PEDIATRIC DENTISTS' PREFERENCE OF GENERAL ANESTHESIA ENDOTRACHEAL INTUBATION ROUTE AND THEIR PERCEPTION OF A MODIFIED ORAL INTUBATION TECHNIQUE

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ABSTRACT

Pediatric dentists' preference of general anesthesia endotracheal intubation route and their perception of a modified oral intubation technique

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Aim: Pediatric airway management in light of notable modifications in endotracheal anesthesia armamentarium is an essential aspect in the pediatric population undergoing general anesthesia (GA). We aimed to assess Gulf Cooperation Council (GCC) pediatric dentists' preference of GA endotracheal intubation and their perception regarding a modified technique of oral intubation using a *Ring, Adair and Elwyn* "RAE" tube during dental treatment under general anesthesia.

Methods: A web-based questionnaire was circulated via social media platforms and emails to pediatric dentists practicing in the GCC. It included demographic variables and questions about preference, familiarity and perception of pediatric dentists related to a modified oral intubation method using an oral RAE tube. Responses were analyzed by using $\chi 2$ and Exact Fischer's test. Statistical significance was set as $p < 0.05$.

Results: A total of 73 pediatric dentists who perform dental treatment under GA responded. Male pediatric dentists were more familiar with RAE tube than females (p=0.031). Sixty-four percent of respondents (n=18) within the age 36-45 agreed on the proposed modified technique (p=0.027). Over 83.3% (n=15) out of 18 with ≥ 21 years of experience believed that the modified technique will cause difficulty when compared to nasal intubation (n=0.009).

Conclusion: The results of this study indicated that 79.5% of the studied sample considered nasal intubation as the route of choice, despite the fact that they believe it was associated with

more complications. The majority of GCC pediatric dentists were unfamiliar with the RAE tube. Interestingly, these results showed 50.7% level of agreement in utilizing a modified oral intubation technique using RAE tube. Therefore, it is recommended that further research should be undertaken and hands on workshops are conducted to familiarize GCC pediatric dentists with the feasibility and easiness in performing dental procedures under GA without tube interference.

DEDICATION

Today at this given opportunity, I would like to say that I am feeling proud and deeply grateful for completing this research. This would not have been possible today without the support of important people in my life that includes my close ones and great colleagues.

I would sincerely like to dedicate this research to my family who is a pillar of support in my life. My father and mother who have shown extreme support and belief in me throughout my life, through them I have understood the meaning of hard work, patience, respect and have received fundamental values to shape me into the person I am today.

My loving husband Mohamed Al Ali and two beautiful kids Maitha and Hamad who make me do what I do today, they make my world complete. They show their love and support in uncountable ways daily to me and with this abundance of care comes an attitude in me 'to never give up' in my life. My husband who has stood by me in each walk of life and supports my aspirations and dreams as if it belongs to him.

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DECLARATION

I declare that all the content of this thesis is my own work. There is no conflict of interest with any other entity or organization

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Signature: 

ACKNOWLEDGMENT

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With this, I would like to express my humble gratitude to all the staff and members of the research committee, my friends for their friendship, happy memories, positive attitude, help and continuous support throughout toward me.

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ABBREVIATIONS

(GA) - General Anesthesia

(DGA) - Dental General Anesthesia

(RAE) - Ring Adair Elwyn

(DHCC) - Dubai Healthcare City

(GCC) - Gulf Cooperation Council

(UAE) - United Arab Emirates

(CFSS-DS) - Children's Fear Survey Schedule-Dental Subscale

(NPO) - Nil Per Mouth

(ASA) - American Society of Anesthesiologist

(AAPD) - American Academy of Pediatric Dentistry

(UK) - United Kingdom

(SDCEP) - The Scottish Dental Clinical Effectiveness Program

(NTI) - Nasotracheal intubation

(OTI) - Orotracheal intubation

(GCP) - Good Clinical Practice

(MBRU) - Mohammed Bin Rashid University of Medicine and Health Sciences

(MBRU-IRB) - Mohammed Bin Rashid University-Institutional Review Board

(USA) - United States of America

1. INTRODUCTION

The management of pediatric patients with behavior management techniques in pediatric dentistry emphasizes the importance of providing a safe and painless experience for patients [(1)]. Pharmacological and non-pharmacological techniques ranging from simple in-office behavior-management techniques to full tracheal intubation general anesthesia (GA) in a hospital setting, are discussed in the literature [(2)]. For the vast majority of pediatric patients, successful in-office behavior management can be accomplished via communicative behavior management (e.g., positive reinforcement, tell show do, modeling) and conscious sedation [(3)]. Pediatric patients would benefit from deep sedation and GA if the former techniques were unsuccessful. General anesthesia (GA) may be taken into account considering patients' medical disability, physical and cognitive ability, perceived anxiety, procedure complexity, and patient, cooperative ability [(1)].

The intubation method is related to post-operative morbidity complications following pediatric dental GA [(4)]. Therefore, various methods have been used to reduce such complications [(5)]. However, there is a widely held view that pediatric dentists prefer an airway management technique (i.e., nasotracheal intubation) due to logistical factors. Several factors are associated with this view: the clearance of the surgical field, lower chance of tube displacement, along with the ease of evaluation of dental occlusion [(6)]. Despite its preference by pediatric dentists [(7)], nasotracheal intubation includes a major drawback associated with its blind traumatizing approach [(8)]. Epistaxis is among the most common problems associated with nasotracheal intubation [(6,8)]. In contrast, orotracheal intubation is characterized by the easiness of use, fewer provider attempts, and a less traumatic nature [(6)]. The preferred route of intubation among pediatric dentists is still under intense debate coupled with a lack of supporting literature to confirm the perception of pediatric dentists regarding this issue [(6)]. Therefore, any solution that addresses the issue with potential for improvement is viewed with optimism.

Endotracheal tubes are catheters that are placed in the trachea to maintain a patent airway. They vary in size, shape, and composition depending on their use [9]. Several types are recognized in the literature. For instance, the *Ring Adair Elwyn* (RAE) tubes that are named after their noble inventors Ring, Adair and Elwyn in 1970 [10]. RAE is a preformed bent tube designed to reduce the probability of kinking and to clear tubing from the surgical field [11]. They are south-facing tubes placed in the midline, which bends downward under the chin, allowing an unobstructed view of the upper face, otolaryngology, and other facial surgeries [11].

Modifications were made to accomplish several tasks, such as the clear surgical field for dental treatment. Dr. Junus Harris, a consultant anesthesiologist in Dubai Healthcare City (DHCC) in Dubai, The United Arab Emirates (UAE) was employing a modified oral intubation technique using RAE tube in a way where it was placed and secured at the corner of the mouth maintaining a clear surgical field for dental treatment. According to his unpublished data (personal communication) since he started employing this technique, no complications were documented, and it was highly accepted by a group of pediatric dentists that had worked with him in the last 8 years. Therefore, the current study aimed to assess the Gulf Cooperation Council (GCC) countries, of which the UAE is part of, pediatric dentists' preference of endotracheal intubation and their perception regarding a modified technique of oral intubation using RAE tube during dental treatment under GA.

2. LITERATURE REVIEW

2.1 Dental treatment under general anesthesia

Behavioral management has a critical role in providing safe, and quality dental treatment for patients [12]. A considerable amount of literature has been published on several behavioral management techniques and their promising outcomes in restoring carious teeth [12,13]. These techniques are categorized as pharmacological and nonpharmacological [14]. The same study reported that communication and language skills are fundamental in the successful application and utilization of all techniques. Pharmacological techniques are used to combat anxiety when simple behavioral management techniques, such as tell-show-do, modeling, and systematic desensitization, fail to gain patient cooperation.

Pharmacological management includes local analgesia, sedation, and GA [15]. These techniques are utilized when children's behavior poses challenges to providing optimal and quality care—in other words, when dental treatment under regular circumstances carries a high risk of causing an injury due to the perilous nature of using dental armamentarium. In addition, the patient's medical status and cognitive state and the treatment's extensiveness will direct the dentist's management method [15].

GA involves putting the patient fully to sleep for medical purposes [13] and in dentistry it is usually a day case procedure. GA is defined by Urban and Bleckwenn [16] as "*a state of medically induced unconsciousness or coma with the loss of protective reflexes and the absence of pain following administration of one or more general anesthetic agen*t." Although it is very safe, GA is associated with risks of mortality and morbidity [17] which are discussed below. It is the most effective option in pediatric dentistry to combat anxiety and pain and, hence, result in a comprehensive and high-quality care [18]. GA for pediatric dentistry should be carried out in a hospital setting by a highly skilled team, including an anesthetist, an anesthetic assistant, an operating theater assistant, a pediatric dentist, and trained nurses [18].

2.1.1 Advantages and disadvantages of general anesthesia

Dental rehabilitation under GA (DGA) has several advantages reported in the literature compared to other means of sedation. Malamed (2018) identified several advantages: Patient cooperation is not required. It is considered the only feasible treatment option among very young children and patients with special needs and very low cooperative ability. It facilitates the provision of quality dental treatment by dealing with unconscious patients who are nonresponsive to pain. A certain degree of post-procedure amnesia is present. A rapid onset of action and anesthetic drugs can be titrated to an optimal dose [19]. Moreover, Goodwin *et al.* elaborated that dental treatment under GA may alleviate anxiety among children according to some dental professionals and parents [20]. However, this finding was contradicted by other studies whose results showed that dental treatment under GA did not reduce anxiety [21,22]. In addition, treatments under GA increased anxiety according to the Children's Fear Survey Schedule–Dental Subscale (CFSS-DS) in a study carried out by Cantekin and co-workers [23].

On the other hand, the disadvantages are attributed to the fact that the patient's protective reflexes and vital signs are decreased. Therefore, administering GA requires a trained and experienced team of professionals capable of managing intraoperative and postoperative complications. Also necessary are special equipment for the continuous monitoring of unconscious patients and a recovery room for post-operative monitoring. Another disadvantage reported in the literature is that before performing GA, each patient must have a pre-anesthetic assessment. A patient should also be nil per mouth (NPO), which means they should fast pre-operatively [19].

The Closed Claims Project conducted by the American Society of Anesthesiologists (ASA) reported that procedures carried out in an office-based setting were associated with significantly higher fatal complications compared to those in a hospital-based setting. The same project elaborated that these office-based complications could have been prevented if better

monitoring had been utilized [24]. In general, although the advantages of performing treatments under GA are considerable, the disadvantages should be judiciously considered by the dentist, patient, and guardian. Each patient should be dealt with as an individual entity, taking into consideration his physical and mental status before proceeding with any treatment under GA [25].

2.1.2 Indications for dental rehabilitation under general anesthesia

Several reliable entities are dedicated to pediatric patients with special needs in oral health, recognizing the existence of a pediatric population for whom regular treatment under communicative nonpharmacological behavior management is not a feasible approach. Highly recognizable among these entities are the American Academy of Pediatric Dentistry (AAPD) [3] and the United Kingdom (UK) Clinical Guidelines in Pediatric Dentistry [26], which provide thorough and clear indications for the use of GA in the pediatric population.

Although a considerable amount of literature has been published on dental rehabilitation utilizing GA specifically for patients with special needs, most of them provide minimal discussions on the indications for GA [25]. The primary indication stated in the majority of the papers is the inability to cooperate or a similar general term [26,27]. However, some papers provided a detailed indication for the use of GA. For example, Malamed [19] provided a detailed list of what is considered appropriate indication for utilizing GA, including extremely anxious patients, patients with physical or mental disabilities, disorientation or dementia, young age, and traumatic or lengthy procedures. Silvestre-Rangil *et al*. stated that in addition to the lack of cooperative ability, special safety conditions and individuals who travel for long distances to receive a specialized dental treatment where treatment completion in a single session is desirable are other indications for DGA [28].

Similar indications were developed by the American Academy of Pediatric Dentistry (AAPD) Guidelines: "*GA is indicated for patients: 1) who cannot cooperate due to a lack of*

psychological or emotional maturity and/or mental, physical, or medical disability; 2) for whom local anesthesia is ineffective because of acute infection, anatomic variations, or allergy; 3) who are extremely uncooperative, fearful, or anxious; 4) who are pre-communicative or noncommunicative child or adolescent; 5) requiring significant surgical procedures that can be combined with dental procedures to reduce the number of anesthetic exposures; 6) for whom the use of GA may protect the developing psyche and/or reduce medical risk; 7) requiring immediate, comprehensive oral/dental care (e.g., due to dental trauma, severe infection/cellulitis, acute pain)" [3].

Interestingly, there is no general agreement that all of the indications are absolute [26]. The majority of the literature places an emphasis on one common theme, which is considering other behavior management interventions prior to going drastic and considering DGA [3,19,27]. Clinical judgment and decision-making are a combined agreement between the dentist, the guardian, and the patient, and it should always be in the patient's best interest [25].

2.1.3 Mortality, morbidity, and complications of general anesthesia

Anesthesia-related morbidity and mortality are fundamental aspects in the pediatric population when GA is the treatment of choice [29]. The Scottish Dental Clinical Effectiveness Program (SDCEP) reported that mortality risk associated with DGA is low, around 1 in 250,000, while the morbidities are significantly more communal [30]. Moreover, a systematic review study [29] reported on several earlier studies carried out in various countries and revealed that the current anesthesia-related mortality is lower compared to that of 50 years ago. The same study elaborated that mortality related to ventilation has markedly decreased since 1990 [29]. The observed improvement was attributed to several factors in providing safer anesthesia. These factors include providing treatment in a specialized pediatric environment using safer anesthetic agents and enhanced respiratory monitoring devices [29].

Several major risk factors associated with anesthesia-related mortality were recognized in the literature, such as age, especially in neonates or infants less than one year old [31], American Society of Anesthesiologists (ASA) III physical status or worse, cardiac surgery, and emergency surgery [29]. Concerning children with comorbidities, cardiocirculatory events and airway management problems were reported as the main cause of anesthesia-related mortality [29]. A systematic review by Mir Ghassemi *et al*. [32] reported that respiratory events are the most common complications followed by cardiovascular events. This finding cannot be generalized because of the high heterogeneity across the contributing studies [32].

In regard to anesthesia-related morbidity, Farsi *et al.* (2009) reported that postoperative complications in pediatrics undergoing dental treatment under GA rate ranges from insignificant to more than 90% of patients [4]. Pediatric patients undergoing dental treatment under GA report postoperative discomfort in varying severity. This was found to be related to several factors, such as the nature of the procedure, traumatic intubation, GA duration, the presence of a double throat pack, pre-existing medical condition the physician experience, and the use of local anesthesia [4]. The reported symptoms include dental pain, nasal bleeds, difficulty in eating, sore throat, drowsiness, vomiting, nausea, dehydration, weakness, fever, hoarseness, altered sleep, diarrhea, and constipation [4,33]. Among these reported complications, dental pain is the most common [4,17]. Interestingly, a study by Erkmen Almaz *et al.* [34] found that post GA complaints were limited to the first day and of mild severity. This finding is consistent with that of Farsi *et al.*, who reported that post 72 hours, complaints were significantly reduced [4]. Given the fact that it has low postoperative complications, Erkmen Almaz *et al*. [34] reported that this GA treatment option could be considered the treatment of choice for patient who lacks cooperative ability.

2.2 Anatomy of the pediatric airway

Respiration is the vital exchange of oxygen and carbon dioxide that occurs in the lungs [35]. It is a function of the respiratory system, which is composed of a network of organs that helps in breathing. It is divided into upper and lower respiratory tracts for the purposes of study. The upper respiratory tract involves the organs located outside the thorax (nose, pharynx, and larynx), while the lower respiratory tract structures are located within the thorax (trachea, bronchi, bronchioles, and lungs). Other accessory organs supplement the process of breathing, including the oral cavity, rib cage, diaphragm, and other respiratory muscles [36].

The safe and successful provision of anesthesia highly depends on the understanding of airway anatomy [37–39]. The pediatric airway anatomy varies from the adult's airway in terms of size and position of some structures. Some reported differences in the literature are the anterior position of the larynx, the shape of the epiglottis, the vocal cords, and the mucous membranes [40]. Another important factors to consider are the small nares and the relatively large tongue besides the short neck and trachea. The trachea was reported to be relatively soft during the first year of life, which makes it compress easily [39]. The same study found that these differences might be behind the obligate nasal breathing in children up to the age of 5 years [39]. In regard to the anatomy of the larynx, several findings are in conflict with the traditional concepts of the shape and the position of the narrowest portion of an infant's larynx [38]. The literature reported that the narrowest point in the pediatric airway is the cricoid cartilage [38,39]. Despite the continuous debate about the shape and the position of the narrowest point, the previous findings were found to be valid [38]. Bayeux in 1897 stated: *"If the intubating hand feels a small resistance against the passing of a tube, it is not caused by the vocal cords but the cricoid ring. If one wanted to grant the active vocal cords within a surrounding of pliable muscles a greater importance for tube selections than the non-dilatable cricoid ring, it would mean to support a theory that the resistance of the perineum is larger (for the passing newborn*

head) than that of the entrance of the pelvis" [41]. This conclusion emphasized the paramount need for understanding the airway anatomy for the safe selection and use of tracheal tubes. Eventually, these differences according to the literature were found to be significant, particularly in neonates and infants, becoming less markedly apparent as the child grows older. In view of everything that has been mentioned about anatomical variations, another interesting finding reported in the literature is the evident difference in pediatric larynx between sexes [39,42].

The anatomical variations stated in the literature pose challenges when airway management is required [43]. Therefore, special consideration should be given to the pediatric population when GA is planned. Several factors associated with the pediatric airway anatomy were found to predispose the pediatric patient to critical and life-threatening events [43]. First, the small diameter of the trachea might predispose the child to serious unwanted effects if small edema developed. Second, the relatively large tongue can obstruct ventilation, and with the displacement of the surrounding soft tissues, both was found to complicate visualization during laryngoscopy [43]. As reported in the literature, proper head positioning will aid visualization during laryngoscopy [43,44].

2.3 Upper airway management

During GA, upper airway management plays a critical role in assisting the function of the respiratory system. There are several means to support the upper respiratory tract, such as 1) continuous positive airway pressure, 2) supraglottic airway devices, 3) oronasal tracheal intubation, and 4) tracheostomy [9].

2.3.1 Nasotracheal intubation

Nasotracheal intubation (NTI) is the procedure where an endotracheal tube is passed through the naris into the nasopharynx and the trachea. It was first introduced in 1902 by Kuhn [45]. It is considered one of the most common approaches utilized in anesthetic induction for head and neck surgeries [46] where it is deemed difficult to intubate through the oral route. Several indications for NTI were reported in the literature, including intraoral and oropharyngeal surgery, patient with limited mouth opening (trismus), patients subject to prolonged intubation in critical care units, surgery needing better surgical access, such as in maxillofacial cases, tonsillectomies, rigid laryngoscopy, and micro-laryngeal surgery [47–51]. In contrast, the contraindications to NTI are further subdivided into relative and absolute contraindications. Absolute contraindications involve midface instability; coagulopathy, which might predispose the patient to epistaxis; suspected epiglottitis; skull base fractures; and impending respiratory arrest [51]. On the other hand, relative contraindications are issues that might compromise the nasal air passage (foreign bodies, large nasal polyps), recent nasal surgery, history of recurrent episodes of epistaxis and upper neck hematoma or infection [46,49,51]. However, in some occasions NTI is unavoidable, such as in recovered burn patients with severe microstomia [52]. NTI complications are considered one of the many causes of anesthetic-related morbidity and mortality [48]. Several complications that might be encountered during NTI were reported in the literature. Epistaxis is one of the most common complications and, in some occasions, serious

risks associated with NTI [46,49,50,53]. Advancing the nasotracheal tube blindly into a delicate and highly vascularized mucosa might predispose the patient to epistaxis, ranging from blood-tinged mucus to massive bleeding [47]. According to the literature, it occurs in around 77% of the cases [47]. Another reported serious but rare complication is the avulsion of the middle and inferior turbinates either partially or totally [51]. In addition, sinusitis was found to be significantly higher in pediatric patients at intensive care unit presenting with nasal tubes than those without [54]. Bacteremia has been found to be associated with the presence of bacteria in the nasal cavity, which might spread out due to traumatic injury during intubation. Moreover, the same study revealed that the tube itself can cause bacterial invasion from the nasal cavity to the trachea [46]. Interestingly, a study offers a contradictory finding where bacteremia was significantly higher subsequent to atraumatic NTI compared to traumatic NTI. According to Berry *et al.*, this finding appeared to be linked to the tracheal mucosa as a possible gateway of systemic bacterial invasion [55]. Positive cultures in the same study showed that the most common bacteria was *Viridans streptococcus* [56]. A pre-existing respiratory disease was found to be associated with a higher incidence of bacteremia when utilizing nasal intubation [46]. Hence, antibiotic prophylaxis is recommended for patients at risk of infective complications [46,56]. Intracranial penetration of the NTI is another reported life-threatening complication [48]. However, this finding was challenged by some authors who claim that it is based on unreliable reports [57]. Nevertheless, it is worthwhile to keep this inadvertent complication in consideration when dealing with patients presenting with fractures affecting the face and base of the skull [48].

Rigorous efforts are applied to reduce complications associated with NTI, such as lubrication of the endotracheal tube, using soft flexible smaller tube with gentle maneuvering, using vasoconstrictors in the nasal canal, and mechanical dilation of the nasal cavity [46–48]. Moreover, video assisted laryngoscopes were found to reduce intubation time and difficulty [58]. The

cornerstone of all these techniques is having adequate knowledge about the anatomy and physiology of the upper respiratory tract [46]. Nasal cavity anomalies are also potential concerns that should be considered. Therefore, enhancing healthcare outcomes through having adequate knowledge about anatomical variations that might affect NTI is of significant importance [50]. Some of these anatomical variations can cause unilateral obstruction, such as nasal polyps, septal deviation, nasal concha, nasal spur, and bulla ethmoidalis. A key consideration should therefore be to plan a preanesthetic assessment and use fiberoptic endoscopic techniques before proceeding with NTI for a predictable and safe management of patients [46,50,51].

2.3.2 Orotracheal intubation

Orotracheal intubation (OTI) is the process of inserting an endotracheal tube via the oral cavity to provide mechanical ventilation [59]. The first elective endotracheal intubation was reported by Macewen in 1878 [60]. OTI is considered the most common and the gold standard route of intubation and is the method of choice in emergencies [48].

Several advantages of orotracheal intubation reported in the literature are worth considering. Bowman *et al*. reported in his study that, compared to nasotracheal intubation, orotracheal intubation can be easily executed by inexperienced providers; it requires shorter duration, and fewer attempts were needed to establish intubation as less traumatic in nature. Moreover, he found that it does not increase procedure time and does not affect radiographs' quality [6].

Multiple indications for OTI were reported in the literature. First, it is indicated whenever appropriate control of the airway is required (e.g., GA) or for managing seriously ill patients [59]. Second, it is used when nasotracheal intubation is ill-advised [18]. In addition, it is the route of choice in emergency situations, such as in respiratory or cardiac arrest; deficient oxygenation or ventilation; failure to protect the airway from aspiration [44,59]. In contrast, a reported contraindication is in the case of trauma were gaining occlusion is fundamental [44].

Regarding OTI complications, the literature reported various complications that might be encountered with OTI. Chinnappa *et al*. reported that dental injuries are one of the most common complications, ranging from 1 in 150 to 1 in 1,000 cases, and the maxillary central incisors were found to be at the highest risk. In addition, the same study reported laceration or paralysis of vocal cords; trauma to the soft tissue; bronchospasm or laryngospasm; corneal abrasion; uvular damage and gastric or oral contents aspiration and a more critical complication subglottic injury [(59)]. Moreover, an incidence of 9% of bacteremia preceding urgent OTI was reported by Rijnders *et al*. He claimed that this fact was attributed to the traumatic nature of repeated attempts, which was the cause of bacteremia, whereas elective intubation was associated with lower incidents (0–5%) of bacteremia [(61)]. Palatal perforation was also reported as OTI complication [(62)]. In addition, rare but serious complication is the temporomandibular joint injury [(63)]. This finding was attributed to the excessive force applied during laryngoscopy to optimize airway visualization. Most of the complications were found to be associated with difficult intubation, or using extreme force which may predispose to perforation, swelling and bleeding [(59)]. As mentioned above, the importance of pre-anesthetic assessment cannot be underemphasized in the cases where immediate intubation is not a requirement. It aids in excluding the presence of congenital abnormalities and any conditions that predispose the pediatric population to any adverse events [(59)].

2.4 Preference of intubation technique

There are various modes of intubation reported in the literature based on the nature of the surgery/restorative procedures, access required by the operator, the urgency of tracheal intubation and the accessibility to each route [(18,52)]. These include 1) oral tracheal intubation, 2) nasal intubation, 3) retro-molar intubation, and 4) sub-mentotracheal intubation [(9)].

To date, little evidence has been found about preferred route of tracheal intubation among pediatric dentists. In most of the literature searched, a higher preference was found to be toward NTI in the oral and maxillofacial field. According to Bowman *et al.,* the preferred airway management route among pediatric dentists is NTI. This was because NTI does not interrupt or interfere with intra oral treatment, it reduces the likelihood of tube displacement, and the operator can evaluate the dental occlusion. Moreover, he believed that NTI according to pediatric dentists will make it faster and easier to obtain radiographs when compared to OTI [(6)]. Nevertheless, these are the authors perception and no supporting evidence, to the authors knowledge, is available to validate these perceptions. Similarly, Mallineni *et al.* and Adewale reported that NTI is the route of choice in DGA among clinicians due to better accessibility [(15,18)]. In the same reword, Piepho *et al*. (2005) reported that for oral and maxillofacial procedures, NTI remains the preferred intubation route (64). Adenekan *et al.*, in his study on anesthetic challenges in the orofacial cleft repair, discussed that NTI was utilized in 82% among all reported cleft palate cases, reflecting that NTI is the surgeon's intubation route of choice [(65)].

Preferred techniques of managing airway may not be applicable in some occasions, as each patient is unique. Therefore, anesthetist should be experienced and capable of utilizing alternative techniques as appropriate [(66)]. A study by Caruos *et al.* discussed the airway management of recovered pediatric patients with severe head and neck burns. He reported that NTI is the route of choice in recovered burn patients with severe microstomia. In contrast, he reported that NTI was difficult to utilize in patients presenting with scaring of the nares [(52)]. This illustrated that the route of intubation, either nasal, oral, or transtracheal, is individualized to each patient. Broennle *et al.* reported that the choice of route of intubation is a combined agreement between the anesthetist and the surgeon after proper assessment and communication between the two parties, taking in consideration the clinical condition [(67)].

2.5 The modified oral intubation technique: The use of Ring, Adair, Elwyn (RAE) tubes

Endotracheal tubes are catheters made to pass through the trachea to maintain patent airway [9]. It was reported that they come in various sizes, shapes, and compositions [9,68]. Several indications were reported in the literature for endotracheal intubation. This involves GA, positive-pressure ventilation, procedures where it is difficult to control the airway, protecting the respiratory tract from gastric contents aspiration, various surgical procedures, and conditions involving neuromuscular paralysis [68].

Since the introduction of endotracheal tubes in the 1800 and the 1900, various evolutionary amendments have been made to these tubes to address particular challenges faced in the operating theatre [11]. These modifications were made to provide a safer and much comfortable anesthetic experience to both the patient and the provider. Some specialty designs were made for lung isolation, for a clear facial surgical field, for airway laser surgery, and for laryngeal nerve integrity monitoring [11].

The Ring–Adair–Elwyn (RAE) tubes, named after their noble inventors Ring, Adair, and Elwyn in 1970 [10], are preformed endotracheal tubes, shaped to be directed away from the operative site [68]. They are south-facing tubes placed in the midline, binding downward under the chin and allowing an unobstructed view of the upper face, otolaryngology, and other facial surgeries [11]. After three years of clinical trials and over 10,000 cases, RAE tubes were found to be an important addition to pediatric anesthesia [10]. Ward and Pandit (2008) reported that their shape makes them useful for cranial and oral surgeries [9].

Several advantages were reported in the literate related to the design of the tube. First, the preformed bend was found to reduce the possibility of tube kinking. Second, it allowed better accessibility and prevented the inadvertent advancement of the tube [10]. Adewale (2012)

reported that they were useful when access to either side of the mouth was required [15]. Their additional advantages were their low cost and easy availability [69].

To date, nasotracheal intubation is considered the route of choice among oral and maxillofacial physicians, as explained above [6,15,18,64,65]. However, this route was associated with more serious complications [46–48,54]. Thus, the RAE tube use may overcome these complications.

The modification of orotracheal intubation using RAE tubes in pediatric dental GA, to the extent that it did not "sway" or move during the procedure and did not obstruct dental accessibility, is proposed by the primary and co-investigator of this present study. The use of the kink-resistant preformed RAE tube means that it is to have the bend secured at the commissure of the lip entering laterally to the oropharynx. This was found according to the primary investigator and the co-investigators to provide a clear surgical view for dental procedures to be performed. According to local anesthilogists in UAE, the modification did not pose any complications or difficulties from the routine orotracheal tube (personal communication, unpublished data). This paradigm shift in our practice of DGA prompted the authors to consider the use of RAE orotracheal intubation and reducing the use of nasotracheal intubation unless the latter was unavoidable. It is always beneficial to think about alternative safe techniques in case conventional techniques carry any risk.

3. AIM

The aims of this study were to assess GCC pediatric dentist's preference of GA endotracheal intubation technique and their perception regarding a modified technique of oral intubation using an RAE tube during dental treatment under general anesthesia.

3.1 Specific objectives

- To determine GA intubation technique preferences among GCC pediatric dentists.
- To explore the participants' views about the potential associated complications of oral and nasal intubation.
- To explore the familiarity and perception of GCC pediatric dentists regarding a modified oral intubation technique.
- To investigate the association between participants demographic characteristics, knowledge, and their perception.

4. MATERIAL AND METHODS

In this chapter the study logistics, including the study design, study population including inclusion and exclusion criteria, questionnaire and statistical analysis are presented.

4.1 Study design

A cross-sectional survey-based study was conducted to assess the GCC pediatric dentists' preference of endotracheal intubation technique and their perception, regarding a modified oral intubation technique using RAE tube during dental treatment under GA (Figure 1). A carefully structured questionnaire was developed by the principal investigator coupled with being edited by a panel of four faculty in pediatric dentistry department at Dubai Dental Hospital - Hamdan Bin Mohammed College of Dental Medicine, Mohammed Bin Rashid University of Medicine and Health Sciences (MBRU) in Dubai, UAE.

The questionnaire was piloted amongst 10 pediatric dentists to assess its usability, reliability, and ease of completion. Minor adjustments were made according to the feedback. These pilot surveys were not included in the results.

4.2 Population

Licensed GCC pediatric dentists who provide dental treatment under GA were invited to participate. The emails of the pediatric dentists in the UAE were obtained from the Emirates Pediatric Dentistry Club (EPDC) while other GCC pediatric dentists were contacted through their respective pediatric dentistry societies and through social networking applications such as Instagram, Twitter, Facebook, and WhatsApp.

4.3 Sample size calculation

A convenience sample of pediatric dentists registered in GCC which the principal investigator and co-investigators contacted within a three-month period (as below). Those who met the inclusion criteria and accepted to participate in the study by signing the consent form were recruited.

4.4 Inclusion and exclusion criteria

4.4.1 Inclusion criteria

- Pediatric dentists working in GCC.
- Pediatric dentists providing dental treatment under GA.

4.4.2 Exclusion criteria

- General dental practitioners
- Dentists from other specialties
- Pediatric dentists not providing dental treatment under GA

4.5 Data collection

Data were collected over a 3-month duration from November 1, 2020 to February 1, 2021. Two reminders were sent for the completion of the survey at approximately 4-week intervals. Completion of the survey was voluntary and confidential (i.e., anonymous) and hence, no identifying personal details were obtained.

4.5.1 Questionnaire

Prior to answering the questionnaire, a standard script involving a brief about the modified oral intubation technique utlizing RAE tube and an illustrative photograph was provided to further clarify the research study. The questionnaire was conducted through Microsoft Forms® and consisted of three sections. The first section elaborated on partcipants' demographics.

The second section explored the pediatric dentists' preferred technique of dental GA endotracheal intubation and their familiarity with the modified RAE technique along with an image for further clarification. Firstly, the participants were asked about their preferred route of intubation and the motive behind their preference. Secondly, they were asked about their knowledge with respect to the intubation route associated with more complications. Thirdly, in order to identify difficulties faced by the operators when oral intubation is the only available choice, participants were asked to select any applicable choice related to the difficulties when operating with oral intubation, and to specify if there are any other limitations. Respondents were then asked to indicate whether they were familiar with Ring Adair Elwyn (RAE) tube and if they have used it to treat patients. In the cases where the RAE tube was used, respondents were asked to specify the RAE tube's location. Furthermore, they were asked if they have faced any problem due to the presence of the tube orally.

The last set of questions aimed to assess participants perception toward the proposed modified intubation technique using oral RAE tube through a Likert scale to evaluate their level of agreement (Appendix 2). In some of the open- ended questions room for comments was made to add a qualitative component to the study.

For the purposes of analysis, the questions were further categorized into 3 main categories, set out to assess pediatric dentist's knowledge, practice and perception regarding their preference, familiarity and insight in a modified oral intubation technique using RAE oral tube. See Tables 2,3,4 for details.

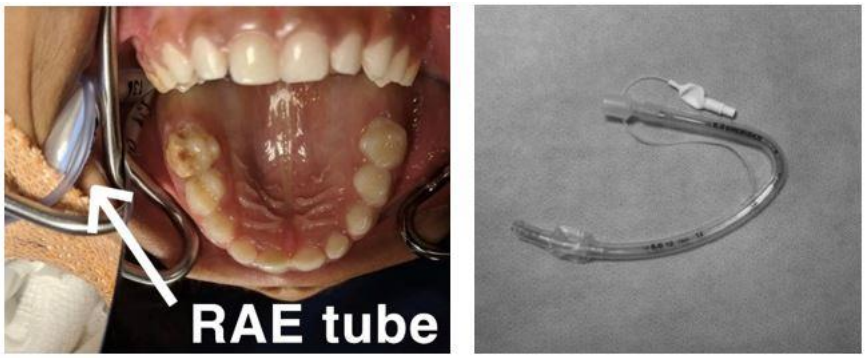


Figure 1: Oral RAE tube secured on the corner of the mouth

4.6 Statistical analysis

All analysis were carried out using IBM-SPSS for Windows Version 25.0 (SPSS Inc., Chicago, IL). Categorical variables were described using frequencies with corresponding proportions. Cross tabulation was utilized to examine the independency between categorical variables. The $\chi 2$-square test and Exact Fischer's test were considered as appropriate to test association. Score of agreement was calculated as ''Completely agree'' and ''agree'' were collapsed into ''agree'', while ''completely disagree'' and ''disagree'' were collapsed into ''disagree''. P-value of less than 0.05 was considered significant in all statistical analysis.

4.7 Ethical considerations

The study was conducted in full conformance with principles of the "Declaration of Helsinki", Good Clinical Practice (GCP), and within the laws and regulations of the UAE/DHCC. The ethical approval was obtained from the Research Ethics Review Committee at Mohammed Bin Rashid University of Medicine and Health Sciences. Mohammed Bin Rashid University Institutional Review Board approved the web-based questionnaire (Appendix 3, RE: MBRU-IRB-2020-012, approved June 2, 2020) powered by Microsoft Forms®.

5. RESULTS

This chapter is divided into four main sections: study demographics (descriptive variables), and the results relating to pediatric dentists' knowledge, perception, practice (descriptive and cross-tabulated with gender; age; experience; and country of pediatric specialty training (Tables 1 - 9).

5.1 Demographics

This survey presents the findings of a web-based questionnaire conducted via Microsoft Forms® with a sample size of 75 participants. Seventy-three out of the seventy-five respondents agreed to participate, while two disagreed. Among those who responded to the survey, 25 out of 73 (34.2%) were consultants, and 48 (65.8%) were specialists in pediatric dentistry. The participants worked in two main practice settings: 20 in private practice (27.4%), 37 in governmental (50.7%), whereas 12 participants (16.4%) reported both settings, and 4 (5.5%) responded as other. Table 1 shows an overview of the participants' demographic tabulation, including gender, age range, total years of practice as a specialist, GCC country of practice, and the country whereby the pediatric specialist degree was granted.

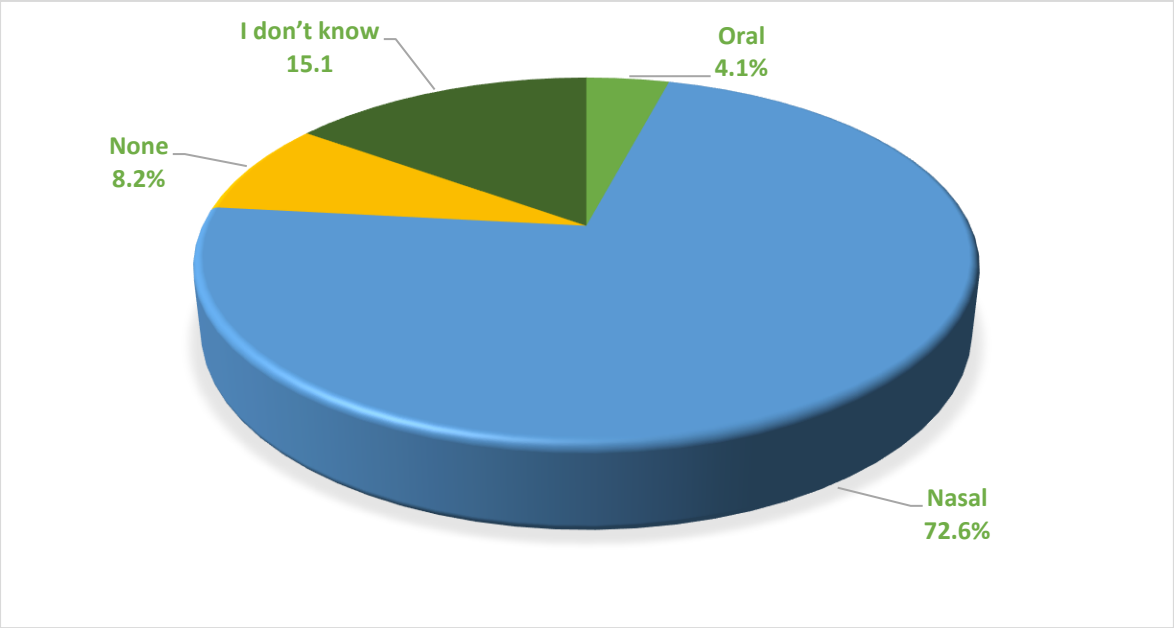
Gender	***n* (%) ***
Male	27 (37)
Female	46 (63)
Age	***n* (%)**
25 – 35	19 (26)
36 – 45	28 (38.4)
46 – 55	18 (24.6)
>55	8 (11)
Total years of professional practice as a specialist	***n* (%)**
< 10	34 (47)
10 – 20	21 (29)
21 – 30	14 (19)
31 – 40	4 (5)
Title	***n* (%)**
Consultant	25 (34)
Specialist	48 (66)
GCC country of practicing	***n* (%)**
United Arab Emirates	36 (49.3)
Saudi Arabia	19 (26)
Kuwait	9 (12.3)
Qatar	1 (1.4)
Bahrain	4 (5.5)
Oman	4 (5.5)
Country of specialization	***n* (%)**
Arab Countries	42 (58)
Asian Countries	6 (8)
Western and USA	25 (34)
* Percentages between parentheses are rounded and included only for comparison.	

Table 1: Study respondents' demographics

5.2 Knowledge of pediatric dentist – descriptive results

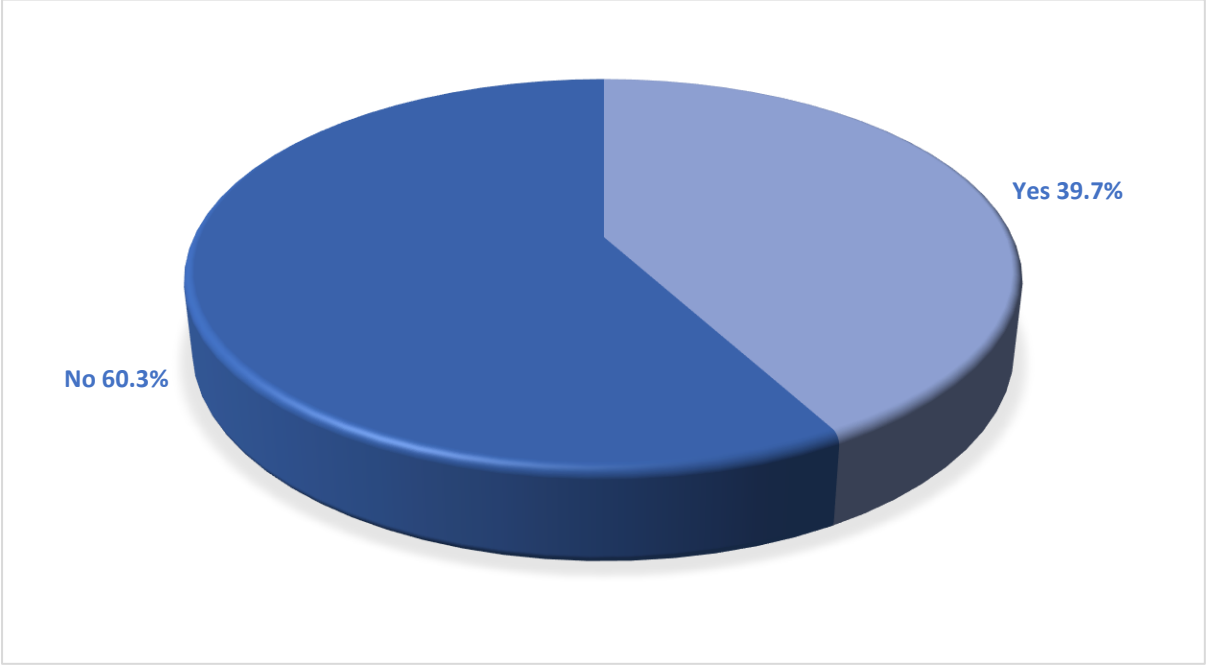
The first set of analysis examined the participants' knowledge and expertise with respect to complications associated with each intubation route which demonstrated a range of diverse opinions, with the majority leaning towards the complications linked to nasal intubation. Fifty-three participants (72.6%) expressed the belief that nasal intubation is associated with more complications. In contrast, oral was chosen by three (4.1%), six (8.2%) reported that none of them produced complications, and the remaining eleven (15.1%) had no idea which one was associated with more complications (Figure 2).

Figure 2: Endotracheal route associated with more complications



Sixty percent of the respondents were unfamiliar with the RAE tube accounting for 44 out of the 73 participants (Figure 3) compared to 29 (39.7%). A total of 27 out of these 29 used the RAE tube while treating children under GA. When the participants were asked about the area of the mouth that the RAE tube was placed, among the 27 participants who reported that they had treated a patient under GA using RAE tube (Table 3), 25 (92.6%) reported that it was in the corner of the mouth. In contrast, the remaining 2 out of 27 (7.4%) reported that it was in the midline. Details are summarized in table 2.

Figure 3: Familiarity with rae tube



Knowledge Questions	***n* (%)**
According to your knowledge which of these techniques have more complications?	
Oral	3 (4.1)
Nasal	53 (72.6)
None	6 (8.2)
I don't know	11 (15.1)
Have you heard about Ring Adair Elwyn (RAE) tube?	
Yes	29 (39.7)
No	44 (60.3)
In which area of the mouth was the oral RAE tube placed?	
Corner of the mouth	25 (92.6)
In the midline	2 (7.4)

Table 2: Pediatric dentists' knowledge of intubation complications and familiarity with RAE tube

5.3 Participants reported endotracheal intubation complications-quantitative and qualitative results

The second set of analysis aimed at assessing respondent's endotracheal intubation difficulties and complications (Table 3). In occasions where oral intubation was the only available choice, the challenges that the pediatric dentists encountered are as follows: obstructed surgical view and difficulties in taking impressions were reported by 45 (61.6%) and 44 (60.3%) participants, respectively. Whereas tube displacement and limitations of other procedures were reported by 36 (49.5%) and 28 (38.4%) participants, respectively. Participants were asked to elaborate more and specify other limitations encountered due to oral intubation. Qualitative explanatory comments were reported like *"Mainly checking the occlusion specially for recent specialists"* or *"Rubber dam, impression, anesthesia and any procedure at that site".*

Twenty-seven out of 29 (93.1%) who were familiar with RAE tube have treated patients under GA using RAE endotracheal tube. Respondents were asked if they have faced any problems due to the presence of RAE tube orally; 21 (77.8%) have not faced any problem, while 6 (22.2%) reported that they did. Challenges were conveyed as qualitative comments such as: *"It is not placed exactly at the corner of the mouth, so still it was obstructing some view and work and needed to shift it to the other side"* or *"limitation of space for intraoral procedures".*

Practice Questions	***n* (%)**
Have you treated a patient under general anesthesia intubated using an RAE endotracheal tube?	
Yes	27 (93.1)
No	2 (6.9)
Have you faced any problems due to the presence of the RAE tube orally?	
Yes	6 (22.2)
No	21 (77.8)
When oral intubation is the only choice, do you face any of these difficulties? Obstructed surgical view	
Yes	45 (61.6)
No	28 (38.4)
Difficulties in taking impressions	
Yes	44 (60.3)
No	29 (39.7)
Tube displacement	
Yes	36 (49)
No	37 (51)
Limitation of some procedures	
Yes	28 (38.4)
No	45 (61.6)

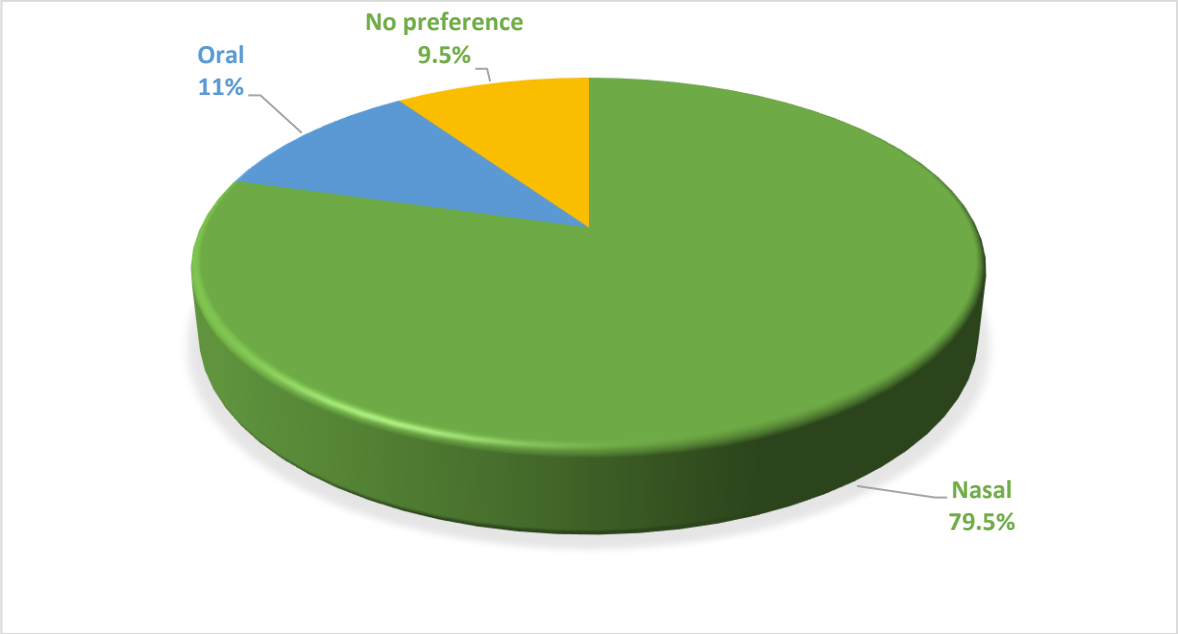
Table 3: Complications and problems of oral intubation

5.4 Perception of pediatric dentists' preferred intubation route

This section analyzed the question related to the respondent's perception about the preferred endotracheal intubation route, nasal intubation was the preferred choice among 58 (79.5%) respondents, while 8 (11%) considered oral intubation as the route of choice, and no preference was reported by 7 (9.5%) respondents (Figure 4). Half of the respondents showed a level of agreement in using the RAE modified technique where the results varied among three main realms as agree and completely agree were collapsed: 37 (50.7%) agreed, 31 (42.5%) had a neutral response, and 5 (6.8%) disagreed. The majority of the respondents indicated that this modified technique is worth considering in lightof the reported NTI complications in the literature, whereby 49 (67.1%) agreed. Whereas 22 (30.1%) of the responses were neutral and the remaining minority of participants 2 (2.7%) disagreed.

Fifty-two percent of the participants expressed the belief that this modified oral intubation technique will make it more difficult to perform the procedure compared to nasal intubation. In comparison, almost forty-eight percent disagreed (Table 4).

Figure 4: Preferred route of intubation



Perception Questions	***n* (%)**
Which route of intubation do you prefer?	
Nasal	58 (79.5)
Oral	8 (11)
No preference	7 (9.5)
What is the level of your agreement in using this modified technique of oral intubation with an RAE tube placed in the corner of the mouth?	
Disagree	5 (6.8)
Neutral	31 (42.5)
Agree	37 (50.7)
The literature has reported that nasal intubation might lead to some complications such as epistaxis. In light of this, do you think this technique is worth consideration?	
Disagree	2 (2.7)
Neutral	22 (30.1)
Agree	49 (67.1)
Do you think using this modified oral technique will make it more difficult for you to perform the procedure compared to nasal intubation?	
Yes	38 (52.1)
No	35 (47.9)

Table 4: Pediatric dentists' perception of endotracheal intubation techniques

5.5 Demographic data cross-tabulated against knowledge, practice, and perception

5.5.1 Gender cross-tabulated against knowledge/practice/perception

The association between respondents' knowledge/practice/perception and gender revealed no statistically significant differences, with the exception of the question "Have you heard about the Ring Adair Elwyn (RAE) tube?". Sixty-nine percent of female pediatric dentists (n=32) were not familiar with the RAE tube, compared to 44.4% of male pediatric dentists (n=12) ($p = 0.031$). See Table 5.

Knowledge	Male	Female	p-value
Have you heard about Ring Adair Elwyn (RAE) tube?			
Yes	15 (55.6)	14 (30.4)	
No	12 (44.4)	32 (69.6)	**0.031**
In which area of the mouth was the oral RAE tube placed?			
Corner of the mouth	12 (92.3)	13 (92.9)	
In the midline	1 (7.7)	1 (7.1)	0.957
Practice			
Have you treated a patient under general anesthesia intubated using Ring Adair Elwyn (RAE) endotracheal tube?			
Yes	13 (86.7)	14 (100)	
No	2 (13.3)	0 (0)	0.157
Have you faced any problems due to the presence of the RAE tube orally?			
Yes	4 (30.8)	2 (14.3)	
No	9 (69.2)	12 (85.7)	0.303
When oral intubation is the only choice, do you face any of these difficulties? Obstructed surgical view			
Yes	18 (66.7)	27 (58.7)	
No	9 (33.3)	19 (41.3)	0.337
Difficulties in taking impressions			
Yes	20 (74.1)	24 (52.2)	
No	7 (25.9)	22 (47.8)	0.052
Tube displacement			
Yes	16 (59.3)	20 (43.5)	
No	11 (40.7)	26 (56.5)	0.145
Limitation of some Procedures			
Yes	11 (40.7)	17 (37)	
No	16 (59.3)	29 (63)	0.469
Perception			
Which route of intubation do you prefer?			
Nasal	22 (81.5)	36 (78.3)	
Oral	4 (14.8)	4 (8.7)	
No preference	1 (3.7)	6 (13)	0.341
What is the level of your agreement in using this modified technique of oral intubation with RAE tube placed in the corner of the mouth?			
Disagree	2 (7.4)	3 (6.5)	
Neutral	9 (33.3)	22 (47.8)	
Agree	16 (59.2)	21 (45.6)	0.317
The literature has reported that nasal intubation might lead to some complications such as epistaxis. In light of this, do you think this technique worth consideration?			
Disagree	1(3.7)	1(2.2)	
Neutral	6 (22.2)	16 (34.8)	
Agree	20 (74)	29 (63)	0.452
Do you think using this modified oral technique will make it more difficult for you to perform the procedure compared to nasal intubation?			
Yes	15 (55.6)	23 (50)	
No	12 (44.4)	23 (50)	0.415

Table 5: Association between gender and knowledge/practice/perception

5.5.2 Age cross-tabulated against knowledge/practice/perception

The results shown in Table 6 indicate an association between knowledge/perception/practice questions and age. There was a clear significant correlation between practice questions in relation to some of the difficulties encountered with oral intubation by pediatric dentists and their age. Respondents were asked to select whatever was applicable with regard to the difficulties encountered with orotracheal intubation in general. A total of 18 (64.3%) respondents who reported tube displacement as one of the encountered difficulties were from the 36-45 age group, whereas 4 (21.1%) among the 25-35 age group and 14 (53.8%) in the ≥46 age group ($p = 0.012$). In addition, 15 (57.7%) of the ≥46 age group faced other limitations, compared to 4 (21.1%) in the 25-35 age group and 9 (32.1%) in the 36-45 age group ($p= 0.013$). Another statistically significant result was found ($p= 0.027$) when pediatric dentists were asked, “What is the level of your agreement in using this modified technique of oral intubation with the RAE tube placed in the corner of the mouth?” 18 (64.3%) of the respondents within the 36-45 age group answered “agree,” while the figures in the age groups 25-35 and ≥46 were 10 (52.7%) and 9 (34.6%), respectively. The chi-square test did not reveal any significant differences between knowledge and age.

	Age of participants in years			
Knowledge	**25-35**	**36-45**	**≥46**	**p-value**
Have you heard about Ring Adair Elwyn (RAE) tube?				
Yes	6 (31.6)	9 (32.1)	14 (53.8)	
No	13 (68.4)	19 (67.9)	12 (46.2)	0.186
In which area of the mouth was the oral RAE tube placed?				
Corner of the mouth	5 (100)	7 (87.5)	13 (92.9)	
In the midline	0 (0)	1 (12.5)	1 (7.1)	0.703
Practice				
Have you treated a patient under general anesthesia intubated using Ring Adair Elwyn (RAE) endotracheal tube?				
Yes	5 (83.3)	8 (88.9)	14 (100)	
No	1(16.7)	1(11.1)	0 (0)	0.337
Have you faced any problems due to the presence of the RAE tube orally?				
Yes	0 (0)	1 (12.5)	5 (35.7)	
No	5 (100)	7 (87.5)	9 (64.3)	0.188
When oral intubation is the only choice, do you face any of these difficulties? Obstructed surgical view				
Yes	11 (57.9)	18 (64.3)	16 (61.5)	
No	8 (42.1)	10 (35.7)	10 (38.5)	0.907
Difficulties in taking impressions				
Yes	10 (52.6)	16 (57.1)	18 (69.2)	
No	9 (47.4)	12 (42.9)	8 (30.8)	0.485
Tube displacement				
Yes	4 (21.1)	18 (64.3)	14 (53.8)	
No	15 (78.9)	10 (35.7)	12 (46.2)	**0.012**
Limitation of some Procedures				
Yes	4 (21.1)	9 (32.1)	15 (57.7)	
No	15 (78.9)	19 (67.9)	11 (42.3)	**0.013**
Perception				
Which route of intubation do you prefer?				
Nasal	16 (84.2)	20 (71.4)	22 (84.6)	
Oral	2 (10.5)	3 (10.7)	3 (11.5)	
No preference	1 (5.3)	5 (17.9)	1 (3.8)	0.457
What is the level of your agreement in using this modified technique of oral intubation with RAE tube placed in the corner of the mouth?				
Disagree	0	0	5 (19.2)	
Neutral	9 (47.4)	10 (35.7)	12 (46.2)	
Agree	10 (52.7)	18 (64.3)	9 (34.6)	**0.027**
The literature has reported that nasal intubation might lead to some complications such as epistaxis. In light of this, do you think this technique worth consideration?				
Disagree	0	1 (3.6)	1 (3.6)	
Neutral	5 (26.3)	69 (21.4)	11 (42.3)	
Agree	14 (73.7)	21 (75)	14 (53.5)	0.539
Do you think using this modified oral technique will make it more difficult for you to perform the procedure compared to nasal intubation?				
Yes	9 (47.4)	12 (42.9)	17 (65.4)	
No	10 (52.6)	16 (57.1)	9 (34.6)	0.227

Table 6: Association between age & knowledge/practice/perception

5.5.3 Experience cross-tabulated against knowledge/practice/perception

Upon analyzing the association between knowledge/perception/practice and experience (Table 7), none of the parameters were found to be significant except for the question related to pediatric dentists' perception: "Do you think using this modified oral intubation technique will make it more difficult for you to perform the procedure compared to nasal intubation?" Surprisingly, 15 (83.3%) who answered "Yes" were more experienced (≥ 21 years of experience), compared to specialists with less than ten years of experience 14 (41.2%), and those with 10-20 years of experience 9 (42.9%) (p=0.009).

Knowledge / Experience	<10 yrs	10-20 yrs	≥21 yrs	p-value
Have you heard about Ring Adair Elwyn (RAE) tube?				
Yes	12 (35.3)	7 (33.3)	10 (55.6)	
No	22 (64.7)	14 (66.7)	8 (44.4)	0.284
In which area of the mouth was the oral RAE tube placed?				
Corner of the mouth	10 (90.9)	5 (83.3)	10 (100)	
In the midline	1 (9.1)	1 (16.7)	0 (0)	0.450
Practice				
Have you treated a patient under general anesthesia intubated using Ring Adair Elwyn (RAE) endotracheal tube?				
Yes	11 (91.7)	6 (85.7)	10 (100)	
No	1 (8.3)	1 (14.3)	0 (0)	0.503
Have you faced any problems due to the presence of the RAE tube orally?				
Yes	0 (0)	2 (33.3)	4 (40)	
No	11 (100)	4 (66.7)	6 (60)	0.67
When oral intubation is the only choice, do you face any of these difficulties? Obstructed surgical view				
Yes	19 (55.9)	16 (76.2)	10 (55.6)	
No	15 (44.6)	5 (23.8)	8 (44.4)	0.267
Difficulties in taking impressions				
Yes	17 (50)	14 (66.7)	13 (72.2)	
No	17 (50)	7 (33.3)	5 (27.8)	0.231
Tube displacement				
Yes	16 (47.1)	12 (57.1)	8 (44.4)	
No	18 (52.9)	9 (42.9)	10 (55.6)	0.686
Limitation of some Procedures				
Yes	9 (26.5)	11 (52.4)	8 (44.4)	
No	25 (73.5)	10 (47.6)	10 (55.6)	0.131
Perception				
Which route of intubation do you prefer?				
Nasal	25 (73.5)	18 (85.7)	15 (83.3)	
Oral	4 (11.8)	2 (9.5)	2 (11.1)	0.719
No preference				
What is the level of your agreement in using this modified technique of oral intubation with RAE tube placed in the corner of the mouth?				
Disagree	0 (0)	1 (4.8)	4 (22.2)	
Neutral	14 (41.2)	10 (47.6)	7 (38.9)	
Agree	20 (58.8)	8 (47.6)	7 (38.9)	0.055
The literature has reported that nasal intubation might lead to some complications such as epistaxis. In light of this, do you think this technique worth consideration?				
Disagree	0 (0)	1 (4.8)	1 (5.6)	
Neutral	7 (20.6)	8 (38.1)	7 (38.9)	
Agree	27 (79.4)	12 (57.1)	10 (55.5)	0.303
Do you think using this modified oral technique will make it more difficult for you to perform the procedure compared to nasal intubation?				
Yes	14 (41.2)	9 (42.9)	15 (83.3)	
No	20 (58.8)	12 (57.1)	3 (16.7)	**0.009**

Table 7: Association between experience & knowledge/practice/perception

5.5.4 Country of pediatric specialty cross-tabulated against knowledge/practice/perception

This section is further divided into two subheadings. The first compares the UAE as the country of specialization with other countries, while the second compares Arab countries with others.

5.5.4.1 UAE vs. Others cross-tabulated with knowledge/practice/perception

The majority of those who answered the questionnaire obtained their specialization degree in the UAE. Table 8 presents the association between knowledge/practice/perception and the respondents' country of specialization. A statistical significance was found (p=0.033) in the answers to the question "Have you faced problems due to the presence of the RAE tube orally?" Interestingly, 10 (100%) of those who were qualified in the UAE answered "No," compared to 11 (64.7%) who were qualified in other countries. Moreover, a statistical finding was revealed in answer to the question which assessed respondents' level of agreement "What is the level of your agreement in using this modified technique of oral intubation with the RAE tube placed in the corner of the mouth?" 16 (76.2) of the respondents agreed were qualified in the UAE, while 21 (40.4) of respondents qualified in other countries (p=0.042). The second perception question that revealed a statistical significance was "Do you think using this modified oral intubation technique will make it more difficult for you to perform the procedure compared to nasal intubation?" Seventy-six percent (n=16) of the respondents who were qualified in the UAE answered "No," compared to 19 (36.5%) of respondents who were qualified in other countries (p=0.002).

Knowledge	UAE	Others	p-value
Have you heard about Ring Adair Elwyn (RAE) tube?			
Yes	10 (47.6)	19 (36.5)	
No	11 (52.4)	33 (63.5)	0.269
In which area of the mouth was the oral RAE tube placed?			
Corner of the mouth	10 (100)	15 (88.2)	
In the midline	0	2 (11.8)	0.260
Practice			
Have you treated a patient under general anesthesia intubated using Ring Adair Elwyn (RAE) endotracheal tube?			
Yes	10 (100)	17 (89.5)	
No	0 (0)	2 (10.5)	0.288
Have you faced any problems due to the presence of the RAE tube orally?			
Yes	0 (0)	6 (35.3)	
No	10 (100)	11 (64.7)	**0.033**
When oral intubation is the only choice, do you face any of these difficulties? Obstructed surgical view			
Yes	10 (47.6)	35 (67.3)	
No	11 (52.4)	17 (32.7)	0.097
Difficulties in taking impressions			
Yes	10 (47.6)	34 (65.4)	
No	11 (52.4)	18 (34.6)	0.127
Tube displacement			
Yes	9 (42.9)	27 (51.9)	
No	12 (57.1)	25 (48.1)	0.329
Limitation of some Procedures			
Yes	6 (28.6)	22 (42.3)	
No	15 (71.4)	30 (57.7)	0.205
Perception			
Which route of intubation do you prefer?			
Nasal	13 (61.9)	45 (86.5)	
Oral	4 (19)	4 (7.7)	
No preference	4 (19)	3 (5.8)	0.059
What is the level of your agreement in using this modified technique of oral intubation with RAE tube placed in the corner of the mouth?			
Disagree	0 (0)	5 (9.6)	
Neutral	5 (23.8)	26 (50)	
Agree	16 (76.2)	21 (40.4)	**0.042**
The literature has reported that nasal intubation might lead to some complications such as epistaxis. In light of this, do you think this technique worth consideration?			
Disagree	0	2 (3.8)	
Neutral	3 (14.3)	19 (36.5)	
Agree	18 (85.7)	31 (59.6)	0.186
Do you think using this modified oral technique will make it more difficult for you to perform the procedure compared to nasal intubation?			
Yes	5 (23.8)	33 (63.5)	
No	16 (76.2)	19 (36.5)	**0.002**

Table 8: Association between country of specialty UAE vs. Others & knowledge/practice/perception

5.5.4.1 Arab countries vs. Non-Arab countries cross-tabulated with knowledge / practice / perception

When comparing Arab countries with others (non-Arab), a statistical significance was found when cross-tabulating country of specialization and practice/perception questions. When participants were asked to elaborate on the difficulties faced when oral intubation is the only choice, 21 (56.3%) who reported tube displacement as a difficulty were qualified in non-Arab countries, while 15 (35.7%) of those who reported the same finding were qualified in Arab countries (p=0.007). When asked, “Do you think using this modified oral technique will make it more difficult for you to perform the procedure compared to nasal intubation?” 19 (61.3%) who answered “No” were qualified in non-Arab countries, whereas 16 (38.1%) were qualified in Arab countries (p=0.042). The chi-square test did not show any significant differences between knowledge and country of specialization. Details are summarized in Table 9.

Knowledge	Arab	Non-Arab	p-value
Have you heard about Ring Adair Elwyn (RAE) tube?			
Yes	15 (35.7)	14 (45.2)	
No	27 (64.3)	17 (54.8)	0.283
In which area of the mouth was the oral RAE tube placed?			
Corner of the mouth	14 (100)	11 (84.6)	
In the midline	0 (0)	2 (15.4)	0.127
Practice			
Have you treated a patient under general anesthesia intubated using Ring Adair Elwyn (RAE) endotracheal tube?			
Yes	14 (93.3)	13 (92.9)	
No	1 (6.7)	1 (7.1)	0.960
Have you faced any problems due to the presence of the RAE tube orally?			
Yes	2 (14.3)	4 (30.8)	
No	12 (85.7)	9 (69.2)	0.303
When oral intubation is the only choice, do you face any of these difficulties? Obstructed surgical view			
Yes	24 (57.1)	21 (67.7)	
No	18 (42.9)	10 (32.3)	0.250
Difficulties in taking impressions			
Yes	23 (54.8)	21 (67.7)	
No	19 (45.2)	10 (32.3)	0.190
Tube displacement			
Yes	15 (35.7)	21 (56.3)	
No	27 (64.3)	10 (32.3)	**0.007**
Limitation of some Procedures			
Yes	15 (35.7)	13 (41.9)	
No	27 (64.3)	18 (58.1)	0.382
Perception			
Which route of intubation do you prefer?			
Nasal	34 (81)	24 (77.4)	
Oral	4 (9.5)	4 (12.9)	
No preference	4 (9.5)	3 (9.7)	0.898
What is the level of your agreement in using this modified technique of oral intubation with RAE tube placed in the corner of the mouth?			
Disagree	2 (4.8)	3 (9.7)	
Neutral	14 (33.3)	17 (54.8)	
Agree	17 (40.5)	4 (12.9)	0.063
The literature has reported that nasal intubation might lead to some complications such as epistaxis. In light of this, do you think this technique worth consideration?			
Disagree	1 (2.4)	1 (3.2)	
Neutral	11 (26.2)	11 (35.5)	
Agree	30 (71.4)	19 (61.3)	0.480
Do you think using this modified oral technique will make it more difficult for you to perform the procedure compared to nasal intubation?			
Yes	26 (61.9)	12 (38.7)	
No	16 (38.1)	19 (61.3)	**0.042**

Table 9: Association between country of speciality Arab vs. Non-Arab & knowledge/practice/perception

6. DISCUSSION

This study aimed to assess pediatric dentists' preferences regarding endotracheal intubation and their perceptions of a modified oral intubation technique using an RAE tube during DGA, focusing on pediatric dentists in the Gulf Cooperation Council (GCC) countries. Airway management in infants and children remains a fundamental component of various aspects of care in the operative theater and the intensive care unit [40]. DGA is a core service in pediatric dentistry, and the surgical procedures conducted as part of DGA are in the mouth [70]. Thus, the type of intubation may directly impact the quality of treatment provided, especially if there is interference with the surgical site. This study showed that NTI was the preferred choice among (79.5%) of participants and that they lacked familiarity with the RAE tube but were willing to consider it in their practice.

In line with previous studies, it was assumed that pediatric dentists prefer the NTI technique because it provides an uninterrupted surgical field [6]. Nevertheless, the complications associated with NTI are considered one of the many causes of anesthetic-related morbidity and mortality [48]. This aligned with the findings of the present study, where 53 participants (72.6%) expressed that nasal intubation is associated with more complications. Nevertheless, our results indicated that nasal intubation was the preferred technique for most of the respondents, despite their belief that it is associated with more complications. Thus, any advancement in intubation techniques to address the issue with potential improvement to reduce these complications is viewed with optimism.

To the authors' knowledge, this study is the first to investigate the preferred intubation route among GCC pediatric dentists and to explore their familiarity with and perceptions of a modified oral intubation technique using an RAE oral tube.

6.1 Pediatric dentists' knowledge

6.1.1 Pediatric dentists' knowledge about RAE

In the present study, 60.3% of the respondents (44 out of 73) were unfamiliar with the RAE tube. Reasons for this may include a lack of knowledge about anesthesia armamentarium or little interest in knowledge development in that particular field. Another reason could be the anesthilogists themselves are not familir with this modified technique or they don't feel comfortable utilizing it. Among the remaining 29 respondents, 27 (93.1%) treated patients under GA using an RAE tube, and 25 (92.6%) out of those 27 respondents reported the tube was positioned in the corner of the mouth. The remaining 2 (6.9%) reported that the tube was placed in the midline. This might be attributed to the anesthetist's skills or comfort and the operator's request. In other words, this might be based on an agreement between the dentist and the anesthetist in line with performed procedure. Overall, age and experience of the participants were not associated with the level of knowledge.

6.1.2 UAE qualified pediatric dentists' knowledge about RAE

The most striking finding is that all dentists who qualified in UAE and familiar with RAE tube had treated patients intubated with modified RAE technique. Moreover, UAE qualified dentists showed a 76.2% level of agreement in using the modified technique of oral intubation when compared to those who were qualified in other countries (40.4%). Another highly significant factor found in UAE qualified dentists was that the majority expressed the belief that this modified oral intubation technique using RAE tube does not impose any difficulty in performing dental treatment when compared to NTI (see Table 8). This might be because the UAE qualified dentists use this modified technique more frequently. Thus, this technique reduced the complications associated with NTI and provided them with uninterrupted surgical view. Nevertheless, to develop a full picture of the effectiveness of this modified technique,

additional studies are needed, with a suitable database available.

6.1.3 Pediatric dentists' knowledge of the complications of endotracheal intubation

Most participants were aware that NTI is associated with more complications, which is in agreement with the literature. Holzapfel (2003), compared nasal and oral intubation techniques, reported that NTI was associated with more significant inconvenience than OTI [71]. These results were consistent with those of Erale *et al.* (2017), who reported that NTI posed more challenges than standard orotracheal intubation [53]. The current survey shows that 61.6% of respondents have encountered obstructed surgical view when oral intubation was the only choice, while 44 (61.3%), 36 (49.5%), and 28 (38.4%) participants, respectively, reported obstructions while taking impressions, tube displacement, and the limitation of some procedures. Possible causes of tube displacement as reported by Weiss *et al.* (2006), who stated that head and neck manipulation and flexion during dental and ENT surgeries and while turning and lifting children leads to the inadvertent extubation of the tracheal tube [72]. No challenges related to dental procedures under GA have been documented in literature to the authors' knowledge. Therefore, the authors believe the reported complications might be attributed to several human- and procedure-related factors. Human-related factors may include the operator's skills and experience in managing dental procedures under GA and the anesthetist's experience in securing the oral tube. Procedure-related factors may include the sizeable orotracheal tube and its connector obstructing the surgical view.

Our study found that 18 (64.3%) respondents who reported tube displacement as one of the difficulties, were in 36–45 age group ($p=0.012$). This might be because most of the respondents were from this age range, 28 out of 73 (38.4%). In addition, this age group might have performed more DGA cases, have higher years of experience and have worked with different anesthiolgists with different skills, compared to the younger age group with limited experience.

Moreover, 15 (57.7%) of the ≥ 46 age group faced other limitations, compared to 4 (21.1%) in the 25–35 age group and 9 (32.1%) in the 36–45 age group (p = 0.013). The same age group (≥ 46 age group) showed the least level of agreement in utilizing the proposed modified intubation technique compared to the younger age groups (p=0.027), which may be attributed to the fact that older pediatric dentists might be more resistant to changing the way they practice. In addition, the qualitative analysis showed most of the respondents believed that it is still orotracheal intubation with its associated interruptions. This was also reflected at the level of significance found between dentists' years of experience, and their belief that this modified technique will make it more challenging to perform dental treatment when compared to nasal intubation. Whereas 15 (83.3%) respondents with ≥ 21 years of experience, believed it would make it difficult compared to those with less than ten years of experience 14 (41.2%), and those with 10-20 years of experience 9 (42.9%) (p=0.009).

6.2 Pediatric dentists' preferences regarding endotracheal intubation

In the current study, we found that most respondents leaned toward nasal intubation as the route of choice (Table 4). These results align with Mallineni *et al*. [18] and Adewale [15], who reported that NTI is the route of choice in dental GA among clinicians due to improved accessibility. In the same vein, Piepho *et al.* [64] reported that NTI remains the preferred intubation route for oral and maxillofacial procedures.

6.3 Pediatric dentists' perceptions of modified endotracheal intubation using an RAE oral tube

The literature does not provide evidence of agreement regarding the use of the modified oral intubation technique using an RAE tube placed in the corner of the mouth. Our survey results indicated that most of the respondents showed a high level of agreement with the proposed

modified oral intubation technique using an RAE tube placed in the corner of the mouth (Table 4). In light of the reported complications associated with NTI in the present study, 49 of the 73 respondents (67.1%) believed it worth consideration. This might be attributed to the fact that pediatric dentists are reconsidering patient safety. In addition to their willingness to provide dental treatment under GA in a safe manner without any interruptions. It is surprising that although most of the respondents reported that this modified technique is worth considering, almost half the respondents, 38 of 73 (52.1%), still believe that this technique would make it difficult to perform procedures compared to NTI. According to the qualitative analysis (see section 6.4), most of the respondents believed that it is still oral intubation and that they would continue to face the challenges mentioned previously. Thus, they felt it would still hinder performance. Others noted that they were not certain that the modified technique provides a clear intra-oral surgical view.

6.4 Qualitative analysis of questions related to the perception on modified RAE tube

The participants' answers to the two open questions— "Can you please specify the problems associated with the RAE tube being placed orally?" and "What are the reasons that make you feel that the RAE intubation technique will make it more difficult for you to perform procedures compared to nasal intubation?"—were grouped into two themes: the difficulty of performing dental procedures compared to NTI and complications faced when using RAE. Most respondents answered the first question with "rubber dam insertion and restoration," "impression is not easy to obtain," or "some reported limitation of space intraorally." The answer to the second question was "having a tube in the mouth still obstructs the field even if it is at the corner" or "I have never seen it implemented, but I think it may interfere with occlusal assessment." A reasonable approach to addressing these issues could be to create a video demonstrating how the tube is secured in such a way that it does not interfere with the

surgical field, and that it offers the possibility to place the rubber dam and showing the ease of performing procedures without any interruptions.

6.5 Study limitations

Several methodological considerations in our study warrant discussion. First, the survey was distributed via e-mail and social networking applications such as Instagram, Twitter, Facebook, and WhatsApp. Having an open population while distributing the sample, the author was not able to predict participants response rate. Moreover, with the use of relatively small sample size, caution must be applied, as the findings might not be conclusive. This may be attributed to the limited number of pediatric dentists in GCC countries who treat patients under GA. In addition, some pediatric dentists may not have access to the aforementioned social media applications. Another limitation of this study is the uneven distribution of sample size among GCC countries included in this study. Thus we were not able to compare the results among GCC countries individualy. Nevertheless, the current study forms a base for future studies in which the sample size could be expanded.

7. CONCLUSIONS

Notwithstanding the study limitations, and among the surveyed GCC pediatric dentists, it can be concluded that:

- The majority of the respondents believed that nasotracheal intubation is associated with more complications compared to orotracheal intubation. Despite that, nasotracheal intubation was considered the route of intubation of choice.
- Less than half of the participants were familiar with RAE tube and reported that it was placed at the corner of the mouth in almost all of the situations.
- Most common complications encountered with oral intubation were obstruction of surgical view, followed by tube displacement.
- Half of the participants showed a high level of agreement in the proposed modified endotracheal intubation technique utilizing and oral RAE tube.
- Participants within the age group ≥ 46 years of age, showed the least level of agreement in utilizing the proposed modified intubation technique using oral RAE tube.

Recommendations

- e-Education of pediatric dentists with videos demonstrating how the RAE tube could be secured in such a way that it does not interfere with the surgical field and that it offered the possibility to place the rubber dam showing the ease of performing procedures without any interruptions.
- Hands-on simulation workshops to be conducted to familiarize GCC pediatric dentists with the RAE tube feasibility for use in pediatric dentistry GDA.
- Future studies comparing post-operative complications when the RAE intubation method is used versus the NTI technique.

- Further research to evaluate anesthetists' knowledge, perception and practice for DGA intubation techniques and their familiarity with modified RAE tube technique.
- Further studies, which recognize the risk and complication of nasal intubation when performed by an untrained anesthetist compared to a trained anesthetist.
- Future studies to measure the anesthetist preference for intubations route and the factors that are dictating it.

8. REFERENCES

1. Fayle SA. Stainless steel preformed crowns for primary molars. Int J Paediatr Dent. 1999;9(4):311–4.
2. Appukuttan DP. Strategies to manage patients with dental anxiety and dental phobia: Literature review. Clin Cosmet Investig Dent. 2016;8:35–50.
3. American Academy of Pediatric Dentistry. Behavior guidance for the pediatric dental patient. Pediatr Dent. 2020;292–310.
4. Farsi N, Ba'Akdah R, Boker A, Almushayt A. Postoperative complications of pediatric dental general anesthesia procedure provided in Jeddah hospitals, Saudi Arabia. BMC Oral Health. 2009;9(1):1–9.
5. Sharma A, Jayaprakash R, Babu NA, Masthan KMK. General anaesthesia in pediatric dentistry. Biomed Pharmacol J. 2015;8SE(October):189–94.
6. Bowman JP, Nedley MP, Jenkins KA, Fahncke CR. Pilot study comparing nasal vs oral intubation for dental surgery by physicians, nurse anesthetists, and trainees. Anesth Prog. 2018;65(2):89–93.
7. Campbell RL, Shetty NS, Shetty KS, Pope HL, Campbell JR. Pediatric dental surgery under general anesthesia: Uncooperative children. Anesth Prog. 2018;65(4):225–30.
8. Tahiriarivelo R, Ndrantoniaina R, Henri AR. Is Nasal Intubation Better than Oral Intubation in Oral and Maxilla-Facial. 2018;4(April 2017):149–53.
9. Ward DS, Pandit JJ. Airway Management and Physiologic Control of Ventilation [Internet]. First Edit. Mechanical Ventilation: Clinical Applications and Pathophysiology. Elsevier Inc.; 2008. 389–400 p. Available from: http://dx.doi.org/10.1016/B978-0-7216-0186-1.50038-7
10. Ring WH, Adair JC, Elwyn RA. A new pediatric endotracheal tube. Anesth Analg. 1975;54(2):273–4.

11. Haas CF, Eakin RM, Konkle MA, Blank R. Endotracheal tubes: Old and new. Respir Care. 2014;59(6):933–55.
12. Mallineni SK, Yiu CKY. Dental treatment under general anesthesia for special-needs patients: analysis of the literature. J Investig Clin Dent. 2016;7(4):325–31.
13. Bailey CR, Ahuja M, Bartholomew K, Bew S, Forbes L, Lipp A, et al. Guidelines for day-case surgery 2019: Guidelines from the Association of Anaesthetists and the British Association of Day Surgery. Anaesthesia. 2019;74(6):778–92.
14. Strøm K, Rønneberg A, Skaare AB, Espelid I, Willumsen T. Dentists' use of behavioural management techniques and their attitudes towards treating paediatric patients with dental anxiety. Eur Arch Paediatr Dent [Internet]. 2015;16(4):349–55. Available from: http://dx.doi.org/10.1007/s40368-014-0169-1
15. Adewale L. Anaesthesia for paediatric dentistry. Contin Educ Anaesthesia, Crit Care Pain. 2012;12(6):288–94.
16. Urban BW, Bleckwenn M. Concepts and correlations relevant to general anaesthesia. Br J Anaesth [Internet]. 2002;89(1):3–16. Available from: http://dx.doi.org/10.1093/bja/aef164
17. Hu YH, Tsai A, Ou-Yang LW, Chuang LC, Chang PC. Postoperative dental morbidity in children following dental treatment under general anesthesia. BMC Oral Health. 2018;18(1):1–7.
18. Gupta P, Mallineni S. Dental General Anesthesia. Pediatr Dent Spec Child. 2016;(January):430–7.
19. Malamed SF. Fundamentals of General Anesthesia. In: Sedation. 2018. p. 407–15.
20. Goodwin M, Pretty IA, Sanders C. A study of the provision of hospital based dental General Anaesthetic services for children in the North West of England: Part 2 - the views and experience of families and dentists regarding service needs, treatment and

prevention. BMC Oral Health [Internet]. 2015;15(1):1–13. Available from: ???

21. Hosey MT, Macpherson LMD, Adair P, Tochel C, Burnside G, Pine C. Dental anxiety, distress at induction and postoperative morbidity in children undergoing tooth extraction using general anaesthesia. Br Dent J. 2006;200(1):39–43.

22. Goodwin M, Sanders C, Pretty IA. A study of the provision of hospital based dental general anaesthetic services for children in the northwest of England: Part 1 - a comparison of service delivery between six hospitals. BMC Oral Health [Internet]. 2015;15(1):1–10. Available from: ???

23. Cantekin K, Yildirim MD enizha., Cantekin I. Assessing change in quality of life and dental anxiety in young children following dental rehabilitation under general anesthesia [Internet]. Vol. 36, Pediatric dentistry. 2014 [cited 2021 Apr 2]. p. 12E-17E. Available from: https://pubmed.ncbi.nlm.nih.gov/24717700/

24. Lee LA, Domino KB. The closed claims project has it influenced anesthetic practice and outcome? Anesthesiol Clin North America. 2002;20(3):247–63.

25. Dougherty N. The dental patient with special needs: A review of indications for treatment under general anesthesia. Spec Care Dent. 2009;29(1):17–20.

26. Davies C, Harrison M, Roberts G. Guideline for the use of general anaesthesia (GA) in paediatric dentistry. UK Natl Clin Guidel Paediatr Dent. 2008;(May 2008):1–11.

27. Enever GR, Nunn JH, Sheehan JK. A comparison of post-operative morbidity following outpatient dental care under general anaesthesia in paediatric patients with and without disabilities. Int J Paediatr Dent. 2000;10(2):120–5.

28. Silvestre-Rangil J, Silvestre FJ, Espín-Gálvez F. Hospital dental practice in special patients. Med Oral Patol Oral Cir Bucal. 2014;19(2):163–9.

29. Gonzalez LP, Pignaton W, Kusano PS, Módolo NSP, Braz JRC, Braz LG. Anesthesia-related mortality in pediatric patients: A systematic review. Clinics. 2012;67(4):381–7.

30. Çelik A, Yaman H, Turan S, Kara A, Kara F, Zhu B, et al. Prevention and Management of Dental Caries in Children. Scottish Dent Clin Eff Program [Internet]. 2018;1(1):1–158. Available from: www.sdcep.org.uk/how-we-work/nice-accreditation.%0Awww.sdcep.org.uk/index.aspx?o=2866

31. Bharti N, Batra YK, Kaur H. Paediatric perioperative cardiac arrest and its mortality: Database of a 60-month period from a tertiary care paediatric centre. Eur J Anaesthesiol. 2009;26(6):490–5.

32. Mir Ghassemi A, Neira V, Ufholz LA, Barrowman N, Mulla J, Bradbury CL, et al. A systematic review and meta-analysis of acute severe complications of pediatric anesthesia. Paediatr Anaesth. 2015;25(11):1093–102.

33. Cantekin K, Yildirim MD, Delikan E, Çetin S. Postoperative discomfort of dental rehabilitation under general anesthesia. Pakistan J Med Sci. 2014;30(4).

34. Erkmen Almaz M, Akbay Oba A, Saroglu Sonmez I. Postoperative morbidity in pediatric patients following dental treatment under general anesthesia. Eur Oral Res. 2019;53(3):113–8.

35. Barberá OF, Navarro IS. Gross anatomy. Operative Hip Arthroscopy. 2013. 85–97 p.

36. Anatomy & Physiology - Kevin T. Patton, Gary A. Thibodeau - Google Books [Internet]. [cited 2021 Apr 18]. Available from: https://books.google.ae/books?id=Zt_itAEACAAJ&dq=anatomy %26 physiology patton pdf&source=gbs_book_other_versions

37. Adewale L. Anatomy and assessment of the pediatric airway. Paediatr Anaesth. 2009;19(SUPPL. 1):1–8.

38. Holzki J, Brown KA, Carroll RG, Coté CJ. The anatomy of the pediatric airway: Has our knowledge changed in 120 years? A review of historic and recent investigations of the anatomy of the pediatric larynx. Paediatr Anaesth. 2018;28(1):13–22.

39. Lander A, Newman J. Paediatric anatomy. Surg (United Kingdom) [Internet]. 2013;31(3):101–5. Available from: http://dx.doi.org/10.1016/j.mpsur.2013.01.002

40. Tobias JD. Pediatric airway anatomy may not be what we thought: Implications for clinical practice and the use of cuffed endotracheal tubes. Paediatr Anaesth. 2015;25(1):9–19.

41. Bayeux R. Tubage de larynx dans le croup. Presse med. 1897;20:1-4 [Internet]. [cited 2021 Apr 18]. Available from: https://scholar.google.com/scholar_lookup?hl=en&volume=6&publication_year=1897&pages=29-33&journal=Presse+Mèd&author=R+Bayeux&title=Tubage+du+larynx+dans+le+Croup.+Auto-Extubation

42. Ripoll JG, Guo W, Andersen KJ, Baker SE, Wiggins CC, Shepherd JRA, et al. Sex differences in paediatric airway anatomy. Exp Physiol. 2020;105(4):721–31.

43. Chidananda M, Mallikarjun D. Applied aspects of Anatomy and Physiology of relevance to Paediatric anaesthesia. Indian J Anaesth [Internet]. 2004;48(5):333–9. Available from: http://www.ijaweb.org/article.asp?issn=0019-5049;year=2004;volume=48;issue=5;spage=333;epage=333;aulast=Chidananda;type=2

44. Rj A, Narendar R, Sp I. Comparison among the Intubation Techniques employed in the Course of Management of Pan-Facial Trauma. 2021;2(1):1–10.

45. Kuhn F. Die perorale Intubation mit und ohne Druck - III. Teil. Apparat zur Lieferung des Druckes für die Überdrucknarkose. Dtsch Zeitschrift für Chir. 1906 Jan;81(1):63–70.

46. Prasanna D, Bhat S. Nasotracheal Intubation: An Overview. J Maxillofac Oral Surg. 2014;13(4):366–72.

47. Williamson R, Shutt LE, Hall CEJ. Nasotracheal intubation for head and neck surgery (multiple letters). Anaesthesia. 2003;58(11):1129–31.

48. Paul M, Dueck M, Kampe S, Petzke F, Ladra A. Intracranial placement of a nasotracheal tube after transnasal trans-sphenoidal surgery. Br J Anaesth. 2003;91(4):601–4.

49. Chauhan V, Acharya G. Nasal intubation: A comprehensive review. Indian J Crit Care Med. 2016;20(11):662–7.

50. Elumalai G. Common Nasal Anomalies and Its Implications on Intubation in Head and Neck Surgeries. J Surg. 2016;4(4):81.

51. Verma D, Sharma N, Garg U, Makkar S, Bansal P, Singh S. Accidental partial middle turbinectomy: A rare complication of nasal intubation. Otorhinolaryngol Clin. 2017;9(2):61–3.

52. Caruso TJ, Janik LS, Fuzaylov G. Airway management of recovered pediatric patients with severe head and neck burns: A review. Paediatr Anaesth. 2012;22(5):462–8.

53. Earle R, Shanahan E, Vaghadia H, Sawka A, Tang R. L'épistaxis pendant l'intubation nasotrachéale: une étude randomisée de la sonde endotrachéale nasale Parker Flex-Tip™ avec un biseau à ouverture postérieure par rapport à une sonde endotrachéale nasale RAE standard. Can J Anesth. 2017;64(4):370–5.

54. Moore BM, Blumberg K, Laguna TA, Liu M, Zielinski EE, Kurachek SC. Incidental sinusitis in a pediatric intensive care unit. Pediatr Crit Care Med. 2012;13(2).

55. Berry FA, Blankenbaker WL, Ball CG. A comparison of bacteremia occurring with nasotracheal and orotracheal intubation [Internet]. Vol. 52, Anesthesia and Analgesia. 1973 [cited 2021 Apr 27]. p. 873–6. Available from: https://journals.lww.com/anesthesia-analgesia/Citation/1973/11000/A_Comparison_of_Bacteremia_Occurring_With.1.aspx

56. Önçağ Ö, Çökmez B, Aydemir Ş, Balcioğlu T. Investigation of bacteremia following nasotracheal intubation. Paediatr Anaesth. 2005;15(3):194–8.

57. Goodisson DW, Shaw GM, Snape L. Intracranial intubation in patients with maxillofacial injuries associated with base of skull fractures? J Trauma - Inj Infect Crit Care. 2001;50(2):363–5.

58. Tseng KY, Lu IC, Shen YC, Lin CH, Chen PN, Cheng KI. A comparison of the video laryngoscopes with Macintosh laryngoscope for nasotracheal intubation. Asian J Anesthesiol [Internet]. 2017;55(1):17–21. Available from: http://dx.doi.org/10.1016/j.aja.2017.05.006

59. Chinnappa A, Ambareen Z. Dental Complications of Intubation in Pediatric Patients and Its Management. Int J Dent Sci Res. 2014;2(6B):9–11.

60. Brandt L, Pokar H, Schutte H. 100 years endotracheal anaesthesia. William Macewen, a pioneer of endotracheal intubation [Internet]. Vol. 32, Anaesthesist. 1983 [cited 2021 Apr 18]. p. 200–4. Available from: https://pubmed.ncbi.nlm.nih.gov/6346938/

61. Rijnders BJA, Wilmer A, Van Eldere J, Van Wijngaerden E. Frequency of transient streptococcal bacteremia following urgent orotracheal intubation in critically ill patients. Intensive Care Med. 2001;27(2):434–7.

62. Bartlett E, Mahabir RC, Verheyden CN. Traumatic palatal perforation after orotracheal intubation: A case report and a review of the literature. Cleft Palate-Craniofacial J. 2013;50(5):614–7.

63. Martin MD, Wilson KJ, Ross BK, Souter K. Intubation risk factors for temporomandibular joint/facial pain. Anesth Prog. 2007;54(3):109–14.

64. Piepho T, Thierbach A, Werner C. Nasotracheal intubation: Look before you leap. Br J Anaesth [Internet]. 2005;94(6):859–60. Available from: http://dx.doi.org/10.1093/bja/aei146

65. Adenekan AT, Faponle AF, Oginni FO. Anesthetic challenges in oro-facial cleft repair in ile-ife, Nigeria. Middle East J Anesthesiol [Internet]. 2011;21(3):335–40. Available from: http://www.embase.com/search/results?subaction=viewrecord&from=export&id=L364586627

66. Jaisani MR, Pradhan L, Bhattarai B, Sagtani A. Intubation Techniques: Preferences of Maxillofacial Trauma Surgeons. J Maxillofac Oral Surg [Internet]. 2015;14(2):501–5. Available from: http://dx.doi.org/10.1007/s12663-014-0679-8

67. Broennle AM, Teller L. Anesthesia for craniofacial procedures. Clin Plast Surg [Internet]. 1987 [cited 2021 Apr 19];14(1):17–26. Available from: https://pubmed.ncbi.nlm.nih.gov/3816034/

68. Duke J. Airway management [Internet]. 4th ed. Anesthesia Secrets. Elsevier Inc; 2011. 58–67 p. Available from: http://dx.doi.org/10.1016/B978-0-323-06524-5.00008-8

69. Raajesh J, Tripathy DK, Shanmugam D, Ravindra BR. Modification of submental intubation using oral Ring-Adair-Elwyn tubes in faciomaxillary surgeries: A novel approach. Indian J Anaesth. 2013;57(4):418–9.

70. Alantali K, Al-Halabi M, Hussein I, El-Tatari A, Hassan A, Kowash M. Changes in preschool children's oral health-related quality of life following restorative dental general anaesthesia. Br Dent J. 2020;229(10):670–6.

71. Holzapfel L. Nasal vs oral intubation. Minerva Anestesiol. 2003;69(5):348–52.

72. Weiss M, Knirsch W, Kretschmar O, Dullenkopf A, Tomaske M, Balmer C, et al. Tracheal tube-tip displacement in children during head-neck movement - A radiological assessment. Br J Anaesth. 2006;96(4):486–91.

9. APPENDICES

Appendix I: Informed consent Form

Questionnaire consent form

This research is being conducted by: Dr. Najla Alderei, pediatric dentistry resident, in Hamdan Bin Mohammed College of Dental Medicine.

Purpose: To assess pediatric dentists' preference of endotracheal intubation and their perception regarding a modified technique of oral intubation using RAE tube during dental treatment under general anesthesia.

Participants: in order to qualify for this study, you must be a pediatric dentist practicing in the United Arab Emirates.

Voluntary participation: Participation in this study is voluntary. Refusal to participate will involve no penalty or loss of benefits to which you are otherwise entitled. The alternative to participate in this study is to not participate.

Confidentiality: All identifying information obtained from this study will be kept strictly confidential, except as may be required by law. Only the investigator and supervisor will see any information that will be obtained, it will be kept under lock and key. Data files will not contain potentially identifying information and will not be published.

Consent: I have read and understood the above information, have had any questions answered satisfactorily, and I willingly consent to participate in this study. I freely consent to participate in this study; I authorize the use and disclosure of the information according to that described above.

Approved by the ethical committee of research at Hamdan Bin Mohammed College of Dental Medicine.

Appendix II (Questionnaire)

Pediatric dentists' perception of a modified oral intubation technique

Part 1: Demographic characteristics

1. Gender: a. Male b. Female

2. Age: a. 25-35 b. 36-45 c. 46-55 d. 56-65 e. 66+

3. Total years of professional practice/experience as a specialist is: a. <10 b. 10-20 c. 21-30 d. 31-40 e. >40

4. Please specify your title: a. Consultant b. Specialist

5. Practice setting: (Please select all applicable)

a. Private practice b. Government practice c. Other ……

6. Gulf Council Cooperation (GCC) country you are practicing in:

a. United Arab Emirates

b. Saudi Arabia

c. Kuwait

d. Qatar

e. Bahrain

f. Oman

7. Country of pediatric specialty training: …….

Part 2: Pediatric dentists' preference of endotracheal intubation

1. **Which route of intubation do you prefer and why?**
    a. Nasal
    b. Oral
    c. No preference
2. **Why do you prefer this route of intubation? …….**
3. **According to your knowledge which of these techniques have more complications?**
    a. Oral
    b. Nasal
    c. None
    d. I don't know
4. **When oral intubation is the only choice do you face any of these difficulties (Select whatever applicable).**
    a. Obstructed surgical view
    b. Difficulties in taking impressions
    c. Tube displacement
    d. Limitation of some procedures. Specify?
    ……..
5. **Have you heard about Ring Adair Elwyn (RAE) tube? Please see the photo. (If no skip questions no. 6 - 9)**

    a. Yes
    b. No
6. **Have you treated a patient under general anesthesia intubated using Ring Adair Elwyn (RAE) endotracheal tube?**
    a. Yes
    b. No
7. **In which area of the mouth was the oral RAE tube placed?**

a. Corner of the mouth
b. In the midline

8. **Have you faced any problem due to the presence of the RAE tube orally?**
    a. Yes
    b. No
9. **If your answer to the previous question is (Yes), can you please specify the problems associated with the RAE tube being placed orally.**

…….

Part 3: Pediatric dentists' perception of modified technique of oral intubation with RAE tube

1. **What is the level of your agreement in using this modified technique of oral intubation with RAE tube placed in the corner of the mouth?**
    a. Completely disagree
    b. Disagree
    c. Neutral
    d. Agree
    e. Completely agree

2. **The literature has reported that nasal intubation might lead to some complications such as epistaxis. In light of this, do you think this technique is worth consideration?**
    a. Completely disagree
    b. Disagree
    c. Neutral
    d. Agree
    e. Completely agree

3. **Do you think using this modified oral technique will make it more difficult for you to perform the procedure compared to nasal intubation?**
    a. Yes

b. No

4. **According to the previous question, what are the reasons that makes you feel that the RAE intubation technique will make it more difficult for you to perform procedures compared to nasal intubation?**

……..

Appendix III

2 June 2020

Najla Alderei

Resident – Pediatric Dentistry

HBMCDM

RE: MBRU-IRB-2020-012

Dear Dr Najla,

Thank you for submitting clarifications to the observations raised by the IRB on the study titled “Pediatric dentists' preference of general anesthesia endotracheal intubation route and their perception of a modified oral intubation technique for pediatric dental patients”. The Board has reviewed the same in its meeting of 2.6.2020 and has agreed to approve it.

The study can now commence. Please note that the IRB should be notified of any change in protocol.

For any questions, please contact the Institutional Review Board irb@mbru.ac.ae.

Thank you for your interest in MBRU-IRB.

Sincerely,

Professor Alexander Milosevic

Vice Chairman, MBRU-IRB

MBRU/IRB/2020/012