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Original Article

Dental treatment provided to special needs children under general anesthesia in a tertiary care hospital – A cross sectional retrospective study

Jawza Alfarraj [a,*], Jenny Louise Gray [b], Taghreed Alargan [a], Maryam Alkathiri [c], Reema Alshehri [c], Marwah Almarwan [a]

[a] Pediatric Dentistry Section, Specialized Dentistry Department, King Fahad Medical City, Riyadh, Saudi Arabia
[b] Dentistry Administration, King Fahad Medical City, Riyadh, Saudi Arabia
[c] Dental Intern, King Saud University, Riyadh, Saudi Arabia

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ABSTRACT

Dental general anesthesia (DGA) can be a preferred approach for treating children with special health needs (CSHCN). It has many benefits, most importantly, the support of the anesthesia team to control the medical status and treat the patient safely. The aim of this study was to evaluate the dental treatment provided to (CSHCN) under (DGA) in a tertiary-care hospital. Moreover, to compare the dental procedures between different medical conditions. This retrospective study involves a sample of 730 children aged between (1–16 years) with complex medical conditions treated under DGA between January 2009 until April 2022. The results show that 4.93 % of these patients had DGA twice. For those children who had DGA only once, the most frequent medical conditions were neuro-developmental disorders (31.8 %), pediatric oncology (17.4 %), and behavioral disorders (autism, ADHD, etc.) (15.1 %). The average age was 6.9 years; almost half were preschool children (4–6 years old, 48.41 %) followed by younger school children (7–9 years old, 28.82 %). The most common dental procedures done were extractions followed by restorative procedures. The use of fissure sealant was significantly higher in neuro-developmental and behavioral disabilities patients than other medical conditions.

1. Introduction

Children with Special Health Care Needs (CSHCN) are defined as children with physical, developmental, mental, sensory, behavioral, cognitive, or emotional impairment or limiting condition that requires medical management, health care intervention, and/or use of specialized services or programs (American Academy of Pediatric Dentistry, 2020). Recently, the practice of pediatric dentistry has shifted towards more preventive protocols to decrease the risk of dental caries in pediatric patients (Marinho et al., 2021). However, CSHCN still has increased risk of caries due to the difficulties in maintaining good oral hygiene, special dietary requirements and some medications taken for their health conditions (Marinho et al., 2021; Choi and Doh, 2021). For these patients with complex medical conditions and extensive dental treatment needs, dental treatment under general anesthesia (DGA) is often the recommended approach (Rajavaara et al., 2018). DGA has many benefits, most importantly, the supporting of the anesthesia team in controlling the medical status to enable the dental team to treat the patient safely (Choi and Doh, 2021; Park et al., 2018). Moreover, it enables the dentist to provide a variety of high-quality procedures, which can be completed within one treatment session (Choi and Doh, 2021; Park et al., 2018).

Studies have shown that pediatric dentists tend to follow a more aggressive treatment approach when treating patients under DGA, particularly for CSHCN patients. They tend to prefer less complex procedures or those with a lower risk of future complications, such as dental extraction (Ramazani, 2016). The analysis of dental treatment characteristics under DGA provides a beneficial overview about the clinical judgment and decisions made by pediatric dentists in DGA.

The primary objective of this study is to evaluate the main characteristics and treatment profiles of CSHCN patients who had dental treatment under general anesthesia in a tertiary care hospital in Saudi Arabia. Additionally, the secondary objective is testing the hypothesis that dental treatment provided to CSHCN patients under GA is the same for all groups of medical conditions. Our null hypothesis is there is no difference in the dental treatment provided to CSHCN patients under GA

* Corresponding author at: Pediatric Dentistry Section, Specialized Dentistry Department, King Fahad Medical City, P.O. Box: 59046, Riyadh 11525, Saudi Arabia.
E-mail address: Jalfarraj@KFMC.med.sa (J. Alfarraj).

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for the various groups of medical conditions.

2. Materials and methods

This is a retrospective descriptive study. Data were collected from R4 dental software system®, (Carestream dental limited, 2023) where the clinical data were stored. The data were for children who had received dental treatment under general anesthesia (DGA) by the Dentistry Administration at King Fahad Medical City, a tertiary care hospital in Riyadh, Saudi Arabia. The sample was from all patients, aged between 1 and 16 years old, who received dental treatment under G.A. between January 2009 and April 2022, who met our inclusion criteria.

2.1. Setting

Dental services in Saudi Arabia are provided in both the governmental and private sectors. Most parents of children with special needs prefer to utilize the governmental health services, including DGA where needed, which are provided free of charge. DGA services are available in both secondary- and tertiary-care hospitals. This study was conducted at a governmental, tertiary care hospital (King Fahad Medical City, Riyadh). The majority of the patients seen in the Pediatric Dentistry section at King Fahad Medical City (KFMC) are referred from other medical specialties within the hospital, therefore the vast majority of patients have complex medical conditions necessitating specialized, hospital-level dental care. The indication for DGA for children with special needs follows the American Academy of Pediatric Dentistry guidelines.

2.2. Participants

Patients aged from 1 to 16 years who underwent DGA between 2009 and 2021.

Inclusion criteria

- Children with special health care needs (CSHCN).
- Age: from 1 to 16 years.
- Who had dental treatment under GA at KFMC.

Exclusion criteria

- Healthy patients.
- Dental patients who had GA for surgical (rather than dental) procedure, such as cleft palate repair.
- Missing clinical data.

2.3. Data collection

The study was approved by the Ethical Committee, the KFMC institutional review board (IRB Log No. 22–120). Permission was obtained from the administration where the study was conducted. Demographic details were obtained, including: date of birth, gender, age, and medical record number. Clinical information included: patient's medical condition, date of dental treatment under GA and details of dental treatment provided such as number of treated teeth and if first permanent molars included or not. The data were collected by two of the authors who evaluated the medical records. The reviewers were supervised by a pediatric dentistry consultant who verified the data separately to ensure conformity.

For the purposes of comparison, the medical conditions were divided into three main categories: class I: Neurodevelopmental/behavior disabilities (DD), class 2: congenital/chromosomal malformations (CD) which includes (syndromic disorders, congenital heart disease and craniofacial anomalies), and class 3 which includes any other systemic disorder (SD).

The number and type of dental procedures completed under DGA were classified under the following: restorative therapy (e.g., glass ionomer and composite restorations), stainless-steel crowns (SSC), tooth extractions, pulpal therapy (pulpotomies and root-canal treatments) and fissure sealants. During the study period some patients had DGA performed more than once. All the data were collected, cleaned and analyzed using spreadsheet software (Microsoft Office, Excel 2016, Redmond, Washington, U.S). At this point those who met the exclusion criteria, i.e. incomplete data and healthy patients were excluded, and then preliminarily analysis on the remaining was done.

2.4. Intra-examiner reproducibility

Two cycles for intra-examiner reproducibility testing performed on 10 % of the total sample population. A random number generator randomly selected ten patients' records to calculate intra-examiner reproducibility using the kappa test. The two recording cycles were separated by a period of 10 days.

2.5. The statistical analyses

All continuous variables such as the number of restorations, pulpal therapies, extractions, SSCs, fissure sealants and number of teeth treated were expressed as median and interquartile range [IQR]. The Kolmogorov-Smirnov test was used to confirm the assumption of normal distribution. Kruskal-Wallis was applied to determine the significant differences between treatment class and factors. A two-sided p-value less than 0.05 was considered statistically significant with a 5 % c confidence interval. All data was entered and analyzed using the SPSS 25 Statistics Package (SPSS Inc., Chicago, Illinois, USA).

3. Results

A total of 730 children who received DGA treatment from January 2009 until April 2022 under the KFMC Dental Administration met our inclusion criteria, 694 patients (95.1 %) had DGA once, 36 patients (4.9 %) had DGA twice. Initially, 794 medical records were identified from the database and their details were reviewed by two of the authors. Out of these, 64 patients were excluded due to the study's exclusion criteria. A 37 medical records of health patients and 23 with incomplete clinical data.

3.1. Demographic data

Total of 694 CSHCN patients had DGA once (388 males 56 %, 306 females 44 %) with an average age of 6.9 years (SD = 2.49) and a median age of 6.5 years. The age distribution was 67 children (9.65 %) were younger pre-school children (toddlers aged 1–3 years), 336 children (48.41 %) were older pre-school children (4–6 years), 200 (28.82 %) were younger school-aged children (7–9 years), 83 (11.96 %) were older school-aged children (10–12 years), and the remaining 8 children (1.15 %) were adolescents (aged 13 years or older). The average age was 6.9 (SD 2.49) and a median age of 6.5 years. At the time of the DGA, the youngest patient was 1.3-year-old while the oldest was 16-year-old.

A total of 36 patients in our sample had DGA twice during the specified time period (26 males 72 %, and 10 females 28 %). The average age was 6 years old (SD = 2.5) and 12 years old (SD = 2.7) for the first and second DGA respectively. For first DGA, the youngest patient was 1.9 years-old and the oldest was 10-years old. For the second DGA, the youngest patient was a 6.4-year-old and the oldest was a 15-year-old patient. The difference in mean ages is 5.57 years. The rate of repeated G.A. found to be 4.93 %. The average number of treated teeth at the first DGA was 13.8 and 13.3 at the second DGA.

3.2. Medical conditions

The medical conditions are summarized in Table 1. The most frequent conditions are neurodevelopment disorders, pediatric oncology patients and behavioral disorders. (31.8 %, 17.4 %, 15.1 %) respectively.

Table 1
Distribution of special needs patients based on their medical conditions.

Medical condition	N (%)	Average age
Neurodevelopment disorders	221 (31.8 %)	8.1
Pediatric oncology	121 (17.4 %)	7.4
Behavioral	105 (15.1 %)	6.5
Syndromic disorders	72 (10.4 %)	5.1
Congenital heart disease	53 (7.6 %)	6.3
Craniofacial anomalies	43 (6.2 %)	7.3
Hematological disease	29 (4.2 %)	6.2
Renal	22 (3.2 %)	7.9
Bone related and clearance prior to bisphosphonate	10 (1.4 %)	7.1
Endocrine	6 (0.9 %)	5.5
Gastrointestinal disease	5 (0.7 %)	6.7
Metabolic	5 (0.7 %)	6.5
Other	2 (0.3 %)	6.5
Total	694 (100.00 %)	6.9

3.3. Dental treatment modalities and teeth treated

3.3.1. Number of teeth treated

The average number of treated teeth during the G.A. session was 14 (SD = 4) teeth. The highest number of teeth treated on a single patient during one DGA was 27 teeth, while the lowest number treated was 2 teeth. The distribution based on number of treated teeth shown in Fig. 1. The general trend is much the same however there is a slight tendency for less teeth to be treated during the second GA compared to the first (average number of teeth treated 13.4 vs 14.4 respectively).Fig. 2..

3.3.2. Type of treatment received

The most common dental procedure done at the first DGA was extraction, with a mean of 5.89 (SD.18) extractions per patient. Followed by restorative procedures with a mean of 3.14 (SD 2.78) treatments per patient as shown at Table 2. The average number of teeth treated with restorative material at the first DGA was 3 teeth (SD = 2.3). It increased at the second DGA to 5.2 teeth (SD = 4.5).

3.4. The association between the medical condition and type of dental treatment

The mean number of treatment procedures for medical condition classes is shown in Table 3. A Kruskal-Wallis test showed that there was no statistically significant difference between the main classes in all type of treatment except for pit and fissure sealant ($p < 0.05$). The systemic disorder (SD) group received less preventive restorative treatment and pulp therapies than the other two medical groups ($p > 0.05$). Congenital/chromosomal malformations (CD) received more extractions and SSC than other medical groups ($p > 0.05$). The use of fissure sealant was significantly higher in neurodevelopmental/behavior disabilities (DD) patients ($p < 0.05$). The post hoc (Dunn test) was done between classes of medication conditions and fissure sealant. It confirms that DD and CD are significantly different to each other. No other significant findings are found (Table 4).

4. Discussion

This study considered CSHCN patients aged from 1 to 16 years old who received dental treatment under GA at a governmental tertiary care hospital in Saudi Arabia. The average age of patients in this study was 6.5 years for those who had DGA once with a slight increase in male predominance (56 %), this is within the age range of other studies. (Karl et al., 2022; Delfiner et al., 2017; Rudie et al., 2018; Bücher et al., 2016; Takriti et al., 2019; Kakaounaki et al., 2011). As suggested by Marinho et al, male predominance could be attributed to the fact that some disorders (like autism) are more common in males.

The low number of patients in this study (n = 36, 4.9 %) had DGA twice, which is similar to other studies (Saleha Alzahrani et al., 2022; Savanheimo and Vehkalahti, 2014; Karl et al., 2022; Rudie et al., 2018; Bücher et al., 2016; Kirby et al., 2020). The average age of patients who had repeated (second) DGA was 12 years old in this study, which is older than those reported in other studies (Saleha Alzahrani et al., 2022; Kirby et al., 2020). This could possibly be attributed to the differences in institution settings between the studies. KFMC pediatric dental services are limited to patients with certain medical conditions, that therefore need specialized dental care. An important factor when considering repeat DGA is the patient / family adherence to follow up, as often patients fail to adhere to post-operative instructions and recalls (Sari et al., 2014). As proven by many studies that with sick patients, parents prioritize their medical care over their dental care (Rudie, 2018). Frequently missing or postponing follow up dental appointments, will lead to delayed examination of such patients, this could suggest one of the reasons behind the older age of repeated DGA in this study. Moreover, this can explain the higher difference in mean ages between DGA twice. As it found to be 5.57 years in this study which is higher than other study (Ramazani, 2016).

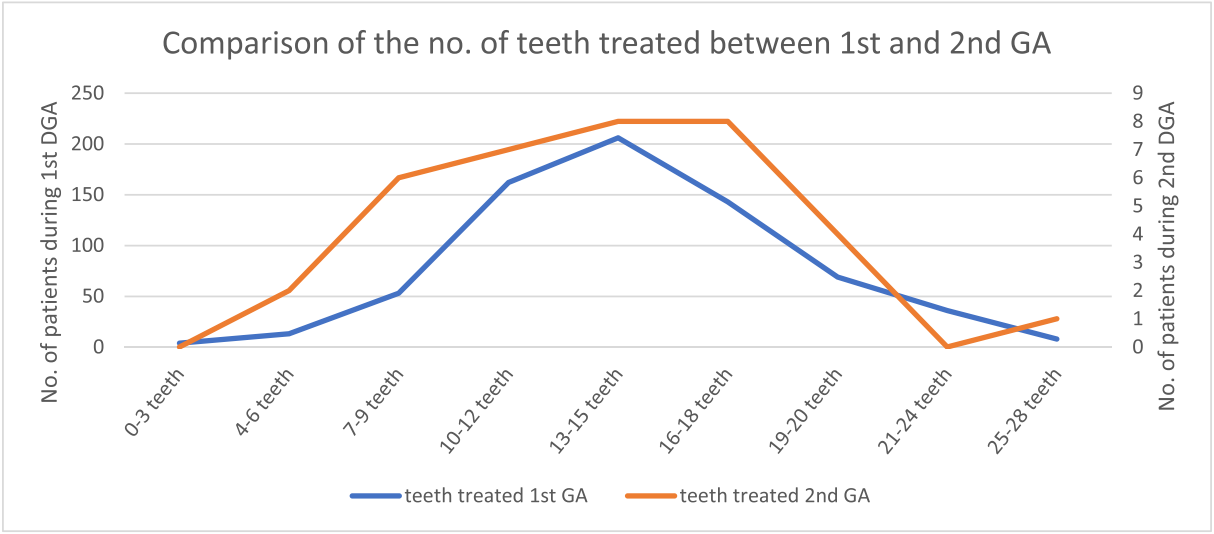

Fig. 1. Number of treated teeth per patient during each DGA.

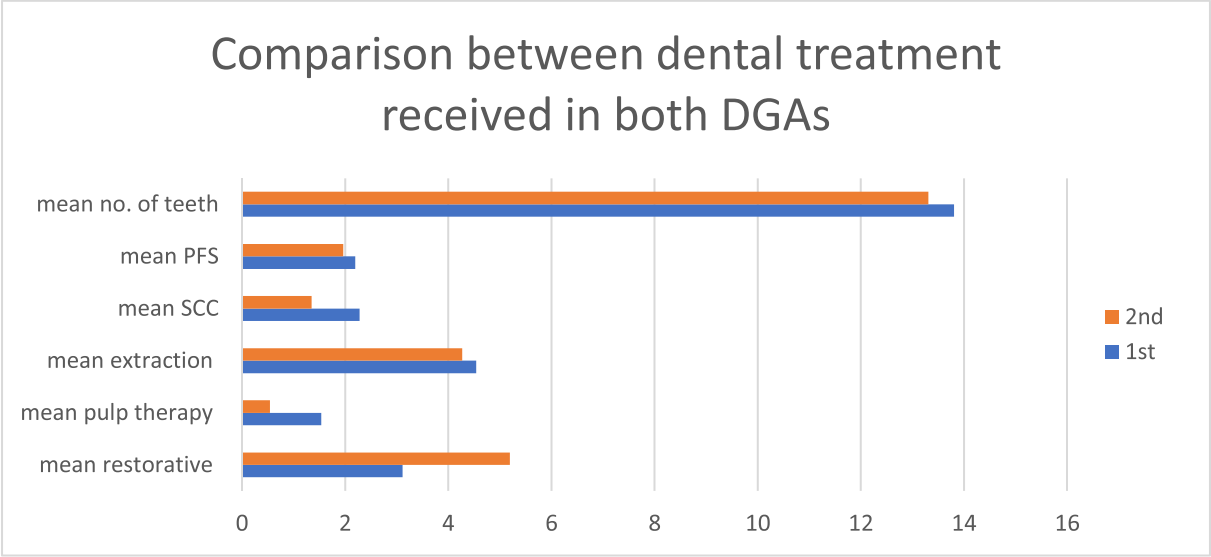

Fig. 2. The comparison between dental treatment received in both DGA.

Table 2
Treatment procedures performed under first DGA.

	Mean number of teeth treated	Standard Deviation (SD)	Maximum number on an individual patient
Restorations	3.14	2.78	18
Pulpal therapy	1.28	1.84	9
Extractions	5.89	0.18	26
SSC	2.92	2.55	12
Fissure sealants	1.17	1.97	12

Table 3
The type of dental treatment provided and medical conditions.

Factors	Description	DD	CD	SD	P-value
Restorative	Median [IQR]	4 [6–2]	4 [5–2]	3 [5–2]	0.126
Pulp therapy	Median [IQR]	3 [4–2]	3 [4–2]	2 [3.25–1]	0.086
Extraction	Median [IQR]	5 [9–3]	6 [9–3]	5 [8–3]	0.303
SSC treatment	Median [IQR]	4 [5–2]	4 [6–3]	4 [5–2]	0.369
Fissure sealant	Median [IQR]	3 [4–2]	2 [4–1]	2 [4–1]	*0.006
No. of teeth	Median [IQR]	14 [18–12]	14 [17–12]	14 [17–11]	0.762

Note: Continuous data expressed as Median [IQR = interquartile range; Q3 – Q1;
* shows that P-value is significant at $P < 0.05$.
DD: developmental disease.
CD: congenital disease.
SD: systemic disease.

Table 4
Pairwise comparison between medical condition and fissure sealant.

	Test Statistics	Std. Error	Std. Test Statistics	Sig.	Adj.Sig.
CD-SD	−12.759	13.151	−0.970	0.332	0.996
CD-DD	35.875	12.133	2.957	0.003	0.009
SD-DD	23.115	10.612	2.168	0.029	0.088

In this study a high prevalence of neurodevelopmental, oncology and behavioral disorders were reported. This is comparable with other studies audited dental treatment under GA for CSHCN especially for mental, behavioral and nervous system disorders (Mallineni and Yiu, 2018; Harrison and Roberts, 1998).

The average number of teeth treated per DGA was high for extraction, followed by restorative treatment including SSC and composite in comparison to other procedures. This is in agreement with Fernández-Feijoo et al. (2019), dental extractions were performed as the most common procedure in a different age distributions. Pei-Ying Lee et al., studied dental treatment under GA in healthy and disabled patients between the ages of 1–18 years old, teeth extractions were significantly higher in disabled patients with a lower number of restoration treatments when compared to healthy patients of the same age group. Moreover, a study by Chia-Ling Tsai et al., found that patients with major illness and/or disability, had more extractions than their counterparts (Ibricevic et al., 2001; Harrison and Roberts,1998; Tsai et al., 2006). Due to the potential of restoration failure, poor oral hygiene, lack of follow up dental appointment and the complexity of the medical conditions that CSHCN may present with, extraction is often the treatment of choice (Harrison and Roberts, 1998; Tsai et al., 2006).

In contrast to the first DGA, the mean number of teeth treated with restorative treatment increased in the second DGA with the average number of 5.2 teeth. This is expected, especially that the average age of the patients with repeated DGA is 12 years old, where permanent dentition (and therefore a larger number of teeth) are present. Some patients presented to the dental clinic at later stages with molar incisor hypominerazation (MIH) involving the permanent teeth, this would be difficult to predict if the patient is too young at the first DGA and not following up on a regular basis (Negre-Barber et al., 2016; Garot et al., 2018). Putting into consideration all the previous factors mentioned above, a repeat DGA is inevitable in some cases (Kakaounaki et al., 2011).

Surprisingly, the use of fissure sealants was significantly higher in those patients with neurodevelopmental/behavior disabilities (DD) than other medical conditions. This can be explained by the fact that these patients were behaviorally-challenging cases to be treated in dental chair, therefore they were referred for DGA with minimal dental treatment needs or as an emergency management to treat one painful tooth (larger number of non-carious teeth). For that reason, the dentist may decide to seal all the remaining non-carious teeth as preventive measures.

As the dental treatment procedures were different for the three

medical classes, our null hypothesis was rejected. There was a total of 13 heterogeneous groups of medical conditions included in our study; hence, we cannot generalize the findings from this study. The strength points of the current study are the large sample size and ten years retrospective period while the main limitation of this study was the nature of its retrospective design. Therefore, a prospective study design will better understand the associated risk factors.

5. Conclusion

In the sample of CSHCN pediatric dental patients treated under DGA within the limitation of this study, it can be concluded that:

- For the patients who had DGA once, the most common treatment performed was dental extraction. In contrast, for second DGA it was restorative treatment.
- The use of fissure sealant was significantly higher in neuro-developmental and behavioral disabilities patients than other medical conditions.

Ethical statement

The authors declare that the work has been approved by the appropriate ethical committee related to the institution in which it was performed, and the patients gave informed consent.

The work described in the article has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans and Uniform Requirements for manuscripts submitted to Biomedical journals.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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