

Accidental Swallowing of Dental Objects During Pediatric Dental Care in Thailand

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ABSTRACT **Aim:** Accidental swallowing of dental objects can occur at any time during dental treatment, especially in child patients. Its severity and sequelae can range from minor to life-threatening. The study aimed to find out the occurrence of accidental swallowing and type of swallowed objects regarding pediatric dental treatment in Thailand. **Materials and Methods:** A nationwide questionnaire survey was performed among Thai dentists to anonymously report child patients' accidental swallowing throughout their working experience for up to 10 years. Percentage and frequencies of accidental swallowing in child patients, as well as types of dental objects swallowed, were investigated. Association between factors of the respondents and their experiences was assessed by the logistic regression analysis. **Results:** Among 408 respondents, 99 respondents [24.26%, 95% confidence interval (CI): 20.10–28.42] had experienced accidental swallowing during pediatric dental treatment. All of them reported ingestion with only one respondent reporting aspiration. Extracted teeth, stainless steel crowns, and rubber cups were top on the list of swallowed items experienced by 11.52%, 8.33%, and 3.92% of respondents, respectively. Dental sharps such as endodontic files and orthodontic wires were reported as well. Dentists with higher educational backgrounds, mostly exposed to more complicated cases, were more likely to experience accidental swallowing (odds ratio of 2.90, 95% CI: 1.61–5.21). **Conclusion:** Our results indicate that accidental swallowing in child patients appeared to occur more frequently than anticipated. Awareness on patient safety of dental professionals and preventive measures against accidental swallowing when dealing with child patients should be greatly emphasized.

KEYWORDS: Accidental swallowing, aspiration, children, dental objects, ingestion

INTRODUCTION

Patient safety is one of the most important issues that provoke a serious public health concern worldwide. It has estimated that nearly 50% of harm caused by adverse events during health care is considered preventable.^[1] The World Health Organization has announced its global action on patient safety: safe surgery is, among its goals, to reduce harm associated with surgical procedures.^[2] Even though an exact number of adverse events during dental care have not

been clearly reported, accidental swallowing of dental objects seems to be one of the most harmful events resulting from dental surgical procedures.^[3]

Accidental swallowing can occur at any time during dental treatment. This may lead to serious complications

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such as damage to the gastrointestinal tract, partial or complete airway obstruction, pneumonia, abscess formation, and septicemia.^[4] There are various kinds of foreign objects which were reported to be swallowed, such as extracted teeth, burs, posts, dental inlays or crowns, endodontic instruments, impression materials, orthodontic brackets, and many others.^[5-8] The literature has shown that ingestion is more common than aspiration.^[9] Most of swallowed dental items could pass through the gastrointestinal tract spontaneously, whereas 10–20% of the cases require non-surgical intervention, and about 1% or less need surgical intervention to retrieve such foreign objects.^[10,11]

Many of the case reports were in adult patients undergoing endodontic, prosthodontic, and orthodontic procedures.^[5-8] Some studies have said that ingestion of dental objects is more frequently found in geriatric patients and those with medical- or mental-compromised conditions.^[12] It is speculated that child patients of any dental procedure are also at high risk, especially when they are not very cooperative. However, fewer studies on the occurrence in pediatric dental patients have been reported.^[13]

Although prevention of accidental swallowing during pediatric dental treatment has been long discussed, it seems that we rarely have a clear evidence on the incidents in the pediatric dental practice. In order to understand and prevent this type of adverse event, data on the occurrence of swallowing accident in Thai pediatric patients were collected and analyzed. This study also aimed to clarify its frequency, types of swallowed objects, and to check whether there were any associated factors from dental practitioners while treating pediatric patients.

MATERIALS AND METHODS

STUDY SETTING

Data on the occurrence of swallowing accidents during pediatric dental care in Thailand were widely collected by using a self-reporting questionnaire during 2017–2018. The questionnaire was sent out to the provincial public health centers nationwide and to members of the Thai Society of Paediatric Dentistry. Respondents could reply anonymously either on the printed questionnaire or via an online form. Data collection included demographic data (gender, age, working years, practice specialty, working place and dental educational background) and their experience with swallowing accidents in pediatric patients. The questionnaire asked for their experience of any accidental swallowing with yes-no questions on each type of dental objects, whether ingestion or aspiration was involved, and how frequent

the incidents occurred throughout their dental practice for up to 10 years. However, no information regarding the severity of the consequences and their management was collected in the survey so as to eliminate chances of hiding the incidents with unacceptable severe consequences.

STATISTICAL ANALYSIS

From 960 questionnaires sent out, 440 dental professionals replied. The response rate was 45.8%. After data were collected, SPSS 22.0 software for Windows (SPSS Inc., Chicago, IL, USA) was used for statistical analyses. Descriptive statistics were calculated. Any possible associations between the demographic variables and the experiences in accidental swallowing of dental objects were initially tested using the univariate logistic regression analysis. Then the significant variables were simultaneously analyzed by a multivariate logistic model with a level of significance set at 0.05. Adjusted odds ratio (OR) with a *P*-value less than 0.05 was considered statistically significant.

RESULTS

Among 440 replies, a total of 408 questionnaires from the respondents were included for data analysis; another 32 respondents were excluded from the study due to not being in service for child patients at all. The demographic characteristics of the included respondents are given in Table 1. The respondents were 81 males and 327 females with a mean age of 34.15. Most of the respondents had less than 10 years working experience (74.3%). The majority of the respondents were general practitioners and non-pedodontic specialists (56.9%) and those working for public hospitals or dental schools (79.4%) and those with post-graduate training and/or certified boards in some dental specialties (53.9%).

Upon completion of data collection, descriptive statistical analysis was performed to find out the most commonly swallowed dental objects during treatment. As shown in Table 2, extracted teeth were reported the most swallowing, showing 47 out of 408 respondents (11.52%, 95% CI: 8.42–14.62). Stainless steel crowns were reported the second on the list from 8.33% of the respondents (95% CI: 5.65–11.02). Next included rubber cups that accidentally spun off from the prophylaxis tip (3.92%), burs (2.45%) off from the handpiece, rubber guards off from the mouth gag (2.45%), and pieces of gauze or cotton roll (1.72%), respectively. Notably, these six items on the top of the list were reported to happen more than once (2–5 times) during the respondents' working experience. It is noteworthy that swallowing of sharp dental objects, such as endodontic files, orthodontic wires, and metal bands, was also reported

even by fewer respondents. The total number of the respondents who had experienced accident swallowing during pediatric dental care was 99 out of 408 respondents (24.26%, 95% CI: 20.10–28.42). Among these, only one respondent (0.25%, 95% CI: 0.00–0.72) reported an experience of aspiration. As mentioned, the researchers did not further collect the consequences and management of the incidents in the survey.

To determine the associated factors, logistic regression analysis was performed and shown in Table 3. Considering each variable separately, respondents aged more than 35 years, those working of more than 10 years,

and those having higher educational background (post-graduate training/certified boards) appeared to be more likely to experience swallowing of dental objects with OR of 3.71 (95% CI: 2.29–6.02), 4.00 (95% CI: 2.45–6.51), and 4.31 (95% CI: 2.54–7.33), respectively. When the multivariate analysis was applied, it was shown that only one significant factor, educational background, remained to be associated with swallowing experience: the respondents with higher educational background (post-graduate training and/or certified boards) were more likely to experience swallowing accidents in pediatric dental practice (OR: 2.90, 95% CI: 1.61–5.21).

Table 1: Demographic characteristics of the respondents

| | Mean±SD | N = 408 | % |
|----------------------------------------|---------------------------|---------|------|
| Gender | | | |
| Male | | 81 | 19.9 |
| Female | | 327 | 80.1 |
| Age (years) | 34.15±8.35 (range: 23–67) | | |
| ≤ 35 | | 271 | 66.4 |
| > 35 | | 120 | 29.4 |
| Not identified | | 17 | 4.2 |
| Working years | 10.81±8.19 (range: 1–42) | | |
| ≤ 10 | | 303 | 74.3 |
| > 10 | | 105 | 25.7 |
| Main workplace | | | |
| Public hospital/dental school | | 324 | 79.4 |
| Private hospital/clinic | | 84 | 20.6 |
| Practice specialty | | | |
| Pediatric dentistry | | 176 | 43.1 |
| General practice/other specialties | | 232 | 56.9 |
| Educational background | | | |
| DDS | | 188 | 46.1 |
| Post-graduate training/certified board | | 220 | 53.9 |

SD = standard deviation

Table 2: Dental objects swallowed accidentally during dental treatment of pediatric patients

| Objects swallowed | Experienced (N=408) | | Once | 2–5 times | >5 times | 95% CI |
|--------------------------------------------------------|---------------------|----------------|------|-----------|----------|--------------------|
| | n | (%) | | | | |
| Extracted tooth | 47 | (11.52) | 45 | 2 | 0 | 8.42–14.62 |
| SSC | 34 | (8.33) | 29 | 5 | 0 | 5.65–11.02 |
| Rubber cup | 16 | (3.92) | 12 | 4 | 0 | 2.04–5.81 |
| Bur | 10 | (2.45) | 8 | 2 | 0 | 0.95–3.95 |
| Rubber guard of the mouth gag | 10 | (2.45) | 8 | 2 | 0 | 0.95–3.95 |
| Gauze/cotton roll | 7 | (1.72) | 6 | 1 | 0 | 0.46–2.98 |
| Filling particles (amalgam/temporary filling material) | 4 | (0.98) | 4 | 0 | 0 | 0.00–1.94 |
| Endodontic file | 3 | (0.74) | 3 | 0 | 0 | 0.00–1.56 |
| Orthodontic wire | 2 | (0.49) | 2 | 0 | 0 | 0.00–1.17 |
| Metal band (for filling) | 2 | (0.49) | 2 | 0 | 0 | 0.00–1.17 |
| Suction tip (plastic/rubber) | 2 | (0.49) | 2 | 0 | 0 | 0.00–1.17 |
| Others (unidentified) | 1 | (0.25) | 1 | 0 | 0 | 0.00–0.72 |
| All swallowings (ingestion and/or aspiration) | 99 | (24.26) | | | | 20.10–28.42 |
| Reporting aspiration | 1 | (0.25) | | | | 0.00–0.72 |

CI = confidence of interval; SSC = stainless steel crown

Table 3: Association between demographic variables of the respondents and experiences with accidental swallowing of dental objects

| Variable (N = 408) | Having experienced | | Univariable OR (95% CI) | P value | Multivariable OR (95% CI) | P value |
|--------------------------------------------------------------------|--------------------------|------------------------|-------------------------------|-----------|---------------------------------|----------|
| | No (n = 309) | Yes (n = 99) | | | | |
| Gender | | | | | | |
| Female (vs Male) | 244 (79.0) 65 (21.0) | 83 (83.8) 16 (16.2) | 1.38 (0.76–2.52) | 0.291 | — | — |
| Age* | | | | | | |
| >35 years (vs ≤ 35 years) | 69 (23.4) 226 (76.6) | 51 (53.1) 45 (46.9) | 3.71 (2.29–6.02) | <0.0001** | 1.20 (0.49–2.94) | 0.69 |
| Working years | | | | | | |
| >10 years (vs ≤10 years) | 57 (18.4) 252 (81.6) | 47 (47.5) 52 (52.5) | 4.00 (2.45–6.51) | <0.0001** | 2.24 (0.92–5.45) | 0.076 |
| Main workplace | | | | | | |
| Public hospital/dental school (vs Private hospital/clinic) | 252 (81.6) 57 (18.4) | 72 (72.7) 27 (27.3) | 1.66 (0.98–2.81) | 0.06 | — | — |
| Practice specialty | | | | | | |
| General practice/other specialties (vs Paediatric dentistry) | 169 (54.7) 140 (45.3) | 63 (63.6) 36 (36.4) | 1.45 (0.91–2.31) | 0.12 | — | — |
| Educational background | | | | | | |
| Post-graduate training/ certified board (vs D.D.S.) | 143 (46.3) 166 (53.7) | 78 (78.8) 21 (21.2) | 4.31 (2.54–7.33) | <0.0001** | 2.90 (1.61–5.21) | 0.0004** |

CI = confidence of interval; OR = odds ratio

*Missing due to unidentified age = 17

**Statistical significance

DISCUSSION

Due to lack of well-established systems to trace the occurrence in Thai dental offices, the retrospective survey helped collecting data from the self-recall of the respondents,^[14] which was expected to represent an incidence estimate of the swallowing situation in the dental office. The survey results showed that ingestion of dental objects during pediatric dental care was experienced by 24.26% of respondents (95% CI: 20.10–28.42), whereas only one reported aspiration (0.25% with 95% CI: 0.00–0.72). Actual incidence of ingestion and aspiration of dental objects in pediatric patients has never been clarified. A 10-year study on institutional documentation in the USA showed that only 3 out of 36 reports of ingestion were related to orthodontic/pediatric dentistry with no aspiration in child patients: it was then concluded that the occurrence in pediatric patients was infrequent.^[15] On the contrary, our study has shown that accidental swallowing in pediatric patients was much higher than previously reported. Owing to the anonymous reporting, the respondents seemed to be more willing to report the real incidents.

Descriptive analysis on types of dental objects swallowed showed a high variety of items. The most commonly reported object in our study was extracted teeth, which accounted for 47 respondents (11.52% 95% CI: 8.42–14.62). Stainless steel crowns (8.33%), rubber cups (3.92%), dental burs (2.45%), and rubber guard of the mouth gag (2.45%) were also commonly reported. Previous surveys and review articles mostly suggested that prosthodontic and endodontic items were most frequently ingested or aspirated by adult patients.^[15–18] Interestingly, our study identified extracted teeth as the most commonly swallowed, followed by prosthodontic (stainless steel) crowns, whereas endodontic items were rarely reported (0.74%). This may somehow reflect frequent work types that Thai dentists are working for their child patients, and it could be due to a preventive outcome of tooth isolation techniques that are more commonly used when treating child patients in the country.

Widely accepted, tooth isolation using rubber dam or dental dam is an ideal preventive measure during dental restorative procedures.^[19] A survey in the UK found that 62.6% of pediatric dentists always use rubber dam isolation

during root canal treatment, whereas a lower percentage of practitioners provide it for other operative procedures,^[20,21] which might help explain the lower number of reports on swallowed endodontic instruments in our study, with a speculation that Thai dentists often utilize rubber dams during root canal treatment for pediatric patients. However, with more frequent numbers of bur swallowing and some reports on other dental objects such as filling particles and metal bands, this implies that rubber dam may be used less in operative works. Data on utilization of rubber dam among Thai dentists on the future study might be necessary to better explain the entire situation. Our findings may also provide some suggestion on a safety treatment guideline to the policy-makers.

In general, surgical procedures such as tooth extraction and repeated try-ins of stainless steel crowns before fixing could be the procedures in which dentists hardly work under tooth isolation. Local anesthesia, commonly used in these procedures, could be another factor that impedes the protective swallowing and coughing reflex. These may have put “extracted teeth” and “stainless steel crowns” to be on the top list. Some even reported repeated experiences. Therefore, apart from rubber dam use, other preventive measures should be called for during these procedures. In recent years, new tooth isolation systems, such as Isolite (Isolite Systems, USA) and Easyprep (CEREC Asia, Taiwan), have been introduced: a mouthpiece with its soft and flexible shield, specifically designed to isolate the working area, was claimed to prevent accidental swallowing and provide more satisfaction to the child patient than conventional rubber dams.^[22,23] Somehow, this might push an extra cost burden on both dentists and patients. Without any special equipment, some have suggested placing a gauze screen across the oropharynx and/or tethering small instruments or crowns with floss ligature to reduce the possibility of swallowing during these surgical procedures and prosthodontic try-ins.^[24,25] Having the patient sit in a less reclining position to protect the airway and allow the best possible vision can be a safe position, if necessary.^[26]

Looking into those less frequently reported items, many tiny dental objects, such as rubber cups, burs, and rubber guard of the mouth gag, were on the list [Table 2]. In regular settings, these tiny objects must be attached securely to rotary handpieces or other instruments. Our results appeared to highlight another risk factor of inappropriate instrument set-ups and check-ups before use. Instrument wear can be an underlying cause of instrument detaching accidentally too. Rigid inspection of all attachable dental instruments and protocol for instrument replacement/preventative maintenance should be implemented so as to alleviate instrumental swallowing during treatment.

Despite being less frequently reported, dental sharps like burs, endodontic files, and orthodontic wires are always considered to be very harmful when swallowed. They may cause severe complications such as perforation of the gastrointestinal tract.^[10,27] At the time of swallowing, many patients remain free of symptoms and the majority of the swallowed objects pass spontaneously to the stomach. It has been suggested that localization of swallowed radiopaque foreign objects with radiographs be necessary in this situation. When the sharp dental instrument fails to progress for 3 consecutive days, surgical intervention with an endoscope should be considered.^[28,29] Thus, dental instruments with sharp ends must be secured, well checked, and operated with high caution at all time.

Although aspiration was reported only from one response in our study, consistent with other studies that the occurrence of aspiration of dental objects in child patients was low, it usually results in more serious complications than ingestion.^[30] Paroxysmal cough, choking, and cyanosis are the common symptoms. When aspirated and not spontaneously expelled, foreign bodies may have to be identified by radiographs and removed under bronchoscopy or even with thoracotomy.^[5] As the risk of morbidity, expenses of special care, and liability for medical mistakes are very high, concerns on aspiration and its prevention can never be overlooked.

Our data found that dental professionals with higher education were more likely to have experienced swallowing accidents (OR: 2.90, 95% CI: 1.61–5.21). Other factors such as age and working years became non-significant when being tested with multivariable logistic model. A survey in Taiwan reported that dental healthcare workers aged 31 years and older, and those working for more than 10 years, seemed to have more positive safety attitudes.^[31] This may suggest that, with higher concern on patient safety, the groups of upper age and longer working years tend to recall and report the incidents deliberately, resulting in some high reports from them. However, the dentists with higher educational backgrounds more commonly have a chance to get referred with and/or work on more complicated cases in terms of disease itself and patient behavior, including special need patients. It is believed that child patients with uncontrollable behavior could be at higher risk for the accidental ingestion/aspiration of the instruments and objects. A Japanese review has reported that accidental swallowing was likely to happen with uncooperative children.^[5] Furthermore, referral of these uncooperative patients to the board-certified dentists who probably have a highly crowded schedule may cause work fatigue and reduce their flexibility to deal with the unforeseen incidents.

To our knowledge, this is the first nationwide study on the pediatric patient safety regarding accidental swallowing of dental objects in Thailand. Due to the information retrieved from self-reporting recalls and not being able to provide details on the incidence, severity, management of the cases, and the sequelae, we found some limitations on data interpretation. However, our findings exactly show the existence of the high-risk incidents of accidental swallowing during dental service to pediatric patients. Protocols and clinical practice guidelines on patient safety from the dental-related organizations should be further established.

CONCLUSION

The study indicates that accidental swallowing during pediatric dental care in Thailand appeared to occur more frequently than previously reported. Extracted teeth and stainless steel crowns were the most commonly swallowed dental objects. Dentists with higher educational backgrounds were prone to swallowing incidents. Our study strongly suggests that all dental professionals need to gain serious awareness on accidental swallowing throughout their pediatric care, and more effective preventive measures on the high-risk procedures should be revised.

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CONFLICTS OF INTEREST

The authors declare that we have no conflict of interest.

AUTHORS CONTRIBUTIONS

Pornpoj Fuangtharnthip: Study conception, data interpretation, and manuscript writing and editing; Patr Pujarern: Study design, data collection and analysis, and manuscript writing and editing; Praewpat Pachimsawat and Phainguethai Loeksomphot: Data analysis and manuscript writing; Prow Janjarussakul and Somchai Manopatanakul: Manuscript writing and editing.

ETHICAL POLICY AND INSTITUTIONAL REVIEW BOARD STATEMENT

All procedures have been performed as per the Declaration of Helsinki (revised in 2008). The ethical clearance from the Ethics Committee of Mahidol University, Thailand (COA. No. MU-DT/PY-IRB 2017/001.1301) was obtained before the start of the study.

PATIENT DECLARATION OF CONSENT

Nil.

DATA AVAILABILITY STATEMENT

The additional data of this study are available on request from Dr. Pornpoj Fuangtharnthip at pornpoj.fun@mahidol.ac.th.

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