

## ARTICLE INFO

Submitted: 16/01/2020

Accepted: 30/05/2020

Online: 15/07/2020

## Characteristics and Dental Treatments of Children under General Anaesthesia

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**To cite this article:** Nadeem S, Mohd Noor SNF, Shahabuddin S, Abdul Ghaffar Z, Chong SE (2020). Characteristics and dental treatments of children under general anaesthesia. *Arch Orofac Sci*, 15(1): 35–44. <https://doi.org/10.21315/aos2020.15.1.413>

**To link to this article:** <https://doi.org/10.21315/aos2020.15.1.413>

### ABSTRACT

The goal of this retrospective study was to determine the types of dental treatments provided to paediatric patients under general anaesthesia (GA) at the Advanced Medical and Dental Institute, Universiti Sains Malaysia, Pulau Pinang, Malaysia. Records of the 113 patients under 18 years old who had undergone dental treatment under GA from November 2015 to February 2019 were retrieved and reviewed. The median age for subjects was six years old and the data were skewed to the left. Subjects were diagnosed with early childhood caries (n = 94) where total oral rehabilitation was performed for most subjects (n = 82). Higher number of deciduous teeth were extracted (n = 488) with average number per person of 5.5 as compared to permanent teeth (n = 43) with 2.9 average number per person. The leading cause of surgical cases was removal of supernumerary and impacted teeth. Tooth colour restoration and stainless-steel crowns were commonly used in restorative procedures. Although most of the patients were in the American Society of Anaesthesiology categories I and II, treatments were performed under GA because complete oral rehabilitation was required. In conclusion, dental treatment under GA is essential for providing complete oral rehabilitation in young patients, especially those with early childhood caries or medical and behavioural problems.

**Keywords:** *Dental treatment; early childhood caries; extractions; general anaesthesia; restorations*

### INTRODUCTION

Management of medical or behavioural problems and delivery of pain-free dental treatment under general anaesthesia (GA) is based on specific criteria, including risks, benefits, effectiveness and expected

results (Andreeva, 2018). Various methods are available to help children cope with dental treatment such as tell-show-do, desensitisation, modelling, hypnosis, sedation and GA (Strøm *et al.*, 2015). Although expensive and posing an overall health risk to patients, GA is a tool used to provide

dental treatment to patients. With careful preoperative assessments, experienced health providers and strong postoperative care, it can be conducted successfully (Ali *et al.*, 2016).

Globally, dental caries is a multi-factorial disease that affects patients at various age levels (Thomson, 2016). Despite a decreasing caries rate over recent decades, early childhood caries (ECC) remains widespread among young children, and it affects their quality of life (Thomson, 2016; Rajavaara *et al.*, 2018). The incidence of dental caries among preschool children in Malaysia decreased from 76.2% in 2005 to 71.3% in 2015, but it remains a major problem (OHD-MOH, 2017). Restorative treatment needs due to ECC are considered to be a main factor for dental rehabilitation under GA (Norderyd *et al.*, 2018; Rudie *et al.*, 2018). The number of children receiving treatment under GA has multiplied over the years. In 2013, the Children's Dental Health Survey reported that about 31% of five years old and 46% of eight years old in England, Wales and Ireland had decay in their deciduous teeth, which increased the number of teeth being extracted due to caries under GA (Lim and Borrromeo, 2017). A study conducted in Selangor, Malaysia at five different hospitals showed that 158 children aged two to six years old who were diagnosed with ECC had undergone dental treatment under GA with the most frequent treatment being extraction followed by restoration of teeth (Hashim *et al.*, 2019). Another recent study reported that one tooth is extracted every 10 minutes in children (Brown *et al.*, 2019).

Uncooperative young children with severe ECC is treated under GA which often become the treatment of choice (Hashim *et al.*, 2019). For such patients, treatment under GA with total oral rehabilitation is considered to be a suitable option for delivery of dental treatment to manage their complex behavioural needs (Rudie *et al.*, 2018) and lack of cooperation (Lim and Borrromeo, 2017). Methods such as inhalation or

conscious, and intravenous sedation are also available for paediatric dental patients, but the method must be used with caution and dentists must be able to manage deep sedation and its associated risks (Yoon and Kim, 2016).

According to the American Society of Anaesthesiology (ASA), patients are classified according to their physical status (Mayhew *et al.*, 2019). Paediatric patients with ASA I (normal healthy patient) and ASA II (patient with mild systemic disease) can be treated as outpatients with mild to moderate sedation, and GA is considered only in cases in which complete oral rehabilitation is required and the patient is uncooperative (Mayhew *et al.*, 2019). Patients with ASA III (patient with severe systemic disease) and above are treated under GA with observation by an anaesthetist and a specialist dental team (Forsyth *et al.*, 2012). Although there are no absolute indications or contraindications for using GA, the ASA suggests that it should be avoided or contraindicated if the patient has a history of allergic reactions or arrhythmias or if the patient has minimal dental needs that can be treated under local anaesthesia.

Currently, the availability of data related to characteristics of paediatric dental treatment performed under GA is limited in Malaysia. One study was based on reports of procedures conducted at a teaching hospital (Abdul Karim *et al.*, 2008) and several studies assessed the outcome following dental treatment of ECC after GA (Hashim *et al.*, 2015, Hashim *et al.*, 2019). The paediatric dental specialties and general anaesthesia services are normally available at tertiary hospitals in major towns of Malaysia (OHP-MOH, 2019). Based on the Annual Report 2018 for the Oral Health Programme, Ministry of Health Malaysia (OHP-MOH, 2019), a total of 68,339 special needs children had received primary oral healthcare, and the number has been increasing steadily over the years. These children may need to be treated in tertiary hospitals in major towns for complete oral

rehabilitation; for example, Pulau Pinang had reported 3677 new attendance cases in 2018 (OHP-MOH, 2019).

The goal of this retrospective study was to determine the types of dental treatments performed under GA and the reason for utilising GA among paediatric patients at the Advanced Medical and Dental Institute (AMDI), Universiti Sains Malaysia (USM), Pulau Pinang, Malaysia. The study also aimed to analyse the relationship between ECC occurrence and the age and weight of the subject.

## MATERIALS AND METHODS

This was a retrospective study of clinical data that was retrieved from records of dental patients 18 years old and younger who underwent dental treatment under GA from November 2015 until February 2019 at AMDI, USM, Pulau Pinang, Malaysia. The study was approved by the Internal Review Board of Human and Ethics Committee, USM prior to its commencement (USM/JEPem/18090437). Based on the operation theatre record book, 113 patients were treated under GA. Hardcopies of the folder for each subject were retrieved from the record unit and no folders were missing, hence all subjects were included in the study.

A data collection sheet divided into several sections was prepared. Section A related to demographic data of subjects such as year of GA, gender, age, past medical and dental histories, and the duration of treatment under GA. Section B contained the tooth charting that recorded the number of teeth extracted and Section C contained the tooth charting that recorded the number of teeth being restored and the type of restoration used, including the type of surgical treatments provided (if any). The duration of GA was recorded as the interval between the time the patient was swabbed and draped until completion of the dental treatment before endotracheal tube removal by the anaesthesia team. The subject demographics

were analysed using descriptive statistics, and the relationship between ECC occurrence, and the age and weight of the subject was analysed using a chi-square test of independence using SPSS software version 24 (SPSS, IBM, Armonk, NY, USA).

## RESULTS

The number of paediatric patients who received dental treatment under GA increased during the 3-year period, despite the small sample size ( $n = 113$ ). Most of the subjects ( $n = 80$ ) did not have any medical problems, but most were diagnosed preoperatively with ECC ( $n = 94$ ). The major reason for providing dental treatment under GA was to provide complete oral rehabilitation for subjects ( $n = 82$ ). Twenty-one subjects had medical problems such as asthma, congenital heart diseases, tuberous sclerosis, cerebral palsy and allergies, and 10 subjects had behavioural problems. Most subjects ( $n = 61$ ) had no past dental history, and this was the first dental visit for 33 subjects. Nearly half of the subjects ( $n = 56$ ) were covered by health funds or allocation funded by their parents' respective government departments or private institutions. Most subjects ( $n = 42$ ) had body weight ranging from 16 to 20 kg. The sample contained an almost equal number of male ( $n = 57$ ) to female ( $n = 56$ ) subjects (Table 1).

Eighty-nine of the subjects had deciduous teeth extracted, and in total 488 deciduous were removed. Of the 566 deciduous teeth restored, stainless steel crowns (SSCs) were used to restore 305 deciduous primary molars, which were prepared using the traditional method (Table 2). Glass ionomer cement (GIC) was the most common material used to restore 125 deciduous teeth. Fissure sealants were placed on 142 deciduous teeth and on 128 permanent teeth, Fuji VII (GIC based) and Helioseal-F (light cured resin sealant) were the most common sealants used.

**Table 1** Descriptive characteristics of subjects treated under general anaesthesia

Variables n = 113	Median (IQR)	Frequency male (%)	Frequency female (%)	Total subjects (%)
Gender		57 (50.4)	56 (49.6)	113 (100.0)
Age	6 (5.0)*			
0–6 years		33 (47.1)	37 (52.9)	70 (100.0)
7–12 years		21 (65.6)	11 (34.4)	32 (100.0)
13–18 years		3 (27.3)	8 (72.7)	11 (100.0)
Body weight				
10 to 15 kg		17 (43.6)	22 (56.4)	39 (100.0)
16 to 20 kg		24 (57.1)	18 (42.9)	42 (100.0)
Above 20 kg		16 (50.0)	16 (50.0)	32 (100.0)
Ethnicity				
Malay		54 (50.5)	53 (49.5)	107 (100.0)
Chinese		2 (66.7)	1 (33.3)	3 (100.0)
Indian		1 (33.3)	2 (66.7)	3 (100.0)
Year of GA				
2015		2 (33.3)	4 (66.7)	6 (100.0)
2016		8 (47.1)	9 (52.9)	17 (100.0)
2017		17 (53.1)	15 (46.9)	32 (100.0)
2018		23 (51.1)	22 (48.9)	45 (100.0)
2019 (until February)		7 (53.8)	6 (46.2)	13 (100.0)
Past medical history				
Yes		22 (66.7)	11 (33.3)	33 (100.0)
No		35 (43.8)	45 (56.3)	80 (100.0)
Past dental history				
Yes		10 (52.6)	9 (47.4)	19 (100.0)
No		33 (54.1)	28 (45.9)	61 (100.0)
First dental visit		14 (42.4)	19 (57.6)	33 (100.0)
Type of payment (funding)				
Health funds by institution		32 (57.1)	24 (42.9)	56 (100.0)
GL/other		10 (55.6)	8 (44.4)	18 (100.0)
Self-funded		15 (38.5)	24 (61.5)	39 (100.0)
Reasons for administering GA				
Medical problem		12 (57.1)	9 (42.9)	21 (100.0)
Behaviour problem		7 (70.0)	3 (30.0)	10 (100.0)
Total oral rehabilitation		38 (46.3)	44 (53.7)	82 (100.0)
Diagnosis				
Early childhood caries		49 (52.1)	45 (47.9)	94 (100.0)
Impacted tooth		4 (40.0)	6 (60.0)	10 (100.0)
Supernumerary tooth		1 (30.0)	3 (70.0)	4 (100.0)
Abscess		2 (66.7)	1 (33.3)	3 (100.0)
Tongue tie		1 (50.0)	1 (50.0)	2 (100.0)
Surgery				
Yes		8 (42.1)	11 (57.9)	19 (100.0)
No		49 (52.1)	45 (47.9)	94 (100.0)

\*The distribution is skewed to the left.

A chi-square test of independence was used to analyse the relationship between ECC and the age and weight of the subject. The results showed lower occurrence of ECC as the age and weight of the subject increased ( $p < 0.001$ ) as shown in Table 3.

Based on the ASA criteria, 83 patients fell under category ASA I, whereas 28 and 3

patients fell under ASA categories II and III, respectively. The duration of the GA used to provide total oral rehabilitation for all subjects was divided into three categories; less than 60 minutes ( $n = 12$ ), more than 60 minutes to 2 hours ( $n = 62$ ) and more than 2 hours ( $n = 39$ ).

**Table 2** Distribution of type of treatment provided to subjects

Treatment provided	Number of teeth (N)	Number of subject (N)	Average per person
Extractions			
Deciduous	488	89	5.5
Permanent	43	15	2.9
Type of restoration			
1. Stainless Steel Crowns			
Deciduous	305	80	3.8
Permanent	3	1	3.0
2. Glass Ionomer			
Deciduous	125	53	2.4
Permanent	2	2	1.0
3. Composite			
Deciduous	112	43	2.6
Permanent	6	2	3.0
Fissure Sealant			
Deciduous	142	46	3.1
Permanent	128	29	4.4
Pulpotomy			
Deciduous	152	59	2.6
Permanent	0	0	

**Table 3** Factors associated with occurrence of ECC

Variables	N	ECC freq. (%)	No ECC freq. (%)	$\chi^2$ statistic (df)	p-value
Age group					
0–6 years	70	67 (95.7)	3 (4.3)	33.98 (2)	0.001
7–12 years	32	24 (75.0)	8 (25.0)		
13–18 years	11	3 (27.3)	8 (72.7)		
Total	113	94	19		
Weight group					
10 to 15 kg	42	41 (97.6)	1 (2.4)	27.77 (2)	0.001
16 to 20 kg	38	35 (92.1)	3 (7.9)		
Above 20 kg	33	18 (54.5)	15 (45.5)		
Total	113	94	19		

## DISCUSSION

In this retrospective study, relatively young children were treated under GA. A previous study reported the mean age of subjects who received treatment under GA to be six years and the maximum age was 18 years, and these subjects were treated under GA mainly due to impaction and orthodontic treatment (Abdul Karim *et al.*, 2008). In the current study, the largest number of patients were Malays, reflecting the major ethnic population in Pulau Pinang, Malaysia (DOSM, 2019). The rest of the subjects were either Chinese or Indian. However, other centre hospitals in Malaysia treat a wider range of racial populations (OHP-MOH, 2019).

Although treatment under GA is accepted by parents, it is an expensive and resource exhausting treatment modality (Norderyd *et al.*, 2018). The majority of the families paid for the treatment with the help of their health funds from respected institution, which meant that the treatment was not deferred due to the financial constraints of parents and the high cost of treatment under GA. Subjects with immediate oral rehabilitation needs were treated using hospital funds if their parents were not able to afford the expenses of treatment. Hence, proper budgeting to cover these costs should be implemented in departments or institutions for their staff members.

Dental treatment under GA should be the last treatment option, but under certain circumstances, it is the treatment option for the practitioner. It is mainly indicated for young children who require extensive treatment, are medically compromised, or are behaviourally challenged (Schroth and Smith, 2007; Gussy *et al.*, 2008; Dziedzic, 2017). In the current study, several children treated under GA had medical problems that necessitated a detailed assessment, and, in most cases, a medical specialist report was needed for further evaluation. These patients were admitted to the ward for pre- and post-operational observation, and their

treatment protocols were discussed in detail with the anaesthetic team before treatment to minimise the chances of a medical emergency or side effects (Rudie *et al.*, 2018). Subjects with existing medical problems may have a high chance of re-referral post-treatment (Abdul Karim *et al.*, 2008). However, all subjects in the current study had no history of repeated GA for dental treatment, as the main reason for administering GA for these subjects was to provide total oral rehabilitation in a single admission, and all patients were admitted to the ward the day before the planned dental treatment under GA for ease of monitoring and treating carious teeth that could be saved to avoid any repetitive GA.

Behavioural problems are a major reason for lack of ability to cooperate for treatment (Hosey *et al.*, 2006; Abdul Karim *et al.*, 2008; Strøm *et al.*, 2015). Fear, anxiety and post-operative morbidity are related to each other, and Abdul Karim *et al.* (2008) reported that subjects in optimum health without any history of behavioural disorders were found to be anxious and fearful on the day of appointment, likely due to young age, inability of the subject to express him/herself, or a bad experience in the past. However, several subjects in the current study had a behavioural disorder such as attention deficit syndrome, hyperactivity disorder, anxiety, fear, and autism; the latter was the most common condition in patients exhibiting non-cooperative behaviour, indicating that non-cooperation was due to behavioural condition and young age of the patient rather than to a bad previous experience.

Comparable to the results of previous studies (Lehtonen *et al.*, 2015; Solanki *et al.*, 2016), most subjects in the current study had no previous dental history. This finding indicated that the recorded visit was the subject's first dental visit, which is suggestive of the parents' poor understanding of primary teeth function and the importance of maintaining dentition. Gussy *et al.* (2008) reported some parents agreed that their child's primary dentition is vital for health,

but Schroth and Smith (2007) found that a small fraction of parents disagreed that primary dentition is important. In Poland, about 60% of mothers agreed that primary dentition care is unnecessary due to low oral health awareness (Gaszyńska *et al.*, 2015), and about 47% of mothers in the United Kingdom knew that decayed primary dentition needs treatment (Clarke *et al.*, 2006). Parental attitudes towards primary dentition care need to be addressed, and caregivers should be counselled regarding the importance of primary dentition, and its effect on psychosocial aspects of the child's life (Hashim *et al.*, 2019).

In several studies, the majority of the subjects were diagnosed with ECC (Mani *et al.*, 2012; Thomson, 2016), which suggests that the high prevalence of ECC in Malaysia. The number of extractions of deciduous teeth under GA was high, indicating non-restorable damage due to ECC and suggesting that the main indication for treatment under GA is ECC, which was in agreement with previous reports (Abdul Karim *et al.*, 2008; Norderyd *et al.*, 2018). ECC is also associated with medical problems, as reported in previous studies suggesting that paediatric patients with medical problems are more susceptible to caries, mainly due to malocclusion, high intake of medication that decreases salivary flow, and low intellectual abilities (Jankauskiene *et al.*, 2014; Giovannitti, 2016). Additionally, children with medical problems (ASA II, III) undergoing treatment under GA have more extractions than restorations due to ECC (Abdul Karim *et al.*, 2008), mainly to meet their rehabilitative needs and to avoid further problems.

Compared to previous results (Mani *et al.*, 2012), in this study, age was found to be related to ECC, as younger patients were more prone to having caries. This trend can be linked to the practice of feeding sweetened milk to children, not exercising brushing habits from an early age, lack of knowledge, and poor management by the caretaker (Mani *et al.*, 2012). Lack of

knowledge among parents and caregivers may be due to low socio-economic status, demographic location, lack of education, ignorance and negative dental experience in the past. A report from Hong Kong stated that prolonged bottle feeding is a major cause of ECC and is very common (73%) among children in Asia (Thomson, 2016). In the Malaysian population, ECC could be a result of dietary habits and eating patterns, with 64.9% of preschool children needing dental treatment (OHD-MOH, 2017). It is believed that as eating habits change with age, the incidence of dental caries decreases, as was found in the current study.

SSCs provide tooth protection for restoration of primary posterior teeth, especially when extensive caries, pulpal exposure, and developmental anomalies are present in the patient. SSCs offers a high success rate, long term affordability, and superior clinical performance to restore posterior dentition (Seale and Randall, 2015). Similarly, the results of the current study suggest that SSCs were mostly used to restore posterior primary dentition, and ongoing trials pertaining to SSCs are much awaited (Lopez-Cazaux *et al.*, 2019). The subjects in the current study had badly broken down and decayed primary molars due to ECC, and they required pulp therapy to allow the teeth to be retained inside the mouth and to function as a space maintainer while awaiting exfoliation. Hence, SSCs were used to ensure that the tooth function could be restored, and to avoid repeated treatment under GA, and to achieve better long-term outcome (Abdul Karim *et al.*, 2008; Lehtonen *et al.*, 2015). Another material of choice to restore primary molars is GIC, which has the advantage of releasing fluoride, calcium, and phosphate ions (Abdul Karim *et al.*, 2008), and a tooth coloured material that provides good aesthetic results. Composite restorations were placed on the anterior dentition using a rubber dam where applicable. Placing composite restorations under GA is helpful for the practitioner, as he/she has better control of moisture. This is also the case for other treatment modalities

such as pulpotomies and surgical procedures. Because children cannot stay immobile for a long period of time, comprehensive restorative treatment can be conveniently performed under GA, and it improves the overall quality of the treatment being provided.

Although most of the subjects in this study were classified as ASA I and II with no medical or behavioural disorder, the purpose of treating them under GA was the need for complete oral rehabilitation in a single appointment, mainly due to their young age and low cognitive abilities (Attari and Roberts, 2006; Abdul Karim *et al.*, 2008). It is believed that dental treatment under GA does not diminish dental fear, and it needs to be dealt with after GA to allow young children to gradually modify their behaviour as they mature. Subjects who were classified as ASA III had complicated medical problems and thus needed dental treatment under GA; these patients had disorders such as congenital heart disease, asthma and Down syndrome with age younger than six years old. Subjects in the study pool were relatively young, and their body weight was below the normal range for their age as compared with the study conducted by Clarke *et al.* (2006). Thus, future studies should evaluate the relationship between low body weight and the occurrence of ECC and whether the patient's body weight improved after dental treatment under GA.

## CONCLUSION

Based on results of the current study, the following conclusions can be made: (1) most subjects aged six years and below received dental treatment under GA for total oral rehabilitation, (2) deciduous teeth were mostly extracted rather than restored due to ECC, (3) younger children with ECC have low body weight, and (4) subjects with medical problems and ECC who cannot be treated otherwise can be managed under GA with close collaboration with the medical and anaesthetic teams. Additionally, there is

a need to educate parents regarding ECC, improve household practices, and urge them to bring their children to the dentist for check-ups as early as one year old. Future studies should assess the effects of treatment under GA on child oral health and quality of life, and post-treatment satisfaction should be recorded to help improve the services being provided.

## ACKNOWLEDGEMENTS

We would like to thank Dr. Rohayu Hami, the staff at the record unit, and helpful dental and anaesthetic staff of AMDI, USM for their support and assistance during this study.

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