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The need for repeated dental care under general anaesthesia in children

ABSTRACT

Aim Though the use of advanced behaviour management may facilitate dental treatment in children, some patients still require comprehensive care under general anaesthesia (GA). This is especially true for young children and/or medically compromised children. Thus, this study aimed to provide information about children undergoing GA with regard to age, sex and medical conditions (ICD-10), repeated treatments, dental procedures and recall.

Material and Methods A total of 464 medically compromised children treated under GA in a dental university clinic between 2004 and 2012 were included. Patients' records were analysed retrospectively using SPSS (Version 21.0) and R for statistical analysis.

Results More than 75% of the patients were younger than six years when receiving initial GA. The proportion of children subjected to repeated treatments was low, at 11% for a second and <2% for a third round of GA. The greatest proportion of dental care consisted of restorative therapy and tooth extractions. The recall behaviour observed between the first and second GA revealed no significant influence on the time elapsed in between events ($p>0.05$).

Conclusions Oral care in children with medical conditions is mostly caries-related, and repeated treatment may be necessary, though it was generally uncommon in this university-based study population.

Keywords Children with special health care needs; Dental care; General anaesthesia.

Introduction

Although the use of special behaviour management techniques is encouraged in challenging patients, some interventions may not be addressed by behaviour guidance alone due to extensive treatment needs, complexity or urgencies. In these cases, general anaesthesia (GA) is an indispensable and reliable tool for safe and successful dental treatment [Enever et al., 2000; Dougherty, 2009]. It also enables the dentist to provide high-quality comprehensive dental care including restorations and extractions as well as the application of preventive measures [AAPD, 2008 & 2012]. This is especially true for very young children and those who are unable to cooperate. Limited cooperation may also be associated with underlying medical conditions [De Jongh et al., 2008; Glassman et al., 2009; Peretz et al., 2012; Thamassebi et al., 2014]. In addition, children with disabilities and chronic diseases are well known to frequently present with unmet dental treatment needs, which will promote the use of GA as well [Lewis et al., 2005; Hennequin et al., 2008]. The decision to employ GA is based on various indications and remains an individual decision based on the patients' capability to cooperate and medical status as well as the risks involved and dental treatment urgencies [Glassman et al., 2009]. Caries experience in children treated under GA is reported to be high, and repeated treatment under GA may be required [Scheller et al., 2003]. However, little is known about the demands for repeat care under GA and the use of recall intervals for children with underlying medical conditions [Thamassebi et al., 2014].

Therefore, the aim of this study was to elucidate the characteristics of children with special health care needs undergoing GA in a university setting with regards to 1) the provided treatment, and 2) repeated treatment under GA.

Materials and methods

The reporting of this study follows the recommendations of the ISPOR guidelines for retrospective studies [Motheral et al., 2003]. Approval by the Ethical Committee of the medical faculty was obtained prior to the investigation (project no. 031-13). In this retrospective single-centre study, all of the dental records of children receiving dental treatment at the department of conservative dentistry of the Dental Clinic of the Ludwig-Maximilians University, Munich (Germany), from January 2004 to December 2012 were analysed to identify treatment under GA. Paediatric dentists had treated all patients using the same operating units. All of the included patients were younger than 14 years at their first visit. Additionally, the subjects were suffering from at least one underlying

medical condition and underwent at least one recall visit following GA.

Data regarding the patients' age, sex, caries experience (dmft/DMFT index) at the first visit and medical status (ICD-10 codes) most relevant to dental treatment as well as the reason for treatment during the first round of GA, number and type of treatments per patient under GA, repeat treatment under GA and number of recall visits, excluding the first recall after GA, were collected and analysed by two independent dentists. The patients' recall with regard to recurrent treatment under GA was also evaluated. When any questions occurred regarding data retrieval, the responsible dental operator was consulted.

Initial visit

Dental treatment was based on commonly accepted treatment guidelines for special health care needs patients [AAPD, 2009; Glassman et al., 2009]. The first visit comprised a thorough oral examination, including caries scoring, assessment of oral hygiene, periodontal health and urgent oral treatments, and treatment planning in relation to the patients' medical conditions. When possible, professional teeth cleaning followed by the application of fluoride or chlorhexidine varnish was performed. This was accompanied by individualised oral health care recommendations for caretakers, e.g., cleaning techniques, the use of an electric toothbrush or other supporting tools and nutritional advice. The decision to undergo treatment under GA was considered in patients with a very young age in combination with extensive treatment needs or when cooperativeness was completely lacking and the patients did not show any changes after desensitisation efforts at a former appointment. Other indications were patients becoming uncooperative throughout further appointments and in cases of emergency treatment, e.g., dental trauma, abscesses or urgent oral rehabilitation. Whenever feasible, other necessary medical procedures were combined with dental care under GA.

General anaesthesia

Prior to treatment, the parents or caretakers of the patients gave their written consent for treatment under GA. The patients were either treated on an outpatient basis or received stationary and perioperative care in a paediatric hospital setting. Paediatricians, medical specialists and anaesthesiologists arranged the necessary perioperative setting in advance, according to the individual anaesthetic risk. The GA procedure itself followed general paediatric standards and was performed by an anaesthetic team comprising at least one anaesthesiologist and nurse. As part of the GA procedure, the patients were intubated nasally. Oral intubation was performed only in patients presenting facial or laryngeal deformities or a risk of bleeding.

Dental procedures

When indicated, panoramic, bitewing or apical X-rays were obtained preoperatively or under GA in accordance with national and international radiological regulations [RöV, 1987; Radiation protection no. 136, 2004]. All patients received comprehensive dental treatment including professional teeth cleaning, fissure sealants, composite fillings, vital pulpotomies, tooth extractions and direct space maintainers. Basically, all teeth were restored quadrant by quadrant. Treatment of traumatised teeth followed the recommendations of the International Association of Dental Traumatology (IADT) [IADT, 2012]. Postoperatively, on the same day as GA treatment, the parents and caretakers were re-motivated to follow recommendations regarding oral hygiene maintenance and a tooth-friendly diet. Following initial full-mouth dental rehabilitation under GA, regular preventive recalls were recommended. The first follow-up visits were scheduled within two weeks and three months after GA. A preventive recall visit was offered to all patients according to their individual risk three to four times a year.

Statistical analysis

The treatment frequency was analysed for four different age groups (0-3 years, 4-6 years, 7-9 years and 10-14 years). The first visit after GA was not recorded as a separate recall appointment, and the medical diagnosis (ICD-10) most severely influencing dental treatment was decisive. All of the data were collected and sorted using a spreadsheet programme (Microsoft Office, Excel 2007, Unterschleissheim, Germany) and were subsequently exported into SPSS software, version 21.0 (IBM Corp., Armonk, NY, USA), and R (www.r-project.org) for descriptive analysis and further testing. The descriptive statistics included mean values and standard deviations (SD). The Mann-Whitney U-Test was used to compare the dental health data between the two groups (GA and ODC) for all patients and for each age category. The level of statistical significance was set two-tailed at 95% ($p = 0.05$).

Results

Population

Out of a total of 464 patients aged 1 to 14 years (median 5 years), with a male-to-female ratio of 1.4:1, 448 children received treatment under GA. An additional 16 patients who had first been treated without GA subsequently received GA due to increased treatment needs, an emergency treatment or the development of adverse behaviour under daily practice conditions. In over two-thirds of the cases (311/464; 67%), the patients were younger than six years, with a peak in the timing of the first treatment under GA

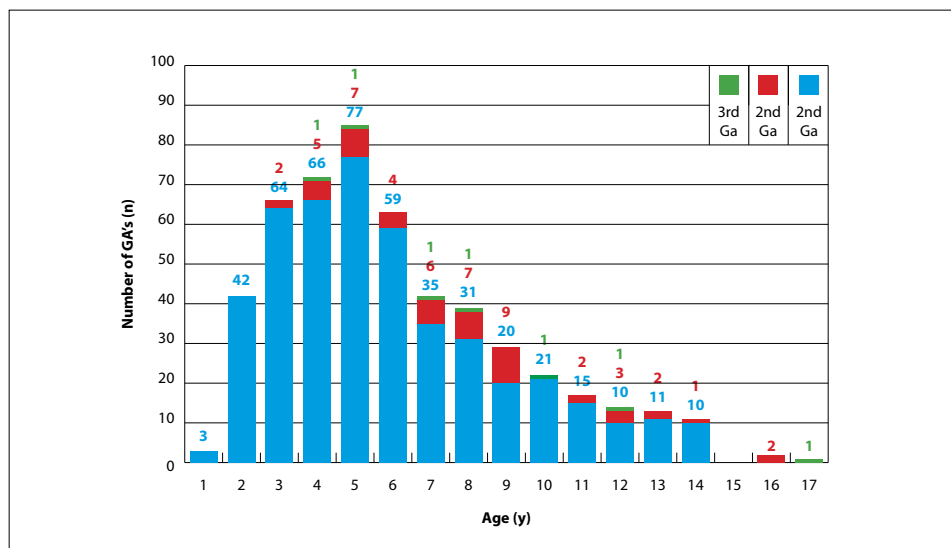


FIG. 1 The distribution of first, second and third GAs shows that the patients undergoing the initial treatment under GA were mainly younger than six years of age. Repeated GA treatments were distributed over the whole age range of the groups in this population.

		1. GA		2. GA		3. GA	
Reason for treatment		n (%)	n / patient (n=464)	n (%)	n / patient (n=50)	n (%)	n / patient (n=7)
Primary Dentition	Restorations (Caries)	385 (44.61%)	0.83	29 (43.28%)	0.58	4 (41.67%)	0.71
	Surgery (Caries)	287 (33.26%)	0.62	24 (35.82%)	0.48	5 (33.33%)	0.57
	Endodontic treatment	128 (14.83%)	0.28	7 (10.45%)	0.14	-	-
	Orthodontic treatment	55 (6.37%)	0.12	7 (10.45%)	0.14	3 (25.00%)	0.43
	Prosthetic treatment	3 (0.35%)	0.01	-	-	-	-
	Dental trauma	5 (0.58%)	0.01	-	-	-	-
	Periodontal treatment	0 (0%)	0.00	-	-	-	-
	Σ	863 (100%)*	1.86*	67 (100%)*	1.34*	12 (100%)*	1.71*
Permanent Dentition	Restorations (Caries)	84 (51.22%)	0.18	17 (65.38%)	0.34	3 (60.00%)	0.43
	Surgery (Caries)	27 (16.46%)	0.06	5 (19.23%)	0.1	-	-
	Endodontic treatment	31 (18.90%)	0.07	1 (3.85%)	0.02	4 (20.00%)	0.29
	Orthodontic treatment	10 (6.10%)	0.02	3 (11.54%)	0.06	-	-
	Prosthetic treatment	1 (0.61%)	0.00	-	-	-	-
	Dental trauma	2 (1.22%)	0.00	-	-	-	-
	Periodontal treatment	9 (5.49%)	0.02	-	-	-	-
	Σ	164 (100%)*	0.35*	19 (100%)	0.52*	5 (100%)*	0.71*

TABLE 1 Caries-related treatments were the most common reason for all three GAs. *Multiple reasons per patient were recorded.

being observed at the age of 5 (Fig. 1). A total of 50 patients (50/464; 10.8%) required a second treatment under GA, and 7 children (7/464; 1.5%) required a third. The age of the children subjected to a second GA ranged between 3 and 16 years (mean: 8 years). When a third treatment was performed, the patients were 4 to 17 years old (mean: 8 years) (Fig. 1).

The largest group of patients undergoing GA initially presented congenital and chromosomal malformations (Q00-99). These patients accounted to over 40% of all patients, followed by children suffering from mental or behavioural disorders (F00-99;13.8%) or diseases of the blood and blood-forming organs (D50-89;10.3%). Patients with congenital and chromosomal malformations were also consistently the largest group

of patients subjected to repeated treatment under GA (Fig. 2a-c).

The mean caries experience of primary teeth was 7.9 (±4.8) dmft, while it was 0.9 (±1.5) DMFT for permanent teeth at the first GA treatment in the overall population. Patients aged 4 to 6 years showed the highest caries experience of primary teeth (9.6 ±5.3 dmft). The highest caries experience for permanent teeth was 4.3±3.4 DMFT, in the group of 10- to 14-year-old patients.

Reasons for treatment and the provided treatments

Caries-related fillings or extractions were the most frequently required care (Table 1). This is also reflected

Treatments per patient Mean (sd)		1. GA				2. GA				3. GA		
		1-3 yrs	4-6 yrs	7-9 yrs	10-14 yrs*	1-3 yrs	4-6 yrs	7-9 yrs	10-16 yrs**	4-6 yrs	7-9 yrs	10-17 yrs***
		N=109	N=202	N=86	N=67	N=2	N=16	N=22	N=10	N=2	N=2	N=3
Primary Dentition	Fissure sealant	3.1 (2.6)	2.2 (2.5)	1.2 (2.0)	0.2 (0.8)	2.0 (0.0)	0.4 (0.9)	0.1 (0.4)	- (-)	- (-)	- (-)	- (-)
	Filling	5.7 (4.0)	6.2 (4.1)	3.7 (3.0)	1.0 (2.0)	6.5 (6.4)	6.6 (5.1)	2.3 (3.1)	0.9 (2.8)	7.0 (5.7)	2.0 (1.4)	0.3 (0.6)
	Stainless steel crown	0.6 (1.3)	0.8 (1.4)	0.3 (0.8)	0.1 (0.5)	0.5 (0.7)	1.4 (2.1)	0.5 (1.0)	- (-)	- (-)	- (-)	- (-)
	Endodontic treatment	0.5 (0.5)	0.7 (0.6)	0.3 (0.3)	0.0 (0.1)	0.5 (0.3)	0.4 (0.4)	0.3 (0.3)	- (-)	- (-)	- (-)	- (-)
	Extractions (caries)	2.1 (2.6)	2.6 (3.2)	2.5 (2.8)	1.4 (2.3)	- (-)	1.9 (2.3)	1.6 (2.0)	0.1 (0.3)	0.5 (0.7)	0.5 (0.7)	1.7 (2.1)
	Extraction (orthodontics)	- (-)	0.1 (0.6)	0.3 (0.8)	1.0 (2.4)	- (-)	- (-)	0.6 (1.5)	0.1 (0.3)	- (-)	- (-)	0.3 (0.6)
Permanent Dentition	Fissure sealant	- (-)	0.4 (1.3)	2.5 (1.9)	2.7 (3.2)	- (-)	- (-)	1.9 (1.8)	1.9 (2.6)	0.5 (0.7)	1.0 (1.4)	- (-)
	Filling	- (-)	0.1 (0.7)	1.3 (2.5)	4.2 (6.0)	- (-)	- (-)	1.5 (2.8)	5.2 (4.0)	- (-)	- (-)	2.3 (0.6)
	Stainless steel crown	- (-)	0.0 (0.2)	0.1 (0.4)	0.1 (0.4)	- (-)	- (-)	0.0 (0.2)	1.1 (1.8)	- (-)	- (-)	- (-)
	Endodontic treatment	- (-)	0.0 (0.1)	0.2 (0.3)	0.6 (0.5)	- (-)	- (-)	0.0 (0.1)	- (-)	- (-)	- (-)	1.0 (0.6)
	Extractions (Caries)	- (-)	- (-)	0.1 (0.5)	0.6 (1.1)	- (-)	- (-)	0.1 (0.5)	0.3 (0.5)	- (-)	- (-)	- (-)
	Extraction (Orthodontics)	- (-)	0.0 (0.1)	0.0 (0.2)	0.2 (0.6)	- (-)	- (-)	- (-)	0.8 (1.5)	- (-)	- (-)	- (-)
Σ Primary dentition	12.0 (2.3)	12.6 (2.4)	8.2 (1.7)	3.7 (1.2)	10.0 (2.4)	10.7 (2.6)	5.3 (1.4)	1.1 (0.9)	7.5 (2.4)	2.5 (0.7)	2.3 (0.7)	
Σ Permanent dentition	0 (0)	0.5 (0.4)	4.2 (1.2)	8.4 (2.3)	- (-)	- (-)	3.7 (1.2)	9.3 (2.2)	0.5 (0.2)	1.0 (0.4)	3.3 (0.8)	
Σ Total dentition	12.0 (1.7)	13.1 (1.8)	12.4 (1.5)	12.1 (1.8)	10.0 (1.7)	10.7 (1.9)	9.0 (1.3)	10.4 (1.7)	8.0 (1.7)	3.5 (0.6)	5.7 (0.8)	

TABLE 2 In the primary dentition, invasive treatments were more dominant over fissure sealants compared with the permanent dentition. Prosthetic, periodontal and orthodontic treatments as well as treatment due to trauma are not listed (n<10).

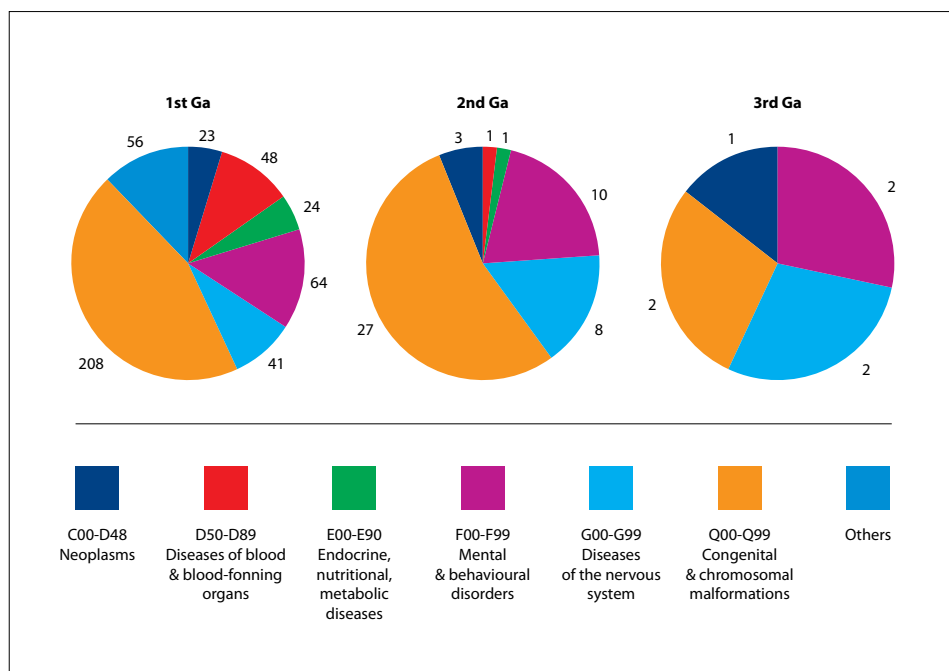


FIG. 2 Proportionally, patients with congenital and chromosomal defects accounted for the greatest number of patients receiving all three GA treatments (a-c). Only 11% (50/464) of the initially treated patients received a second GA (b). The number of patients undergoing GA for the third time was low (7/464; 0.5%) (c).

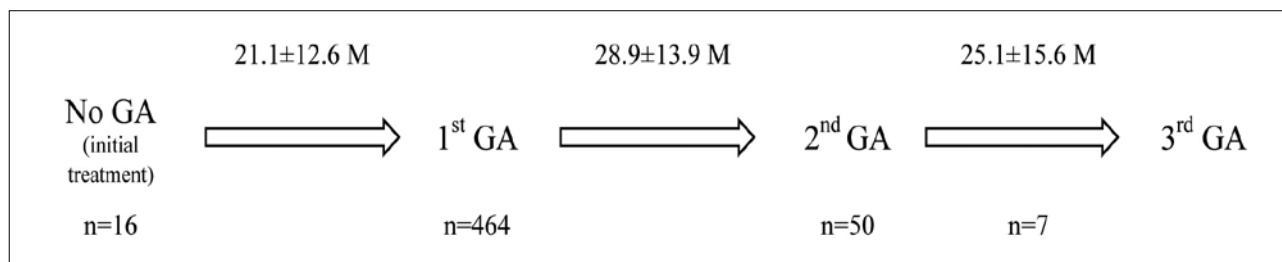


FIG. 3 The mean time (in months, including the standard deviation) elapsed between the initial treatment and the first and repeat GA treatments.

in the provided treatment (Table 2). Additionally, a large number of fissure sealants were placed in both dentitions, with significantly more fissure sealants being placed in the first than in the second GA ($p < 0.01$). Stainless steel crowns or endodontic treatment were only rarely applied in primary teeth. In permanent teeth, the number of fillings, endodontic treatments and extractions increased with age (Table 2).

Overall, prosthetic and periodontal treatment, as well as treatment for dental trauma, were rare incidents under GA. Only six patients were treated for trauma, 4 of whom were treated for prosthetic reasons and 9 for periodontal reasons. A total of 29 space maintainers were placed in the first GA and 2 in the second and third GA.

Intervals between rounds of GA and recall

The mean time gap between the initial treatments of the 16 patients who did not receive GA as a first measure and their first treatment under GA, as well as the gaps between the first and second GA and second and third GA were within the same range of magnitude, at approximately one to three years (Fig. 3). There were no significant differences between the number of recall visits and the time span between the first and second treatment under GA ($p = 0.537$) (Fig. 4).

Discussion

This study presents valuable information about dental treatment under GA in a large paediatric population in a university setting over a time period of up to nine years. In addition, it provides information about repeated treatments and the frequency of recall. Children who are referred to specialised centres, e.g., at a university, often have severe underlying medical conditions [Faulks et al., 2013; Alkilzy et al., 2014]. Children with or without disabilities under the age of six with great dental needs may typically receive GA due to a limited ability to cooperate during complex chair-side treatments [Sheller et al., 2003; Alkilzy et al., 2014; Almeida et al., 2000; Kvist et al., 2014]. Additionally, caries experience was extremely

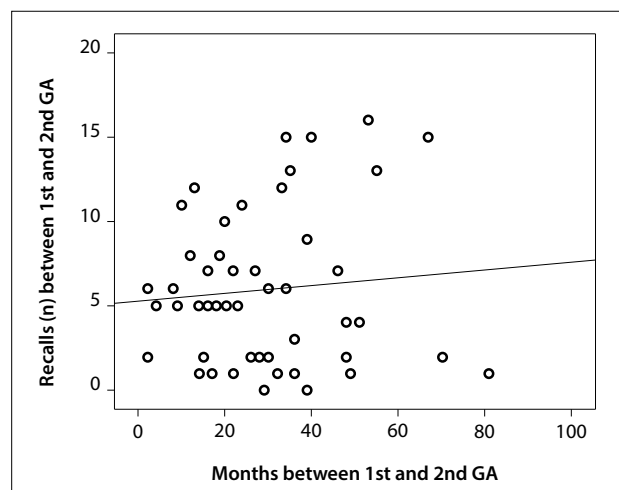


FIG. 4 No statistically significant correlation between the number of recalls and the time elapsed between the first and second GA was found ($p > 0.01$).

high in our study population compared with the child population of Bavaria, but it was slightly lower than that reported for other populations receiving GA [Peretz et al., 2012; Kvist et al., 2014; DAJ, 2010; Chen et al., 2014]. Although the sample does not represent all children with medical conditions, it reflects a population treated in a specialised setting at a university clinic with the standard of care routinely provided for this patient group on a long-term basis.

The main findings of this study included the observation that 89.2% of this population did not require an additional GA; repeated GA was indicated in only 10.8% of this sample, despite the high caries experience of the group at the initial treatment. Regarding the severity of the medical status of the included children, the observed frequency of repeated treatments, which occurred in just under 11% of the children for a second GA and less than 2% for a third GA, appeared to be rather low and was within the range described for healthy paediatric populations at high caries risk [Almeida et al., 2000; Kakounaki et al., 2011]. For a group of children with and without chronic illnesses or disabilities, Thamassebi et al. [2014] reported a similar rate of repeated treatment

of 12.5%. However, among this 12.5%, the majority of children undergoing repeated GA exhibited severe underlying conditions. Therefore, in comparison with our population, the percentage of repeated GA treatments only in children with disabilities was most likely higher than in our population. This implies that a medical condition alone may not be highly influential regarding repeated treatments. Additionally, the relatively low caries experience of our study population in comparison with other populations, in combination with the application of preventive dental care, may have contributed to this outcome.

The time interval between GA treatments was approximately two years for the initial treatment without GA, the initial round of GA and repeated treatments under GA. This is approximately the same range observed for healthy children suffering from early childhood caries treated under GA that has been reported by other authors [Albadri et al., 2006; Almeida et al., 2000; Sheller et al., 2003]. The reasons for undergoing repeated GA could be manifold. Inappropriate treatment planning and limited awareness of caretakers regarding the general health benefits of maintaining good oral hygiene for the patient, resulting into caries recurrence and delayed treatment, are a major issue [De Jongh et al., 2008; Albadri et al., 2006; Martens et al., 2000; Klingberg and Hallberg, 2012]. Additionally, patients who postpone minor treatments that could have been performed chair-side until the problem reaches an acute status may have contributed to the occurrence of repeated GA treatments, e.g., in the case of pain or swelling.

Treatment of dental caries was the primary reason for employing GA in our population. The dental treatment needs of children with disabilities and chronic illnesses are reported to be high, especially with regard to caries-related needs [Hennequin et al., 2008; Desai et al., 2001]. A number of studies have investigated the dental procedures applied in children with special health care needs undergoing GA. Compared with these data, the treatments per patient recorded in our population were at the lower end of the scale [Chen et al., 2014; Tsai et al., 2006; De Nova García et al., 2007]. With regard to the type of care performed, the treatments performed in this sample showed a less invasive character. For example, Lee et al. [2009] reported frequent use of stainless steel crowns and few applications of fissure sealants in patients up to the age of six, which may indicate differences in the caries experience (dmft/DMFT) of the populations and, most likely, differences in the applied treatment concepts regarding the use of a more conservative or more invasive approach [Lee et al., 2009]. Although these studies focus on the dental procedures provided under GA, none of them provides information about repeated treatment under GA or the recall behaviour of the patients [Chen et al., 2014; Tsai et al., 2006; De

Nova García et al., 2007].

Surprisingly, the number of attended recalls did not influence the time span between the first and the second GA for patients receiving repeated GA treatment. This is in accordance with the findings of Almeida et al. [2000], who also did not find any significant relationship between the numbers of recall visits and future treatments under GA. Multiple specific factors may have influenced this outcome. Thus, some patients may have attended recalls with their general dentist, but this information was not retrievable from the dental records. Furthermore, acute medical problems with hospitalisation and the burden to oblige many other therapeutic appointments may have contributed to delayed recall visits. On the other hand, regular professional preventive recall attendance that is not accompanied by appropriate domestic oral care will have only a very small influence on oral health. The reasons for insufficient oral hygiene lie not only in the awareness of caretakers, but are also related to the underlying medical condition. A limited ability to cooperate during daily oral care, in combination with other oral features such as manual dexterity, perioral spasticity, open mouth or tongue movement as well as unfavourable tooth alignment, make oral hygiene more challenging [Martens et al., 2000]. Therefore, common preventive measures might fail for the majority of this patient group, as described for other high-caries-risk children [Savanheimo and Vekalahti, 2008]. A solution to these specific and population-related issues might be to bring dental care and oral hygiene education directly into schools and homes to facilitate access to direct dental prophylaxis and education for caretakers.

A weakness of this study lies in the retrospective design, in which certain questions cannot be addressed properly. In addition, there was no control group for comparison of our findings (e.g., a study population without underlying medical conditions) and formulating a null hypothesis. It would also have been interesting to obtain more information about the reasons for referral and the reasons for the use of GA, such as the ability to cooperate. Limited cooperation may be age-related or associated with the underlying medical condition itself. Unfortunately, data regarding the ability to cooperate were inconsistent throughout the patients' records and were unreliable for the investigated population. Additionally, recall behaviour must be addressed under a prospective study design with defined recall intervals to more thoroughly investigate different co-factors that may have influenced the outcome regarding recall visits and future repeated treatments in a statistical model. At the same time, the applied study design reflects the treatment routine for this patient group provided in a university-based setting, including invasive and preventive treatments, as well as the aspects of retreatment and recall on a real-life basis.

Conclusions

General anaesthesia is a tool that is routinely used to for the treatment of children with underlying medical conditions, especially in younger children and in patients showing limited cooperation. Repeat care under GA may be necessary but appears to be uncommon in the described population.

Conflict of interest

The authors declare that they have no conflicts of interest.

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