fig. 3.** Gender ratio of autism spectrum disorder patients

rates of general anesthesia, N<sub>2</sub>O-O<sub>2</sub> sedation, and midazolam sedation were the highest for those aged 6–9 years and lowest for those aged < 6 years.

The distribution of quadrant-specific treatments for patients with ASD is shown in Table 4. The proportion of treatments involving all four quadrants was the highest for general anesthesia, whereas for the 1- and 2-quadrant

treatments, N<sub>2</sub>O-O<sub>2</sub> sedation and midazolam sedation recorded the highest rates, respectively.

The sex distribution of patients with ASD treated under general anesthesia or sedation showed a predominance of males over females in each year (Fig. 2). There were 81.7% males and 18.3% females, with males outnumbering females by approximately 4:1 (Fig. 3).

## DISCUSSION

A total of 2,211 patients with ASD visited the Department of Pediatric Dentistry at Dankook University College of Dentistry, Jukjeon Dental Hospital over 11 years, with an increasing trend annually. An increase in the number of patients with ASD may be one of the reasons behind this trend. According to the results of the 2021 Developmental Disabilities Survey conducted by the Ministry of Health and Welfare, 3.2 million people in Korea have ASD, an increase of approximately 17,000 compared with 1.5 million in 2010, showing a continuous upward trend [7]. Second, Jukjeon Dental Hospital of Dankook University College of Dentistry was designated as the Gyeonggi-do Oral Health Center for the Disabled in 2012 by the Ministry of Health and Welfare. Being designated as an oral health center for individuals with disabilities, the facility has augmented its capacity to accommodate those in need of sedation or general anesthesia through improvements in the treatment environment and medical staff reinforcement [8]. Increased awareness of dental treatment for individuals with disabilities, driven by various promotional initiatives and government support for treatment costs, is evident in the growing number of patients seeking dental care in hospitals. The largest increase was observed in 2020, with an increase of 40% from the previous year. In general, the number of patient visits tended to decrease because of the coronavirus pandemic in 2020. However, in this study, the number of ASD cases increased, which is believed to be due to the influx of patients into the clinic, as neighboring dental clinics that accepted people

with disabilities stopped treating them because of the coronavirus pandemic [9].

Analysis of treatment distribution in patients with ASD revealed a discernible shift. General anesthesia was predominant before 2017, with N<sub>2</sub>O-O<sub>2</sub> sedation emerging as the primary modality thereafter, except in 2021. The number of cases treated under general anesthesia, N<sub>2</sub>O-O<sub>2</sub> sedation, and midazolam sedation nearly doubled after 2019, possibly reflecting an increase in the number of medical staff. General anesthesia accounted for the largest share (46.4%) of all treatments over the decade. Comparing these findings with national statistics from the Ministry of Health and Welfare, 47.2% of patients with intellectual disabilities, 19.2% with ASD, and 14.2% with brain lesions were treated under general anesthesia in 2019, underscoring the importance of general anesthesia in the dental care of patients with ASD [10]. Dental treatment under general anesthesia is lauded for its efficiency, enabling comprehensive procedures in a single session and serving as a strategic behavioral modification approach for managing patients with disabilities [11].

However, communication is impossible in 11.4% of patients with ASD; thus, behavioral management and sedation techniques during dental treatment are desired [10,12]. Despite the variety of management techniques, the main techniques used for patients with ASD at the Jukjeon Dental Hospital of Dankook University College of Dentistry are tell-show-do and distraction techniques. The tell-show-do technique involves directly discussing, showing, and allowing patients to enact situations that may occur before treatment, whereas distraction techniques involve diverting attention during dental treatment by counting numbers or watching videos. Applying behavioral management and sedation techniques simultaneously can reduce anxiety regarding dental treatments [13]. N<sub>2</sub>O-O<sub>2</sub> sedation, with advantages, such as reduced exposure to general anesthesia risks and cost-effectiveness, can be safely and effectively employed by trained non-anesthesia specialists. Similar to the study by Tak and Park, the present study showed a trend toward an increased use of N<sub>2</sub>O-O<sub>2</sub> sedation [14,15]. This can

be attributed to the preference for relatively safe N<sub>2</sub>O-O<sub>2</sub> sedation and the burden of repeated general anesthesia. In Faulks' study, the success rate of N<sub>2</sub>O-O<sub>2</sub> sedation in patients with intellectual disabilities, including those with autism symptoms, was relatively low, but still showed a high success rate of 87.5% [16]. According to Mangione, although adults with ASD often undergo surgery under general anesthesia, N<sub>2</sub>O-O<sub>2</sub> sedation is highly effective in children [12]. Based on these results, N<sub>2</sub>O-O<sub>2</sub> sedation was employed in a proportion of patients with ASD, similar to general anesthesia, and patients who underwent N<sub>2</sub>O-O<sub>2</sub> sedation or midazolam sedation showed excellent cooperation and fewer treated teeth. Therefore, in patients with ASD, particularly those who cooperate well and have a small number of treated teeth, N<sub>2</sub>O-O<sub>2</sub> sedation can be attempted instead of general anesthesia.

General anesthesia, N<sub>2</sub>O-O<sub>2</sub> sedation, and midazolam sedation were the most commonly employed in patients aged 6–9 years and least commonly employed in those aged < 6 years. This may be because private dental clinics can afford to try physical methods of behavioral induction, such as protective restraints, in patients aged < 6 years; however, as patients get older, they are more likely to be referred to tertiary hospitals because they are more likely to require medication-based sedation. The eruption of the first molars around the age of 6 may also be a contributing factor, increasing the risk of caries and consequently amplifying the demand for treatment [17].

The annual incidence of ASD is higher in men than in women, with total incidences of approximately 81.7% and 18.3%, respectively. According to the 2021 Developmental Disabilities Survey conducted by the Ministry of Health and Welfare, 84% of men and 16% of women with ASD are registered under the Disability Welfare Act, which is similar to the results of this study [7]. This was similar to the 4:1 ratio reported by Baird et al. and Loo et al. [6,18].

In the realm of dental treatment for patients with ASD, decisions regarding behavioral control, sedation, or general anesthesia should hinge on the severity of the

autism, cooperation levels, caries status, treatment frequency, duration of each visit, and patient age [19]. However, the lack of research supporting specific indications for these choices underscores the need for further investigation in this field. Future research should strive to elucidate evidence-based guidelines to optimize dental care strategies for individuals with ASD.

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**Jongbin Kim:** Conceptualization

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**Miran Han:** Conceptualization

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#### REFERENCES

1. Lord C, Elsabbagh M, Baird G, Veenstra-Vanderweele J. Autism spectrum disorder. *Lancet* 2018; 392: 508-20.
2. Nazeer A, Ghaziuddin M. Autism spectrum disorders: clinical features and diagnosis. *Pediatr Clin North Am* 2012; 59: 19-25.
3. Kwon CS, Wirrell EC, Jetté N. Autism spectrum disorder and epilepsy. *Neurol Clin* 2022; 40: 831-47.

4. Bagattoni S, Lardani L, D'Alessandro G, Piana G. Oral health status of Italian children with autism spectrum disorder. *Eur J Paediatr Dent* 2021; 22: 243-7.
5. Jaber MA. Dental caries experience, oral health status and treatment needs of dental patients with autism. *J Appl Oral Sci* 2011; 19: 212-7.
6. Loo CY, Graham RM, Hughes CV. Behaviour guidance in dental treatment of patients with autism spectrum disorder. *Int J Paediatr Dent* 2009; 19: 390-8.
7. Ministry of Health and Welfare. Survey on the status of people with developmental disabilities in 2021. Ministry of Health and Welfare, 2022.
8. Huh J, Lee HG, Cheong J, Lee B, Jung HI. The current status and the future directions of dental services for disabled people. *J Korean Acad Adv Gen Dent* 2020; 9: 71-6.
9. Lee GY, Jeon JE. Factors affecting COVID-19 economic loss to dental institutions : application of multilevel analysis. *J Korean Dent Assoc* 2020; 58: 627-38.
10. Ministry of Health and Welfare. A study on the critical pathway of dental treatment for the persons with special needs. Ministry of Health and Welfare, 2020.
11. Arapovic LL, Karlovic Z, Brzovic VR, Bukvic A, Coric A, Vukojevic K, et al. Dental treatment for special needs patients under general anaesthesia: a 14-year experience from south Bosnia and Herzegovina. *Acta Med Okayama* 2021; 75: 261-8.
12. Mangione F, Bdeoui F, Monnier-Da Costa A, Dursun E. Autistic patients: a retrospective study on their dental needs and the behavioral approach. *Clin Oral Investig* 2020; 24: 1677-85.
13. Korean academy of pediatric dentistry. Korean guideline of pediatric procedural sedation. Korean academy of pediatric dentistry, 2017.
14. Tak M, Kim J, Yang Y, Lee D. Trends in dental sedation of Korean children and adolescents. *J Korean Acad Pediatr Dent* 2021; 48: 313-23.
15. Park S, Kim J, Kim J, Lee J, Han M, Shin J. Trends of conscious sedation in the department of pediatric dentistry at the Dankook University dental hospital for 11 years. *J Dent Anesth Pain Med* 2023; 23: 265-71.
16. Faulks D, Hennequin M, Albecker-Grappe S, Manière MC, Tardieu C, Berthet A, et al. Sedation with 50% nitrous oxide/oxygen for outpatient dental treatment in individuals with intellectual disability. *Dev Med Child Neurol* 2007; 49: 621-5.
17. Lee K. The cariological, epidemiologic considerations and prevention of dental caries of the first molar. *Korea Dent Assoc* 1997; 35: 943-5.
18. Baird G, Simonoff E, Pickles A, Chandler S, Loucas T, Meldrum D, et al. Prevalence of disorders of the autism spectrum in a population cohort of children in south Thames: the special needs and autism project (SNAP). *Lancet* 2006; 368: 210-5.
19. Chang CR, Kim JH. Behavior management technique for autistic children. *J Korean Acad Pediatr Dent* 2011; 38: 181-6.