Original Article

A retrospective comparison of dental treatment under general anesthesia versus non-pharmacological approach in patients with special health care needs

Pornpailin Kasemkhun*, Apiwan Smutkeeree, Varangkanar Jirarattanasopha

Department of Pediatric Dentistry, Faculty of Dentistry, Mahidol University, Bangkok, Thailand

Received 25 October 2021; Final revision received 29 November 2021
Available online 12 December 2021

KEYWORDS
Dental treatment; General anesthesia; Non-pharmacological; Special health care needs

Abstract  Background/purpose: The unmet dental needs are still at the highest rate in patients with special health care needs (SHCN) owing to their physical conditions, lack of cooperation, anxiety and dental fear. This study was aimed to investigate the differences in characteristics and outcomes of dental treatment between general anesthesia (GA) and non-pharmacological approach (NP) in patients with SHCN.

Materials and methods: This study reviewed the dental chart records of SHCN patients from 2005 to 2019. The dental chart records were divided into two subgroups: GA and NP groups. The demographic data, recall behavior and treatment outcomes were analyzed and compared between groups. The comparisons between groups were analyzed by Pearson’s chi-squared test, Fisher’s exact test and Mann–Whitney U test at a significant level of 0.05.

Results: Two hundred and sixty-one patients aged 2.2 ± 43.1 years with mean age 14.2 ± 8.64 years old were included. The proportion of cases treated under GA (62%) and NP (38%) was 1.6:1. General anesthesia group had significantly higher in mean ages, caries experience, definitely negative behavior and treatment needs than NP group (P < 0.001). Moreover, recall rates in GA group were significantly lower than NP group (P < 0.001) without a significant difference in regularity. New caries occurrence (P = 0.015) with faster rate (P = 0.035), and behavior changes was significantly found in GA group (P = 0.007) after 24 months of recall.

Conclusion: Patients with SHCN who were at older age and had high caries experience, definitely negative behavior and numerous treatment needs were more justifiably for GA.
Introduction

Special health care needs (SHCN) are people that live with some form of disability; physical, developmental, behavioral, sensory, and intellectual disabilities, or any limiting conditions that could be barriers in performing daily life routines and most of activities in a normal way. According to those limitations, patients with SHCN have undeniably faced with some medical and oral health problems throughout their lifetime and that exceedingly affects the quality of life. Patients with SHCN are more at increased risk of caries, likely to have poorer oral hygiene and periodontal status in consequence of inadequate oral health care, diet problems, insufficient fluoride exposure, malocclusion, enamel defect and so on. However, the unmet dental needs are still at the highest rate in this group of patients owing to their limitations in cooperation, higher level of anxiety and dental fear. Therefore, using the appropriate behavior management techniques in dental treatment has played an important role for pediatric dentist in order to perform the procedures with effective treatment outcomes.

Generally, there are two alternative behavior management approaches in treating SHCN patients. In routine dental setting, non-pharmacological approach (NP) such as Tell-show-do, positive reinforcement and desensitization can be used in patients who have quite high cognitive functions, whereas physical restraint is more effective for patients who have resistant behavior, despite the use will be limited when patients physically grow bigger and/or have extremely resistant behavior. The alternative behavior management is pharmacological approach that have been used when patients cannot undergo the dental treatment under routine dental setting. General anesthesia (GA) is the most frequently used technique because it can provide reliable and effective outcomes as it could allow all required treatments done in one visit. Nonetheless, GA requires carefully concerns in pre-operative assessments and reveals some disadvantages such as high cost, intra- and postoperative complications, and hospital-based setting is required.

Most of the previous studies have focused on differences in comprehensive dental treatment under GA between SHCN patients and healthy uncooperative children. To our knowledge, there is limited study focusing on SHCN patients with different behavior management approaches. Thus, this study is aimed to investigate the differences in characteristics and outcomes of dental treatment under GA and NP approach in patients with SHCN.

Materials and methods

Ethical considerations

The retrospective analysis of dental chart records of SHCN patients at Pediatric dental clinic, Faculty of Dentistry, Mahidol University between January 2005 and December 2019 (14 years) was approved by The Ethics Committee of Mahidol University, Thailand (MU-DT/PY-IRB 2021/DT002).

Data collection

The data were reviewed and collected by a single pediatric dentist. Before the assessment of all dental chart records, 10% of the dental chart records were randomly reviewed to evaluate the intra-examiner reliability which was considered as good (Kappa values was 0.77) before the study began.

Patients with SHCN who were at any ages and had at least one disability from these categories; behavioral, developmental, intellectual, physical and sensory, were included as the study population. Moreover, they had to complete comprehensive treatment either under GA or NP approach by pediatric dental residents. The records clearly revealed demographic data; age, gender, residency area, type of disability, dental conditions; the simplified oral hygiene index (OHI-S) using Greene–Vermillion index, the decayed-missing-filled teeth in both primary and permanent dentitions (dmft/DMFT), behavior level (Frankl scores), treatment needs, recall behavior and treatment outcomes. Patients with SHCN who had incomplete comprehensive dental treatment were excluded. The subjects were divided into two groups according to behavior management approach; GA versus NP.

In GA group, the preoperative assessments were carefully and individually considered for both physical and mental status to be assured that patients met the GA indication criteria. The standard comprehensive dental treatment under GA were performed by the anesthesiologist and pediatric dental residents in one visit under supervision of highly experienced pediatric dentist of Faculty of Dentistry, Mahidol University, Bangkok, Thailand. All GA patients were arranged an appointment for a week later for close follow-up after GA and also made routine recalls in accordance to their caries risk level.

In NP group, the standard oral examination, preoperative assessment of physical and mental status was also performed by pediatric dental resident under supervision of
highly experienced pediatric dentist of Faculty of Dentistry, Mahidol University, Bangkok, Thailand to assure that the patients were appropriate to have comprehensive dental treatment in routine dental setting using NP approach; both basic (tell-show-do, positive reinforcement, distraction and desensitization) and advanced (protective stabilization) behavior guidance. Patients were recalled according to their caries risk level after completed the comprehensive treatment.

Subjects in both groups received a caries risk-based preventive program individually; oral hygiene instructions, diet counseling and professional fluoride since in the first visit, then remotivated and emphasized in every single visit. Recall behavior; number and regularity of recalls (<6 months = regular and >6 months = irregular) as well as treatment outcomes; failure of treatments, new caries detected, and changes (last recall visit - baseline) in OHI–S and Frankl behavior level were collected in both groups.

**Statistical analysis**

Descriptive statistics were calculated and reported as frequencies and mean ± standard deviation. Comparisons between GA and NP group were analyzed by Pearson’s chi-squared test, Fisher’s exact test and Mann—Whitney U test (non-normal data distribution) at a significant level of 0.05. All data analyzed using SPSS (version 23.0. IBM, Armonk, NY, USA).

**Results**

Four hundred and seven dental chart records were reviewed and 146 of them were excluded due to incomplete comprehensive treatment. Thus, a total of 261 cases were included in this study. There were 162 cases (62%) in GA group and 99 cases (38%) in NP group. The flow chart of subject recruitment in the study is shown in Fig. 1. The mean age of GA group was significantly greater than NP group (*P* = 0.027); 15.51 ± 9.57 and 12.11 ± 6.35 with a range from 3 to 43.1 and 2.2 to 31.2 years respectively. The number of male patients was almost two times higher than female patients and the gender ratios were similar in both groups as shown in Table 1. The data showed the highest number of cases with developmental disability (80.1%) without significant difference in type of disability between two groups (*P* > 0.05). The mean decayed, missing, filled teeth of both primary and permanent dentition (dmft/ dMFT) or caries experience were significantly higher in GA group (*P* < 0.001). Poor level of OHI–S index was found the most in both groups but there was no significant difference in percent ratio of OHI–S index level among groups (*P* > 0.05). There were significantly higher number of cases with definitely negative behavior in GA group, whereas NP group had higher number of cases with definitely positive behavior (*P* < 0.001). All performed treatment procedures were significantly higher in GA group (*P* < 0.001) except for pulp therapy.

In GA group, there were 136 cases (84%) that presented at 1-week recall after treatment then 121 cases (74.7%) continued their recalls in routine dental setting (Fig. 1), which were significantly lower than 96 cases (97%) of NP group (*P* < 0.001). When categorized recall behavior as regularity, there was no significant difference between two groups (*P* > 0.05) as shown in Table 2.

Treatment outcomes after 24 months of recall were presented in Table 3. The number of stainless steel crown dislodgement significantly higher in GA group (*P* = 0.014). A significant occurrence of new caries (*P* = 0.015) and the mean elapsed time that caries had been first detected after completed the comprehensive treatment were shorter in GA group (*P* = 0.035) without association in regularity of recall (*P* > 0.05). The OHI–S index improvement showed no differences between two groups, while improvement in behavior was observed in GA group significantly (*P* = 0.007).

**Discussion**

This is the first study that revealed the information about characteristics and outcomes of dental treatment in patients with SHCN between general anesthesia and non-

---

![Figure 1](image.png)  
**Figure 1** Flow of case recruitment.
pharmacological behavior management approaches. It was found that almost two third of our study population (62%) received dental treatment under GA, while only 38% were able to undergo the routine dental setting with NP approach. The reason could be that our dental hospital is one of the main referral center due to the full facilities with multidisciplinary team, thus most SHCN cases that has been referred are purposefully referred for GA. Referring to the significantly higher mean ages, higher number of cases that presented with definitely negative behavior and distinctly high dmft/DMFT of both primary and permanent dentitions in GA group, it may imply that patients who have sought for their dental treatment at older age tend to have more severe caries experience and negative behavior, which lead them to more invasive behavior approach as GA. In other words, the reasons for dental treatment under GA were based on the level of the patient’s cooperation and

Table 1  Demographic data.

|                          | Total (N = 261) | General anesthesia (N = 162) | Non-pharmacological (N = 99) | P-value |
|--------------------------|-----------------|------------------------------|------------------------------|---------|
| **Age (Mean ± SD years)** | 14.22 ± 8.64    | 15.51 ± 9.57                 | 12.11 ± 6.35                 | 0.027   |
| Gender N (%)             |                 |                              |                              |         |
| Male                     | 169 (64.8)      | 107 (66.0)                   | 62 (62.6)                    | 0.574   |
| Female                   | 92 (35.2)       | 55 (34.0)                    | 37 (37.4)                    |         |
| Residency area N (%)     |                 |                              |                              |         |
| Bangkok & vicinity       | 232 (88.9)      | 140 (86.4)                   | 92 (92.9)                    | 0.104   |
| Up-country               | 29 (11.1)       | 22 (13.6)                    | 7 (7.1)                      |         |
| Type of disability N (%) |                 |                              |                              |         |
| Physical disability      | 54 (20.7)       | 36 (22.2)                    | 18 (18.2)                    | 0.434   |
| Developmental disability | 209 (80.1)      | 129 (79.6)                   | 80 (80.8)                    | 0.817   |
| Intellectual disability  | 34 (13.0)       | 25 (15.4)                    | 9 (9.1)                      | 0.140   |
| Sensory disability       | 13 (5.0)        | 8 (4.9)                      | 5 (5.1)                      | 1.000   |
| Behavioral disability    | 20 (7.7)        | 10 (6.2)                     | 10 (10.1)                    | 0.247   |
| **Caries experience (Mean ± SD case)** |           |                              |                              |         |
| Primary dentition        | 9.21 ± 5.85     | 11.9 ± 4.72                  | 5.75 ± 5.33                  | <0.001  |
| Permanent dentition      | 6.57 ± 6.17     | 8.3 ± 6.49                   | 3.41 ± 3.93                  | <0.001  |
| OHI–S index N (%)        |                 |                              |                              |         |
| Good                     | 21 (8.0)        | 11 (6.8)                     | 10 (10.1)                    | 0.619   |
| Fair                     | 83 (31.8)       | 53 (32.7)                    | 30 (30.3)                    |         |
| Poor                     | 157 (60.2)      | 98 (60.5)                    | 59 (59.6)                    |         |
| Frankl behavior scores N (%) |              |                              |                              |         |
| Definitely negative (1)  | 130 (49.8)      | 107 (66)                     | 23 (23.2)                    | <0.001  |
| Negative (2)             | 76 (29.1)       | 39 (24.1)                    | 37 (37.4)                    |         |
| Positive (3)             | 25 (9.6)        | 11 (6.8)                     | 14 (14.1)                    |         |
| Definitely positive (4)  | 30 (11.5)       | 5 (3.1)                      | 25 (25.3)                    |         |
| **Treatment needs**      |                 |                              |                              |         |
| Sealant                  | 165 (63.2)      | 118 (72.8)                   | 47 (47.5)                    | <0.001  |
| Filling                  | 179 (68.6)      | 131 (80.9)                   | 48 (48.5)                    | <0.001  |
| Stainless steel crown    | 80 (30.7)       | 66 (40.7)                    | 14 (14.1)                    | <0.001  |
| Pulp therapy             | 38 (14.6)       | 28 (17.3)                    | 10 (10.1)                    | 0.110   |
| Extraction (caries)      | 122 (46.7)      | 99 (61.1)                    | 23 (23.2)                    | <0.001  |
| Minor Surgery            | 53 (20.3)       | 50 (30.9)                    | 3 (3.0)                      | <0.001  |

SD: standard deviation; OHI–S: simplified oral hygiene index.

a The differences in mean age and caries experience were analyzed by the Mann–Whitney U test, whereas other demographic data were analyzed by the Pearson’s chi-squared and the Fisher’s exact test.

b Statistical significance (P < 0.05).

Table 2  Recall behavior.

|                          | General anesthesia (N = 162) | Non-pharmacological (N = 99) | P-value |
|--------------------------|-----------------------------|------------------------------|---------|
| Recall 1-week after GA   | 136 (84)                    |                              |         |
| Continued recall         | 121 (74.7)                  | 96 (97)                      | <0.001  |
| Regularity of recall     |                             |                              |         |
| Regular (≤6 months)      | 94 (77.7)                   | 68 (70.8)                    |         |
| Irregular (>6 months)    | 27 (22.3)                   | 28 (29.2)                    | 0.249   |

a Statistical significance (P < 0.05).
The differences in mean elapsed time of new caries occurrence were analyzed by the Mann–Whitney U test, whereas other treatment outcomes were analyzed by the Pearson’s chi-squared and the Fisher’s exact test.

Table 3: Outcomes of dental treatments at ≥ 24 months of recall.

| General anesthesia (N = 78) | Non-pharmacological (N = 70) | P-value |
|-----------------------------|-------------------------------|---------|
| **Failure of treatments**    |                               |         |
| Sealant loss                 | 28 (35.9)                     | 15 (21.4)| 0.053  |
| Defective Filling            | 14 (17.9)                     | 5 (7.1)  | 0.050  |
| SSC dislodgement             | 7 (9.0)                       | 0        | 0.014b |
| **New caries**               |                               |         |
| New caries (case)            | 49 (62.8)                     | 30 (42.9)| 0.015b |
| Mean elapsed time ± SD (years)| 2.5 ± 2.4                     | 3.1 ± 2.3| 0.035b |
| OHI–S change                 |                               |         |
| Improved                     | 34 (43.6)                     | 33 (47.1)| 0.665  |
| No change & worse            | 44 (56.4)                     | 37 (52.9)|         |
| Frankl behavior change       |                               |         |
| Improved                     | 29 (37.2)                     | 12 (17.1)| 0.007b |
| No change & worse            | 49 (62.8)                     | 58 (82.9)|         |

SD: standard deviation; SSC: stainless steel crown; OHI–S: simplified oral hygiene index.

The improvement of behavior (Fig. 2) could be seen significantly higher in GA group, possibly due to a greater number of GA cases had negative baseline behavior (Frankl score 1–2) than NP group. This result showed that the negative behavior of children with SHCN could be adjusted and improved by many techniques of NP approaches in the subsequent recall visits, not unless ones who had been through GA before.

Although oral hygiene is one of the predictors for caries occurrence, a significant caries occurrence with faster rate was detected in GA group although there were no significant OHI–S change, and any associations in regularity of recall in the present study. Conversely, focusing on OHI–S change in Fig. 3, there was a trend of great improvement in GA group at ≥ 24 months of recall. Thus, it could be implied that effective and individual prevention strategy is beneficial to improve oral hygiene beside the regularity of recall behavior due to the limitation of secondary data retrieval.

Treatment outcomes showed only stainless steel crown dislodgement was significantly higher in GA group (9%) when none of NP group was detected. This could be due to the higher number of crown performed in GA group and other specific factor such as parafunctional habits which mostly found in more severe SHCN patients that required GA.

The improvement of behavior (Fig. 2) could be seen significantly higher in GA group, possibly due to a greater number of GA cases had negative baseline behavior (Frankl score 1–2) than NP group. This result showed that the negative behavior of children with SHCN could be adjusted and improved by many techniques of NP approaches in the subsequent recall visits, not unless ones who had been through GA before.

Although oral hygiene is one of the predictor for caries occurrence, a significant caries occurrence with faster rate was detected in GA group although there were no significant OHI–S change, and any associations in regularity of recall in the present study. Conversely, focusing on OHI–S change in Fig. 3, there was a trend of great improvement in GA group at ≥ 24 months of recall. Thus, it could be implied that effective and individual prevention strategy is beneficial to improve oral hygiene beside the regularity of recall behavior due to the limitation of secondary data retrieval.

One-week after GA recall rate was quite high (84%) when compared to previous study (68.68%). It was observed that 79.4% of patients in this current study who came for 1-week recall after GA, continued their following recalls and this finding was consistent with Kakaounaki et al. that found patients who disappeared at 1-week recall visit tended to disappear at the following recall and ended up with repeat GA. Nevertheless, continued recall rates in GA group were significant lower than NP group. The possible reason was that patients in GA group might have more complex condition and worse behavior than NP group which is the great obstacle for routine check-up. The other reason would be most cases in GA group were referred from dental clinic or hospital that was still able to treat patients conventionally. Thus, their routine recalls were mostly taken place at where they were from. However, the socioeconomic status of major caretaker is still a crucial factor that is needed to take into account in recall behavior for the fact that the oral health was not taken as seriously as earning their living. As a result, they could not bring their children for recall visit routinely particularly in low-income families. Unfortunately, the present study could not analyzed the relationship between this factor and the recall behavior due to the limitation of secondary data retrieval.

Treatment outcomes showed only stainless steel crown dislodgement was significantly higher in GA group (9%) when none of NP group was detected. This could be due to the higher number of crown performed in GA group and other specific factor such as parafunctional habits which mostly found in more severe SHCN patients that required GA.
recalls, particularly in patients treated under GA who had more complex physical and mental status as a great obstacle for having frequent recall visits. In addition, another preventive approach such as teledentistry should be more studied and apply into this context to improve the quality of life in SHCN patients especially in the Covid 19 pandemic.

Based on the result of this retrospective study, there were some differences in characteristics of dental treatment under GA versus NP approach in SHCN patients. It can be concluded that patients who were at older age and had high caries experience with definitely negative behavior and numerous treatment needs were more justifiably for GA, nonetheless the behavior could be significantly improved on subsequent visits. A significant new caries occurrence with faster rate tended towards SHCN patients who underwent GA. The limitation of this retrospective study was that some information could not be obtained from the dental chart record such as socioeconomic status of caretakers. Moreover, some correlations between various factors could not be answered due to the limited samples. Further studies regarding the related factors that might affect the failure of treatments including recall behavior, and long-term outcomes involving repeated GA rate should be of interest.

Declaration of competing interest

The authors have no conflicts of interest relevant to this article.

References

1. American academy of pediatric dentistry. Management of dental patients with special health care needs. Pediatr Dent 2016;38:171–6.
2. Anders PL, Davis EL. Oral health of patients with intellectual disabilities: a systematic review. Spec Care Dentist 2010;30:110–7.
3. Norwood KW, Slayton RL. Oral health care for children with developmental disabilities. Pediatrics 2013;131:614–9.
4. Nelson LP, Getzin A, Graham D, et al. Unmet dental needs and barriers to care for children with significant special health care needs. Pediatr Dent 2011;33:29–36.
5. Pettler B. Psychological treatment of fearful and phobic special needs patients. Spec Care Dent 2009;29:51–7.
6. Dougherty N. The dental patient with special needs: a review of indications for treatment under general anesthesia. Spec Care Dent 2009;29:17–20.
7. Needleman HL, Harpavat S, Wu S, Allred EN, Berde C. Post-operative pain and other sequelae of dental rehabilitations performed on children under general anesthesia. Pediatr Dent 2008;30:111–21.
8. Ciftci V, Yazicioglu I. A retrospective comparison of dental treatment under general anesthesia provided for uncooperative healthy patients and patients with special health care needs. J Clin Pediatr Dent 2020;44:196–201.
9. Al-Ogayyel S, Al-Haj Ali S. Comparison of dental treatment performed under general anesthesia between healthy children and children with special health care needs in a hospital setting, Saudi Arabia. J Clin Exp Dent 2018;10:963–9.
10. Sari ME, Ozmen B, Kayuturk AE, Tokay U. A retrospective comparison of dental treatment under general anesthesia on children with and without mental disabilities. Niger J Clin Pract 2014;17:361–5.
11. Greene JC, Vermillion JR. The simplified oral hygiene index. J Am Dent Assoc 1964;68:7–13.
12. Frankl SN, Shiere FR, Fogels HR. Should the parent remain with the child in the dental operatory? J Dent Child 1962;29:150–63.
13. Limeres Posse J, Vazquez Garcia E, Medina Henriquez J, Tomas Carmona I, Fernandez Feijoo J, Diz Dios P. Pre-assessment of severely handicapped patients suitable of dental treatment under general anesthesia. Med Oral Pathol Oral Cir Bucal 2007;12:496–503.
14. de Nova Garcia MJ, Gallardo Lopez NE, Martin Sanjuan C, Maurelle Martinez NR, Alonso Garcia Y, Carracedo Cabaleiro E. Criterias for selecting children with special needs for dental treatment under general anaesthesia. Med Oral Patol Oral Cir Bucal 2007;12:496–503.
15. Mallineni SK, Yiu CKY. A retrospective audit of dental treatment provided to special needs patients under general anesthesia during a ten-year period. J Clin Pediatr Dent 2018;42:155–60.
16. Hsiao SY, Chen PH, Huang SS, et al. Dental treatment needs and related risk factors among school children with special needs in Taiwan. J Personalized Med 2021;11:452.
17. van Dyck PC, Kogan MD, McPherson MG, Weissman GR, Newacheck PW. Prevalence and characteristics of children with special health care needs. Arch Pediatr Adolesc Med 2004;158:884–90.
18. Bethell CD, Read D, Blumberg SJ, Newacheck PW. What is the prevalence of children with special health care needs? Toward an understanding of variations in findings and methods across three national surveys. Matern Child Health J 2008;12:1–14.
19. Ningrum V, Bakar A, Shieh TM, Shih YH. The oral health inequalities between special needs children and normal children in Asia: a systematic review and meta-analysis. Healthcare 2021;9:410.
20. Guidry J, Bagher S, Felemban O, Rich A, Loo C. Reasons of repeat dental treatment under general anaesthesia: a retrospective study. Eur J Paediatr Dent 2017;18:313–8.
21. Kakounakhi E, Tahmasebei JF, Fayle SA. Repeat general anaesthesia, a 6-year follow up. Int J Paediatr Dent 2011;21:126–31.
22. Oredugba FA, Akindoyomi Y. Oral health status and treatment needs of children and young adults attending a day centre for individuals with special health care needs. BMC Oral Health 2008;8:30.