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Patterns of Paediatric Dental Treatment Under General Anaesthesia: A Retrospective Study

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ABSTRACT

This retrospective study aimed to evaluate patterns of comprehensive dental treatment under general anaesthesia (GA) for healthy children in Universiti Teknologi MARA, Malaysia. The treatment records of healthy paediatric patients who received dental treatment under GA from February 2017 to January 2021 were reviewed. The patients were divided into two groups: (1) less than 6 years old and (2) 6 to 16 years old. Patients' characteristics were summarised using descriptive statistics while an independent *t*-test was applied to investigate the influence of "age group" on treatment duration, number of procedures and use of various restorative materials. A total of 125 paediatric patients (67 boys and 58 girls) were included. The patients' mean age at the time they underwent GA was 5.77 ± 1.94 years old and the average duration of dental treatment was 62.58 minutes. There was a significant difference in the duration of treatment between the two age groups ($p < 0.05$). Tooth extraction was the most dental procedure performed (63.31%). The 6 to 16 years old group had a significantly shorter treatment duration ($p < 0.05$). However, no significant differences were found in all procedures (extraction, restoration, preventive and pulp therapy) and the utilisation of composite, glass ionomer cement (GIC) and compomer in both groups. The use of stainless steel crown (SSC) restorations was significantly higher in the less than six years old group ($p < 0.05$). Most of the dental procedures performed under GA on healthy children were extraction procedures. Children less than six years of old had a longer treatment duration under GA. Composite restorations and SSC were more frequently used in primary dentition.

Keywords: Children; comprehensive dental care; general anaesthesia; paediatric dentistry

INTRODUCTION

Dental services have been introduced in Malaysia since the late 1960s (OHD-MOH, 1998), which has been expanded

to advance the dental health status of the population of Malaysia through the provision of promotional, preventive, curative and rehabilitative dental services over the years (Karim *et al.*, 2008). In managing paediatric patients, the administration of local

anaesthesia, sedation and general anaesthesia (GA) is an essential part of paediatric dental practice (American Academy of Pediatric Dentistry, 2004). Furthermore, the American Academy of Paediatric Dentistry endorsed a guideline regarding GA for paediatric dental patients who are unable to cooperate, experience ineffective local anaesthesia, extremely fearful, anxious, or uncommunicative and require significant surgical procedures (American Academy of Pediatric Dentistry, 2016). The same guideline posits that such patients requiring immediate or comprehensive care will benefit from GA by protecting them from psychological trauma and reducing medical risks.

In addition, GA is given prior to treatment to ensure the comfort of the paediatric patient (Dziedzic, 2017), aids the clinicians to provide better treatment standards and a higher level of care (Karim *et al.*, 2008), to alleviate patients' stress (Nick *et al.*, 2003), or for children presented with less cooperation in the dental clinic because of age, maturity and physical or learning disability (Albadri *et al.*, 2006, Harun *et al.*, 2021). Studies have revealed that the strength of dental restoration performed under GA was more superior to local analgesia, as the operator can achieve better control of moisture, discuss pre-operative restoration and treatment plan with parents (Eidelman *et al.*, 2000; Tate *et al.*, 2002).

The present study was carried out to identify the characteristics and the type of treatment for paediatric patients below 16 years old, who underwent dental rehabilitation under GA in Universiti Teknologi MARA (UiTM), Malaysia – one of the dental teaching institutions in Malaysia. The results from this study will assist researchers and dentists in the planning and providing the appropriate and definitive treatment for children in the future. Overall, these findings will improve the quality of service in dental care and paediatric patients' health in Malaysia.

MATERIALS AND METHODS

This was a retrospective study of clinical data that was retrieved from dental records of healthy paediatric patients of 16 years old and below who had undergone comprehensive dental treatment under GA. The patients were treated by paediatric dental specialists from February 2017 until January 2021 at the Faculty of Dentistry, UiTM, Malaysia. Ethics approval was obtained from the University Research Ethics Committee (Ref. No.: REC/11/2020 [UG/MR/229]). In addition, the complete records of all healthy children who received dental rehabilitation under GA were reviewed at the Paediatric Dental Specialist, Faculty of Dentistry, UiTM. The records that were in line with the present study criteria were included in the current study. Children with special needs and medical illnesses were excluded from this study due to inappropriate data records at the time of data collection.

Both the hard copy post-operative notes and soft copy post-treatment notes were used for the data extraction. Detailed patients' clinical records were extracted, including the patient's name, date of birth, age, gender and race. The patient's information such as medical status, date of operation, time of start and end of treatment, diagnosis and type of treatment given were collected. All the hard copy post-operative GA and soft copy GA post-treatment notes were cautiously examined. The patient's record with inadequate clinical data, such as date of birth, time of start and end of each GA session was not included in the study.

The treatment procedures were classified as preventive (scaling and fissure sealants placement), restorative (amalgam, composites resin, compomer, glass ionomer cement [GIC] and stainless steel crown [SSC]), pulp therapy (pulpotomy and pulpectomy for primary teeth and pulpotomy for permanent teeth) and dental extractions.

Data were entered and analysed using Statistical Package for Social Science software, version 23.0 (SPSS Inc., IBM, Armonk, NY, USA). Descriptive and analytical statistics were performed. Descriptive analysis was presented as frequencies and percentages of the type of treatment procedures, patient's gender and duration of each GA session. An independent *t*-test was used to assess the influence of "age group" on treatment duration, number of treatment procedures and the use of different dental restorative materials. The level of statistical significance was set at 0.05 and below.

RESULTS

A total of 125 patients that underwent dental treatment under GA at the Faculty of Dentistry, UiTM between February 2017 and January 2021 were included in the final analysis. From a total of 223 records retrieved at the initial search, 125 records of medically fit and healthy patients were included while 98 records were excluded because of the following: adult patients ($n = 18$), all special needs patients (adult and children) with inappropriate data ($n = 46$) and healthy paediatric patients with insufficient data ($n = 34$).

All patients were treated on an elective basis. Table 1 shows the characteristics of the children receiving dental treatment under GA. A higher proportion were males (53.6%; $n = 67$) compared to females (46.4%; $n = 58$). The patient's mean age at the time they underwent GA was 5.77 ± 1.94 years old, ranging from 3 to 16 years old. Furthermore, they were divided into two age groups of < 6 years old (primary dentition) and 6 to 16 years old (combination of primary and permanent dentition). Based on the age grouping, 76.8% ($n = 96$) of the patients were < 6 years old while 23.2% ($n = 29$) were between 6 to 16 years old. As described in Table 1, the patients were presented with either early childhood caries (ECC), severe

early childhood caries (S-ECC) or multiple dental caries ($n = 110$), dental caries with supernumerary tooth ($n = 4$), dental caries with dental abscess ($n = 2$), dental caries with molar incisor hypomineralisation ($n = 2$), dental caries and mucocoele ($n = 2$), dental caries with dental cellulitis ($n = 1$), a non-vital tooth of mandibular left first permanent molar ($n = 1$), molar incisor hypomineralisation ($n = 1$), hypomineralised primary second molar ($n = 1$), dental caries, oral granuloma and cyst ($n = 1$). Approximately 45.6% ($n = 57$) of paediatric patients were referred for comprehensive dental treatment under GA because they were either uncooperative or had behavioural problems. Another 54.5% ($n = 68$) of paediatric patients were referred due to planning for multiple dental procedures, which include several extractions and dental restoration (Table 1).

The period of dental treatment depended on the complexity of the provided treatment. The average duration of dental treatment was 62.58 minutes \pm 23.81 with a range of 13 to 139 minutes. A combination of the treatment complexity and the clinician's experience contributed to the wide standard deviation of the average duration of dental treatment. In this study, the duration of dental treatment was defined from the time the patient was intubated until the completion of dental treatment. There was a significant difference in the duration of treatment between the age groups ($p < 0.05$), with the 6 to 12 years old group recording a significantly less treatment duration than the < 6 years old group (Table 2).

Over a four-year duration, a total of 1,390 treatment procedures were completed under GA. A higher proportion of the treatment procedures was dental extractions (63.31%; $n = 880$), which included 99.4% ($n = 875$) of primary teeth and 0.6% ($n = 5$) of permanent teeth; 27.41% ($n = 381$) were restorative procedures, involving 96.6% ($n = 368$) of primary teeth and 3.4% ($n = 13$) of permanent teeth; 5.90% ($n = 82$) were preventive procedures, which comprised

Table 1 The characteristics of paediatric patients based on demographics

Characteristics of patient	Number	Percentage (%)
Gender		
Male	67	53.6
Female	58	46.4
Age		
< 6 years old	96	76.8
6–16 years old	29	23.2
Race		
Malay	118	94.4
Chinese	4	3.2
Indian	2	1.6
Others	1	0.8
Year of GA		
2017	14	11.2
2018	44	35.2
2019	33	26.4
2020	34	27.2
2021	0	0
Diagnosis		
ECC/S-ECC/multiple dental caries	110	88
Dental caries with supernumerary tooth	4	3.2
Dental caries with dental abscess	2	1.6
Dental caries with molar incisor hypomineralisation	2	1.6
Dental caries and mucocele	2	1.6
Dental caries with cellulitis	1	0.8
Non vital of mandibular first permanent molar	1	0.8
Molar incisor hypomineralisation	1	0.8
Hypomineralised primary second molar	1	0.8
Dental caries, oral granuloma and cyst	1	0.8
Reason for GA		
Behavioural problems	57	45.6
Comprehensive dental care	68	54.4

51.2% ($n = 42$) of primary teeth and 48.8% ($n = 40$) of permanent teeth. The least treatment procedure was pulp therapy (3.38%; $n = 47$), which was only performed on primary teeth. As shown in Table 3, the most common procedure performed under GA was extractions. The mean number of tooth extraction done per patient was 7.00 for primary teeth and 0.04 for permanent teeth. Dental extraction was performed on five permanent teeth due to molar incisor hypomineralisation with or without dental caries.

The second most common treatment procedure provided under GA was restorative (Table 3). The preventive procedure which is fissure sealant placement was the third most common procedure that was performed under GA with an average of 0.66 per patient, which involved an average of 0.34 in primary dentition and 0.32 in permanent dentition (Table 3). In addition, six patients from the 6 to 16 years old group underwent cyst enucleation surgery, surgical removal of mucocele and the supernumerary teeth as shown in Tables 3 and 4. As

Table 2 Treatment duration for dental treatment under GA based on age group

Treatment duration (minutes)	Age group		Total (%)
	< 6 years old (%)	6–16 years old (%)	
< 30	3 (2.4)	5 (4.0)	8 (6.4)
31–60	47 (37.6)	18 (14.4)	65 (52.0)
61–90	31 (24.8)	5 (4.0)	36 (28.8)
91–140	15 (12.0)	1 (0.8)	16 (12.8)

Table 3 Treatment procedures performed under GA based on type of teeth

Treatment procedures	Number of procedures	Percentage (%)	Mean (\pm SD)
Extraction			
Primary	875	99.40	7.00 (\pm 3.86)
Permanent	5	0.60	0.04 (\pm 0.27)
Total	880	63.01	7.04 (\pm 3.82)
Restorative			
Primary	368	96.60	2.94 (\pm 2.40)
Permanent	13	3.40	0.10 (\pm 0.47)
Total	381	27.29	19.03 (\pm 125.49)
Preventive (fissure sealants)			
Primary	42	51.20	0.34 (\pm 1.00)
Permanent	40	48.80	0.32 (\pm 0.95)
Total	82	5.87	0.66 (\pm 1.73)
Pulp Therapy			
Primary	47	100.00	0.38 (\pm 1.05)
Permanent	0	0.00	0.00 (\pm 0.00)
Total	47	3.37	0.38 (\pm 1.05)
Surgical Procedures			
	6	0.43	0.04 (\pm 0.24)

presented in Table 5, SSC (49.6%; $n = 189$) was the most restorative material used for both age groups, followed by composite resin restoration (36.2%; $n = 138$), glass ionomer restoration (12.9%; $n = 49$) and compomer restoration (0.26%, $n = 1$).

Tables 4 and 6 shows the mean number of procedures and restorative procedures performed under GA by age groups, respectively. The restorative treatment of using SSC was significantly higher in the < 6 years old group compared to the 6 to 16 years old group ($p < 0.05$). There was no significant difference in the composite resin restoration, glass ionomer restoration and compomer restorative procedures between the two age groups. The reason for dividing the age groups was because only two of the

healthy paediatric patients included in this study were between 12 and 16 years old, hence, these two patients were included in the 6 to 16 years old group.

DISCUSSION

In this study, a total of 125 patients had received dental treatment under GA from February 2017 until January 2021, excluding those that were more than 16 years old, children who presented with special needs and were medically compromised, and patients with insufficient data. Treatment under GA is indicated for young children who need extensive dental treatment, who are medically compromised, or who are behaviourally challenged. Hence, treatments

Table 4 Distribution of dental procedures performed under GA by the age groups

Treatment procedures	Age group		t-test	p-value
	< 6 years old	6–16 years old		
	Mean (\pm SD)	Mean (\pm SD)		
Extraction	7.14 (\pm 3.62)	6.72 (\pm 4.97)	0.51	0.61
Restorative	24.28 (\pm 142.94)	1.66 (\pm 1.57)	0.85	0.40
Preventive (fissure sealants)	1.43 (\pm 0.15)	1.40 (\pm 0.26)	0.04	1.00
Pulp therapy	1.11 (\pm 0.11)	0.74 (\pm 0.14)	1.41	0.16
Surgical procedures	0.03 (\pm 0.19)	0.05 (\pm 0.30)	NA	NA

Table 5 Restorative materials used for dental treatments under GA based on type of teeth

Restorative material	Number of procedures	Percentage (%)	Mean (\pm SD)
Composite			
Primary	132	95.7	1.05 (\pm 1.54)
Permanent	6	4.3	0.05 (\pm 0.38)
Total	138	36.2	1.10 (\pm 1.56)
GIC			
Primary	44	89.8	0.35 (\pm 0.89)
Permanent	5	10.2	0.04 (\pm 0.27)
Total	49	12.9	0.38 (\pm 0.90)
Compomer			
Primary	1	100	0.01 (\pm 0.09)
Permanent	0	0	0.00 (\pm 0.00)
Total	1	0.26	0.01 (\pm 0.09)
SSC			
Primary	188	99.5	1.50 (\pm 1.73)
Permanent	1	0.5	0.01 (\pm 0.09)
Total	189	49.6	1.52 (\pm 1.72)

Table 6 Distribution of restorative materials performed under GA by the age groups

Restorative procedures	Age group		t-test	p-value
	< 6 years old	6–16 years old		
	Mean (\pm SD)	Mean (\pm SD)		
Composite	1.27 (\pm 1.61)	0.72 (\pm 1.33)	1.66	0.10
GIC	0.33 (\pm 0.89)	0.52 (\pm 0.95)	-0.96	0.34
Compomer	0.01 (\pm 0.01)	0.04 (\pm 0.19)	-1.87	0.64
SSC	1.90 (\pm 1.80)	0.38 (\pm 0.73)	4.44	0.01

under GA should be the last treatment option (Nadeem *et al.*, 2020; Harun *et al.*, 2021).

The patients that received treatment under GA in UiTM were referred for comprehensive dental treatment under GA because these patients were uncooperative because of young age, had behavioural problems, or were scheduled for multiple dental extractions. These findings are consistent with the study reported by Karim *et al.* (2008). Likewise, another research revealed that some children were treated under GA due to their dental fear and phobia, or too immature to cooperate at the dental chair (Wong *et al.*, 1997).

Among the 125 patients analysed in this study, 53.6% were males and 46.4% were females. As stated by Karim *et al.* (2008), there was no marked difference in the proportion of females and males using the service. Most of the patients were Malays (94.4%) followed by Chinese (3.2%), Indian (1.6%) and other ethnicities (0.8%) as presented in Table 1, which reflects the major ethnic population in Selangor, Malaysia (Department of Statistics Malaysia, 2019).

The majority of patients that received treatment under GA were in the age group of < 6 years old. Understandably, those from the age group of 12 to 16 years old were less commonly treated under GA as they were older and had higher tolerance to dental treatment (Tsai *et al.*, 2006).

The predominant cases treated were those diagnosed with ECC, thereby indicating high incidence of ECC among young children in Malaysia. The participants' diagnoses were explained in the results and presented in Table 1, however, the decayed, missing, and filled teeth (dmft/DMFT) indices are not usually stated in the GA data records. These findings corroborate the reports from other teaching institutes in Malaysia (Karim *et al.*, 2008; Nadeem *et al.*, 2020; Samsudin *et al.*, 2021), as well as from other countries (Kakaounaki *et al.*, 2006; Tahmassebi *et al.*,

2014; Bücher *et al.*, 2016). In addition, this result is in line with the reported epidemiologic data of high caries prevalence (76.2%) among children aged 5 years old (OHD-MOH, 2007) and paediatric patients aged 6 years old, which was 74.5% in 2007 (OHD-MOH, 2009). Around 55.8% of 5-year-old children had three or more primary teeth affected by early childhood caries, whereas 25.3% of children had dmft score ≥ 10 (OHD-MOH, 2007).

The mean for extractions, restorative procedures, preventive procedures, and pulp therapy in the age group < 6 vs of 6 to 16 years old were 7.14 vs 6.72, 24.28 vs 1.66, 1.43 vs 1.40 and 1.11 vs 0.74, respectively. These results indicate a higher frequency of these procedures were performed in the age group of < 6 years old than those between 6 and 16 years old. The main provision of paediatric dental treatment under GA was very young patients with early childhood caries or severe childhood caries, amalgamated with severe dental fear and anxiety. These events may potentially induce cooperative behaviour and severe management difficulties at the chairside (Vinckier *et al.*, 2001). The needs of children undergoing treatment under GA is fundamental, especially when the definitive treatment could not be provided as planned. Such cases require thorough management to evade aggressive approach of not treating ECC, such as removal of the grossly carious tooth (Rayner *et al.*, 2003), to further prevent any bad consequences of untreated carious teeth such as instances pain, infection, poor appetite, disturbed sleep, premature loss of primary molars, which might lead to malocclusion and facial cellulitis (King *et al.*, 2007). A combination of regular follow-up, aggressive preventive approach and evaluation of dental restoration is essential for children who underwent rehabilitation under GA (Vinckier *et al.*, 2001).

Extractions were performed more frequently as compared to other treatments. There were 880 extractions, which included 875 primary teeth and five permanent teeth.

On average, 7.04 teeth were extracted per patient. The mean of extraction was higher in the age group of < 6 years old compared to the age group of 6 to 16 years old. Some children in this age group had a pre-operative radiographic assessment if they were cooperative and able to undergo the radiographic procedure. A study conducted by Chen *et al.* (2017) found that the increase in the number of extraction cases in patients aged less than 6 years old was due to the instability of primary teeth from root resorption and tooth mobility that required extraction as the treatment choice. The higher amount of tooth extractions of the primary teeth signify that the tooth damage exceeds restorable limits. In children that require extensive restoration or after pulpotomy procedure on the primary molar tooth, the tooth is then restored with SSC.

In this study, a total of 381 restorative procedures were recorded and divided into SSC placement ($n = 189$), composite resin restoration ($n = 138$), GIC restoration ($n = 49$) and compomer restoration ($n = 1$). Moreover, other procedures such as pulp therapy ($n = 47$) and fissure sealant placement ($n = 82$) were also performed under GA, as mentioned in Table 5. The use of composite resin restoration under GA is effective as it provides better moisture control. In addition, long-duration procedures such as pulpotomies and surgical procedures are attained under GA because most children with a short attention span cannot stay immobile for a long period (Nadeem *et al.*, 2020). In one session under GA, multiple procedures were performed, however, most accomplished treatments will be prioritised for extractions and SSC compared to other procedures (Ramazani, 2016).

SSC was the treatment of choice to ensure that the tooth can function normally. By choosing SSC, the clinician can prevent re-treatment under GA in cases where the tooth had extensive decay, necessitating pulp therapy to retain the tooth and to act

as a space maintainer while waiting for tooth exfoliation. Treating the tooth with SSC will yield a better long-term outcome (Karim *et al.*, 2008).

On average, each treatment undergoing GA had lasted for 62.58 minutes \pm 23.81, with a range of 13 to 139 minutes. Most treatments were completed within one hour. However, the duration of each session is dependent on the type and complexity of the treatment provided. The more the number of restorative treatments executed, the longer the duration of treatment (Mallineni & Yiu, 2018). The knowledge of operating time will permit optimum use of theatre time (Foley & Soldani, 2007). Significant variation in the duration of treatment was observed among these two age groups. As described in Table 5, the < 6 years old group utilised more operating time. This could easily be justified as dental treatment for patients from this age group was mainly restorative, as reflected by the higher mean number of restorative procedures and hence, the longer treatment time. The present findings are consistent with the reports by Mallineni & Yiu (2018), but in patients with special needs. For both age groups, treatment was completed in eight patients before 30 minutes while that of 16 patients were extended beyond 90 minutes (Table 2). This result agrees with the findings reported in two previous studies (O'Brien & Suthers, 1983; Mallineni & Yiu, 2018), where 4.5% to 5% of cases were completed before half an hour.

Despite this study yields evidence on patterns of dental treatment under GA for paediatric patients, the limitations are well acknowledged. There was a reduction in the number of patients that received dental treatment from 11th March until 22nd June 2020 (approximately three months duration) as compared to the average number of patients undergoing treatment during the same period. The number of patients had decreased during this period due to the implementation of the first movement

control order, as a preventive measure by the Federal Government of Malaysia in response to the COVID-19 pandemic (Tang, 2020). The data collected was only up to January 2021 due to the implementation of a third movement control order in Selangor implemented from 13th January until 26th January 2021 (Rodzi, 2021). Additionally, this study was conducted in one teaching centre, hence limiting the generalisation of the findings to other teaching centres in Malaysia. On the other hand, the outcome of this study could still act as baseline data to assist dentists in deciding the most relevant treatment plan for paediatric patients, as well as a parameter in supporting dentists to improve treatment plans and provide high-quality health care services for paediatric patients in the future.

CONCLUSION

Most of the dental procedures performed under GA on healthy paediatric patients were extraction procedures. Children < 6 years old of age had longer treatment time under GA. Composite restorations and SSC were more frequently used in the primary dentition. Furthermore, evaluating the parents' satisfaction with dental treatment under GA and the impact of treatment outcome on child oral health-related quality of life for providing better health services is highly recommended.

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