

Toothbrush Swallow: A Scoping Review

Mahomed Sidique Abdul Cadar Dadá ^{1,*}, Abdul Habib Mahomed Dadá ^{1,2}, Zulaikhah Mahomed Sidique Dadá ³

¹ Universidade Eduardo Mondlane, Maputo, Mozambique.

² DentalCare Professional Training Center, Maputo, Mozambique.

³ Pharmacology Service, Eduardo Mondlane University, Maputo, Mozambique.

* Correspondence: motiar786@gmail.com.

Abstract: The ingestion of foreign bodies is a frequent problem in the emergency services of hospitals, but the ingestion of a toothbrush is very rare and, because it is large, it entails potential complications. The objective of the present study was to investigate, through a scoping review, the etiology of toothbrush ingestion. This review intends to describe all clinical cases of toothbrush ingestion mentioned in the main databases. Initially, 136 studies were selected, 31 duplicate studies were excluded, resulting in a final sample of 32 articles in 114 minutes of work, divided into 28 sessions in the Rayyan application. Incidents with foreign bodies are common in Otolaryngology and Surgery practice, however, toothbrush swallow is rare. In this study it was found that most cases of toothbrush ingestion were intentional (bulimia, induction of vomiting and mental disorder) and the Toothbrushes that appear in the gastrointestinal tract are placed by the own patients accidentally or intentionally and rarely by someone else.

Keywords: Foreign Body; Ingestion; Scoping Review; Swallowing; Toothbrush.

1. Introduction

The concept of “foreign body” (FB) in the Otolaryngology (ENT) area refers to any animate or inanimate element, which is introduced voluntarily or involuntarily into any of the natural orifices of the head and neck and becomes lodged in them or in their channels (including the gastrointestinal and respiratory tracts) [1]. Cases of FB have been reported since ancient times with the discovery of tobacco residues in the ear channel of skeletons from the beginning of our civilization [1, 2].

Ingestion of bodies is a problem frequently encountered in emergency services and relatively common in children. There are several reports in the medical literature that describe incidents with different types of foreign bodies found in the gastrointestinal tract, mainly from accidents, but sometimes as manifestations of a psychiatric disorder (compulsive conditions or self-injurious behaviors) or as a way of attracting attention. Small objects are ingested by children, while strange and more bizarre objects are found in people with mental disorders [3, 4]. The disturbances of eating behavior can lead to involuntary ingestion of objects used voluntarily to induce vomiting, and this can become the first warning sign of an underlying disease that has gone unnoticed until now [3]. In the literature there are several cases of ingestion of different objects, such as coins, fishbones, pieces of meat, bones, toys, etc., but cases of ingestion of a toothbrush are rare. Because this topic is of interest to ENT specialists, surgeons, general practitioners, radiologists, and dentists, we wanted to know what leads people to ingest a toothbrush and raise awareness of the cases of bulimia that are very common at young ages.

However, it is unclear what kind of information is available in literature toothbrush ingestion. For this reason, a scoping review was conducted in order to systematically map the research done in this area, as well as to identify any existing gaps in knowledge.

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This scoping review aimed to describe and synthesize scientific literature on toothbrush ingestion etiologies.

2. Methodology

This is a scoping review.

2.1 Protocol

Our protocol was drafted using the Preferred Reporting Items for Systematic Reviews and Meta-analysis Protocols (PRISMA).

2.2 Research questions

The following research question was formulated:

1. How toothbrush bodies appear in the gastrointestinal tract?
2. What is the most common cause of ingesting toothbrushes?.

2.3 Eligibility criteria

For the selection of studies, the following inclusion criteria were used:

- Language: English;
- Publication date: No limits;
- Text Availability: Free full text;
- Article type: case report;
- Article attribute: not.

2.4 Exclusion criteria

- Repeated studies;
- Publications out of context.

2.5 Identification of information sources

For the identification of the articles, the following descriptors were used - "toothbrush swallow" OR "toothbrush ingestion" following the PRISMA guidelines for scoping reviews (<https://www.equatornetwork.org/reporting-guidelines/prisma/>).

2.6 Information sources

To identify potentially relevant documents, the following bibliographic databases were searched from 28th of July and the 10th of August 2022: PubMed (<https://www.ncbi.nlm.nih.gov/pubmed/>), Cochrane (<https://es.cochrane.org/es>); Scielo (Scientific Electronic Library Online); Science Direct (<https://www.sciencedirect.com/>); University of Manoa Hawaii (<https://manoa.hawaii.edu/>); Wiley Online Library (<https://onlinelibrary.wiley.com/>); Liverpool University Press (<https://www.liverpooluniversitypress.co.uk/>); Latindex (<https://latindex.org/latindex/>); Sage (<https://sistema.bibliotecas-bdigital.fgv.br/bases/sage-journals-online>) and Repositório da Universidade de Lisboa (<https://repositorio.ul.pt/?locale=en>); Biblioteca Virtual de Saúde Pesquisa em bases de dados (<http://bases.bireme.br/cgi-bin/wxis>): PAHO, LILACS; CidSaude, REPIDISCA, DESASTRES, ADOLEC, BBO, BDENF, HomeoIndex, MedCaribe, WHOLIS and IBECs.

2.7 Data charting process

A data-charting form was jointly developed by two reviewers to determine which variables to extract. The two reviewers independently charted the data, discussed the results, and continuously updated the data-charting form in an iterative process.

The selection and screening of eligible publications and studies was carried out independently by two raters in two stages:

- 1st Stage – the titles and abstracts of the references identified through the search strategy were reviewed and evaluated and potentially eligible studies were pre-selected;
- 2nd Stage – the full text evaluation of the pre-selected studies and potentially relevant citations was reviewed and carried out to confirm the eligibility.

2.8 Data items

We abstracted data on article characteristics. The variables for which data were sought age, sex, symptoms, aetiology, anatomical location, procedure, mental disorder, and complication. The research question was based on PEO: P (Population): Human being E (Exposure): Toothbrush O (Outcome): Toothbrush ingestion.

2.9 Critical appraisal of individual sources of evidence

An in-depth assessment of the conduct of the knowledge synthesis approaches underlying the NMA (network metanalysis) is lacking. As such, we aimed to explore the characteristics and methodological quality of knowledge synthesis approaches of NMAs. We also aimed to assess the statistical methods applied using the Analysis subdomain of the ISPOR checklist. The quality of the knowledge synthesis methods was appraised using the AMSTAR tool. The AMSTAR tool was created and validated to assess the methodological quality of systematic reviews of RCTs. The tool measures overall quality, where a score of 8 or higher is considered high quality, 4 to 7 is moderate quality, and 0 to 3 is low quality. Information for quality assessment was incorporated into the data extraction form, which was pilot tested on a random sample of seven included articles that ranged from low to high quality.

2.10 Discrepancies were resolved by consensus

2.10.1 Data extraction and quality assessment

Data was extracted from eligible studies by one reviewer and crosschecked by another two. Data from articles published in languages other than English, were excluded. We used a Rayyan free app, invented and offered by Qatar to help investigators working with systematic reviews and other types of reviews, screening and selection process. The valuation was carried out by one investigator.

Disagreements between authors were resolved by consensus; if no agreement could be reached, a senior author would make the decision. We used six items: 1. Patient data (age, sex), 2. History of toothbrush ingestion, 3. Symptoms, 4. Object location, 5. History of mental disorder, 6. Aetiology of the incident, 7. Procedure for its extraction and 6. Presence of complication.

2.10.2 Period

Information sources were consulted between 28th of July and the 10th of August 2022. The search strategy and article selection are summarized in Figure 1.

2.10.3 Ethical considerations

Since this research is based on the literature review, it did not need prior ethical permission. The authors follow the PRISMA-ScR checklist for the entire manuscript [5].

3. Results

3.1 Synthesis of results

We grouped the studies by the types of behaviour they analysed, and summarized the type of settings, populations and study designs for each group, along with the measures used and broad findings. Where we identified a systematic review, we counted the number of studies included in the review that potentially met our inclusion criteria and noted how many studies had been missed by our search. Data were summarized using SPSS which means standard deviations for continuous variables and frequencies and percentages for dichotomous variables.

The data extracted from the different databases were exported to the Rayyan application, choosing the inclusion and exclusion words mentioned below, the selection and screening of the studies, from the 136 initially selected, deleted 31 duplicated studies resulting in a final sample of 32 articles, in 114 minutes of work, divided by 28 sessions in the application (Table 1).

Table 1. Databases used.

| Search | n |
|-------------------|----|
| PubMed | 80 |
| ScienceDirect | 13 |
| Univ Hawaii Manoa | 41 |
| Willy | 1 |
| sage | 1 |

Legend. n. Absolute number.

- **Keywords included in the Rayyan Selection:** Toothbrush, Ingestion, gastro-intestinal tract, Accidental, Intentional, Case report, Impaction, Swallow, Esophagus and Complication.
- **Keyword excluded in the Rayyan Selection:** toothpaste, prevalence, oral health, tooth wear, survey, literature review, cross-sectional, regression analysis, longitudinal, trials, fish.

3.2 Characteristics of sources evidence

Of the 32 articles found (Figure 1), most were female (64.9%), with the age group from 15 to 19 years being the most affected (12/32; 32.4%), with a minimum age of 1.5 years and a maximum of 71 years. In the table 2 we can observe that accidental (32.4%) causes and bulimia (32.4%) occupy the same position.

Table 2. Distribution of causes of toothbrush ingestion.

| | n | % |
|-----------------|----|-------|
| Accidental | 12 | 32,4 |
| Bulimia | 12 | 32,4 |
| Induce vomiting | 5 | 13,5 |
| Intentional | 8 | 21,6 |
| Total | 37 | 100,0 |

Legend. n. Absolute number.

3.3 Characteristics of sources evidence

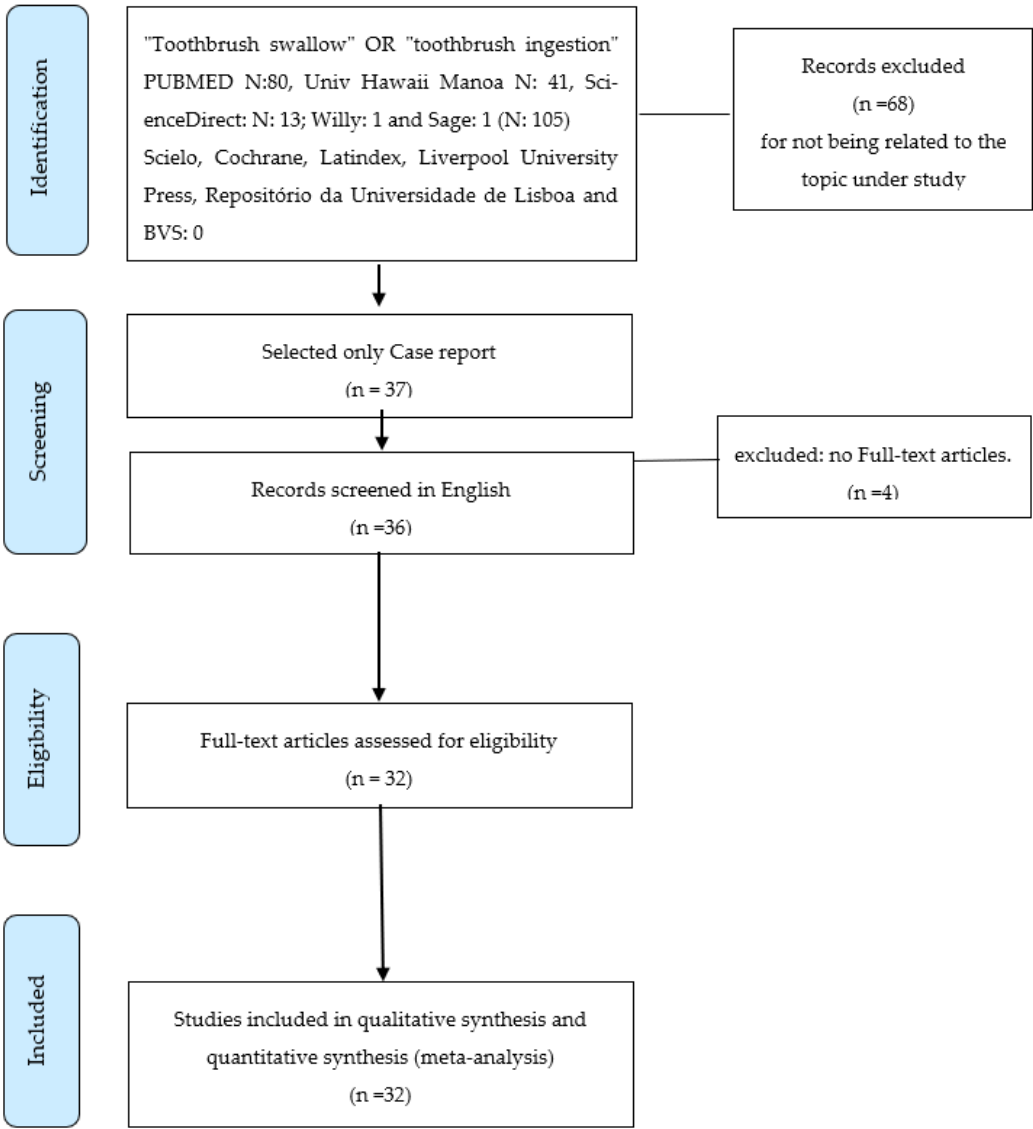
Of the 136 articles identified by means of information sources, 68 were excluded because they were not related to the topic under study (60) and wrong publication type (8), resulting in a sample of 37. Of these, 36 were chosen because they were in English, leaving 32 articles for quantitative and qualitative study, after excluding 4 because the full text was not found.

Among the accidental cases, we have two reports of ingestion that occurred during a seizure [4, 6] and two cases that occurred due to collision with another person [7] or door [8] while brushing their teeth. A case happened in a peculiar way in a patient in Africa, where the toothbrush was introduced by the healer for his treatment, having been swallowed [9]. Five patients tried to induce vomiting to relieve nausea resulting from alcohol abuse or overeating, having accidentally swallowed the toothbrush [4, 10-13]. A 33-year-old attempted suicide by swallowing a toothbrush two years earlier, having refused extraction [14]. Eight patients had diagnosed mental disorders (8/37; 21.6%).

3.4 Results of individual sources of evidence

The majority of the reported cases (13/37; 35.1%) are from the USA and the UK (5/37; 13.5%). Most swallowed toothbrushes became lodged in the stomach (23/37; 62.2%), followed by the esophagus (4/37; 10.8%) (Table 3).

Figure 1. PRISMA Flow Diagram for the scoping review process.



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Table 3. Anatomical location of Swallowed Toothbrush.

| Location | n | % |
|----------------------|----|-------|
| Pharynx | 3 | 8,1 |
| Esophagus | 4 | 10,8 |
| Stomach | 23 | 62,2 |
| Duodenum | 2 | 5,4 |
| Ileum | 1 | 2,7 |
| Colon | 2 | 5,4 |
| Parapharyngeal space | 1 | 2,7 |
| Neck | 1 | 2,7 |
| Total | 37 | 100,0 |

Legend. n. Absolute number.

More than half of patients were asymptomatic (22/37; 59.5%), followed by abdominal pain (6/37; 16.2%) and odynophagia (6/37; 16.2%). Most patients underwent endoscopy (18/37; 48.6%) and laparotomy (16/37; 43.2%) (Table 4). Almost 3/4 of patients had no complications (27/37; 73%). There were 10 complications and 9 (9/10; 90%) were gastrointestinal tract perforations (including fistulas) (Table 5).

Table 4. Distribution of Symptoms of the patients who swallowed toothbrushes.

| | n | % |
|---------------------------|----|-------|
| Asymptomatic | 22 | 59,5 |
| Throat Pain | 6 | 16,2 |
| Chest pain | 1 | 2,7 |
| Abdominal pain | 6 | 16,2 |
| Abdominal Distension | 1 | 2,7 |
| Vomiting, Fever, Diarrhea | 1 | 2,7 |
| Total | 37 | 100,0 |

Legend. n. Absolute number.

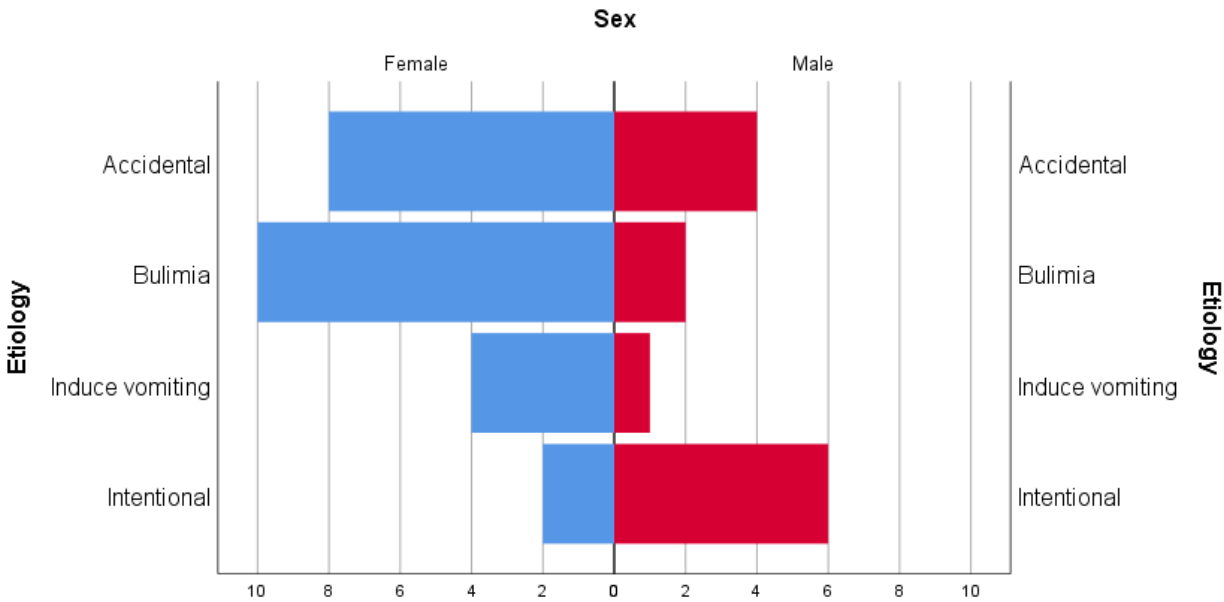
Table 5. Distribution of complications resulting from toothbrush ingestion.

| | n |
|------------------------------------|---|
| Colon Perforation and liver injury | 1 |
| Duodenal perforation | 1 |
| Fistula Hepato-colon | 1 |
| Gastrobronchial fistula | 1 |
| Ileum terminal perforation | 1 |
| Intraoral laceration | 1 |
| Pharyngeal abrasion | 1 |
| Pharynx perforation | 1 |
| Soft tissue edema | 1 |
| Stomach perforation | 1 |

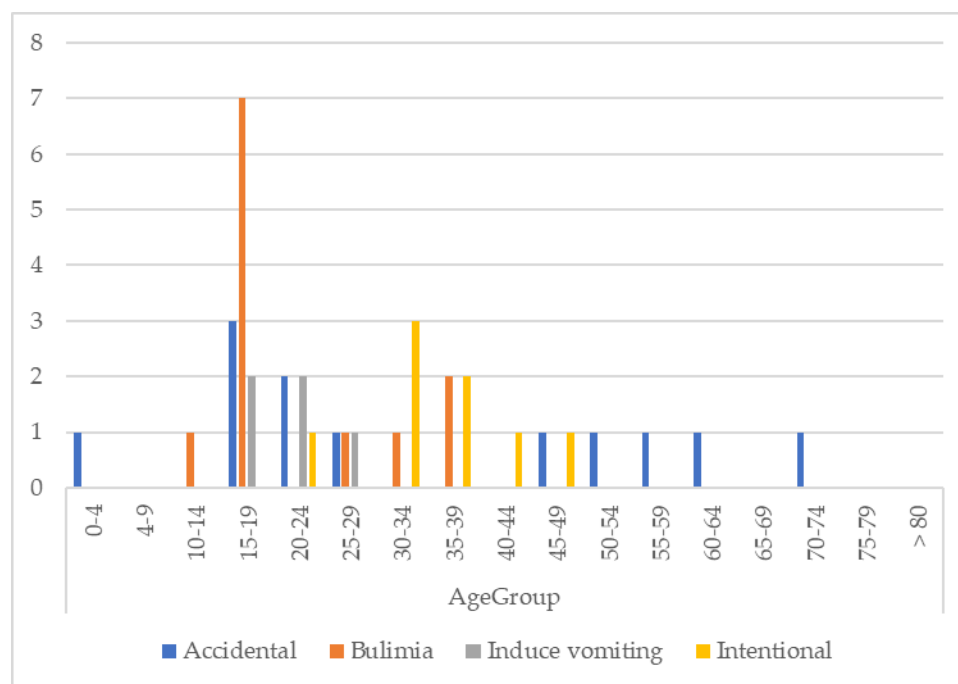
Legend. n. Absolute number.

In the figure 2 we can see that bulimia is more frequent in females, while intentional cases of mental disorder are more frequent in males. Most patients ingested toothbrushes because they suffered from bulimia, belong to the age group of 15 to 19 years old and there is one case of a 14-year-old patient (Figure 3).

Figure 2. Distribution of causes of toothbrush ingestion by sex.



There are many cases described in the grey literature that were not included in this research, including my own case report about an 8-year-old girl who ingested the brush head while struggling with her sister to brush her teeth with whom she shared a tooth-brush.

Figure 3. Distribution of causes of toothbrush ingestion by age groups.

4. Discussion

In this systematic review, we attempted to describe the clinical cases described in English available in the main databases that appeared between 28 July to 10 August 2022.

Of the articles found there are a few studies about toothbrush swallowing. We found 32 articles with 37 case reports. One of the first published cases dates from 1927, where Johnson describes one case report about one man of 49, that was admitted to the Los Angeles General hospital after accidental swallow of a toothbrush while scrubbing his tonsils and was extracted by laparotomy [28].

The majority of incidents occurred among females (64.9%), especially in the age group of 15 to 19 years of age (32.4%), with a minimum age of 1.5 years and a maximum of 71 years. The main causes of toothbrush ingestion are accidental (32.4%) and bulimia (32.4%). However, if we consider that inducing vomiting (13.5%) with toothbrush, then we have more cases of incidents caused by the patient putting the toothbrush down his throat (45.9%). And if we consider bulimia, induction of vomiting (is a prelude to a future bulimic disorder) and intentional mental disorder as non-accidental causes, then we can say that effectively, the intentional cause is predominant (67.5%).

Among the accidental cases, we have two reports of ingestion that occurred during a seizure (2/5) and two cases occurred due to collision with another person [7] or door [8] while brushing teeth. A case happened in a peculiar way in a patient in Africa, where the toothbrush was introduced by the healer for his treatment, having been swallowed [9]. Five patients tried to induce vomiting to relieve nausea resulting from alcohol abuse or after eating too much, having accidentally swallowed the toothbrush [4, 10-13]. A 33-year-old attempted suicide by swallowing a toothbrush two years earlier, having refused extraction [14]. Eight patients had diagnosed mental disorders (8/37; 21.6%). Bulimia is more frequent in females, while intentional cases of mental disorder are more frequent in males.

Table 6. Selected articles.

| Reference | Country | Age | Sex | Etiology | Mental disease | Anatomical Location | Symptoms | Procedure | Complication |
|-----------|--------------|-----|-----|-----------------|----------------|----------------------|---------------------------|---------------------|--------------|
| [4] | USA | 51 | F | Accidental | No | Pharynx | Asymptomatic | Endoscopy | No |
| | | 60 | F | Accidental | No | Esophagus | Asymptomatic | Endoscopy | No |
| | | 19 | F | Induce vomiting | No | Stomach | Asymptomatic | Endoscopy | No |
| [15] | UK | 38 | M | Intentional | Yes | Stomach | Abdominal pain | Laparotomy | No |
| [16] | UK | 45 | M | Intentional | Yes | Ileum | Asymptomatic | Laparotomy | Yes |
| [17] | UK | 35 | F | Bulimia | Yes | Stomach | Throat Pain | Endoscopy | No |
| [7] | UK | 16 | F | Accidental | No | Stomach | Asymptomatic | Endoscopy | No |
| [18] | USA | 20 | F | Accidental | No | Stomach | Asymptomatic | Laparotomy | No |
| [19] | Germany | 27 | F | Bulimia | No | Esophagus | Asymptomatic | Endoscopy | No |
| [14] | USA | 33 | F | Intentional | No | Stomach | Abdominal Distension | Laparotomy | Yes |
| [20] | Poland | 1,5 | F | Accidental | No | Parapharyngeal space | Throat Pain | surgical extraction | Yes |
| [21] | Korea | 31 | M | Intentional | Yes | Colon | Abdominal pain | Laparotomy | Yes |
| [10] | Taiwan China | 22 | F | Induce vomiting | No | Duodenum | Abdominal pain | Laparotomy | Yes |
| [22] | South Korea | 44 | M | Intentional | Yes | Pharynx | Throat Pain | surgical extraction | Yes |
| [23] | Croatia | 18 | F | Bulimia | No | Stomach | asymptomatic | Endoscopy | No |
| [24] | South Korea | 31 | M | Intentional | Yes | Colon | Abdominal pain | Laparotomy | Yes |
| [8] | USA | 24 | M | Accidental | No | Pharynx | asymptomatic | Endoscopy | No |
| [25] | USA | 36 | F | Intentional | Yes | Stomach | Abdominal pain | Endoscopy | No |
| | | 16 | F | Bulimia | No | Stomach | Asymptomatic | Endoscopy | No |
| | | 16 | F | Bulimia | No | Duodenum | Asymptomatic | Laparotomy | No |
| [26] | Germany | 20 | M | Intentional | Yes | Stomach | Vomiting, Fever, Diarrhea | Laparotomy | Yes |
| [27] | China | 19 | F | Bulimia | No | Esophagus | Asymptomatic | Endoscopy | No |

| | | | | | | | | | |
|------|-------------|----|---|-----------------|----|-----------|----------------|---------------------|-----|
| [28] | USA | 49 | M | Accidental | No | Stomach | Throat Pain | Laparotomy | No |
| [29] | USA | 17 | F | Bulimia | No | Esophagus | Asymptomatic | Laparotomy | No |
| [30] | USA | 16 | F | Bulimia | No | Stomach | Asymptomatic | Laparotomy | No |
| | | 16 | F | Bulimia | No | Stomach | Asymptomatic | Laparotomy | No |
| [3] | Spain | 14 | F | Bulimia | No | Stomach | Asymptomatic | Endoscopy | No |
| [31] | India | 36 | M | Bulimia | No | Stomach | Asymptomatic | Endoscopy | No |
| | | 31 | M | Bulimia | No | Stomach | asymptomatic | Endoscopy | No |
| [13] | Iran | 26 | M | Induce vomiting | No | Stomach | asymptomatic | Endoscopy | No |
| [32] | Croatia | 71 | M | Accidental | No | Stomach | Throat Pain | Endoscopy | No |
| [6] | Iran | 17 | F | Accidental | No | Neck | Throat Pain | surgical extraction | Yes |
| [33] | UK | 18 | F | Accidental | No | Stomach | Abdominal pain | Laparotomy | No |
| [9] | Uganda | 56 | F | Accidental | No | Stomach | Chest pain | Laparotomy | No |
| [34] | Tonga | 28 | M | Accidental | No | Stomach | Asymptomatic | Laparotomy | No |
| [11] | Spain | 16 | F | Induce vomiting | No | Stomach | Asymptomatic | Endoscopy | Yes |
| [12] | New Zealand | 24 | F | Induce vomiting | No | Stomach | Asymptomatic | Endoscopy | No |

A significant number of patients were asymptomatic (59.5%), followed by abdominal pain (16.2%) and odynophagia (16.2%). The most common method for extraction was endoscopic (48.6%) and surgical removal (43.2%). Almost 3/4 of patients had no complications (73%). Almost all complicated cases were gastrointestinal perforation (90%). Abdominal foreign bodies can produce several complications, especially perforation of the hollow viscus, peritonitis, bleeding, and intestinal obstruction [35].

The most common anatomical locations of foreign body obstruction along the digestive tract are normal lumen constrictions, anatomical sphincters, acute angulations, curvatures, congenital deformities, tumors or sites of previous injury, surgical procedures that alter the anatomy of the area (e.g., adhesions or gastric rings) [36].

Eating disorders (anorexia and bulimia nervosa) are psychiatric illnesses characterized by severe food behavioral changes and affect, for the most part, female adolescents, and young adults, and may cause biological and psychological damage and increase of morbidity and mortality. Nervous anorexia leads to weight loss at the expense of an extremely restricted diet, in the search of slimming, image distortion body and menstrual cycle changes [37].

Ingestion of toothbrushes is rare but tends to increase in young girls with an eating disorder. It is necessary to pay attention to patients who induce vomiting in the presence of nausea or after food abuse, because this is a prelude to bulimia or nervous anorexia. It should also be noted that alcohol reduces reflexes and patients under the influence of alcohol who have tried to induce vomiting have a greater risk of accidental ingestion of the toothbrush.

5. Conclusion

Incidents with foreign bodies are common in ENT clinical practice, however, toothbrush swallow is rare. In this study it was found that most cases of toothbrush ingestion were intentional (bulimia, induction of vomiting and mental disorder) and the Toothbrushes that appear in the gastrointestinal tract are placed by the own patients accidentally or intentionally and rarely by someone else.

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