

Endoscopic removal of accidental aspirated and ingested dental foreign bodies

A cross-sectional study

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Abstract

The incidence of accidental ingestion and aspiration of foreign body (FB) is likely to occur. Many FBs are discharged spontaneously, but many dental FBs are often sharp and may remain in the pharynx, esophagus, and stomach, causing serious complications such as hemorrhage, asphyxia, perforation of the digestive tract, mediastinal emphysema, peritonitis, and ileus. We aimed to examine which type of dental foreign bodies can be removed by endoscope.

In this study, we enrolled 32 patients who were evaluated at the Emergency and Critical Center between January 2014 and December 2019 and who accidentally ingested or aspirated dental FBs. Medical records were reviewed to determine the patients' sex, age, medical history, time from accidental ingestion of a FB to consultation, cause, location, occurrence status, nature of the FB, location of retained FB, treatment, complications, and outcome.

We enrolled 32 patients (14 men, 18 women), with a mean age of 74.5 ± 12.8 years. Accidental ingestion at treatment was common. The most frequent site where the FB was retained was upper gastrointestinal tract (26 cases, 81.3%). In this study, endoscopic removal was indicated for dentures under the size of 43.3 mm, for dental FB (except dentures) more than 13.6 mm. In dentures, between the number of missing teeth, clasp, type, and endoscopic removal was not statistically significant.

Dentures under the size of 43.3 mm was likely to be removed by endoscope. Dental FB (except dentures) more than the size of 13.6 mm was likely to be removed by endoscope. There were no indications for endoscopic removal except for size.

Abbreviations: FB = foreign body, ROC = receiver operating characteristic.

Keywords: aspiration, dental, foreign body, ingestion

1. Introduction

Foreign bodies (FBs) ingestion is a common clinical emergency. An approximately 30% of accidents during dental treatment are accidental aspirations and ingestions, which can be life-threatening in the case of an aspirated FB in the respiratory tract.^[1] The frequency of occurrence of accidental ingestion is

0.7%.^[2] Of all patients with FB in the esophagus, 0.2% to 3.6% required surgical treatment due to difficulty in endoscopic removal, while 9.5% to 33.3% of them had dental FB.^[3] Many dental FBs are excreted spontaneously but may remain in the pharynx, esophagus, or stomach. Serious complications such as bleeding, asphyxia, gastrointestinal perforation, mediastinal emphysema, peritonitis, and ileus may occur depending on the type of FB, location of retention, and endoscopic treatment.^[4-9] FB ingestion, prevention of aspiration, early detection, and treatment are important. The aim of this study was to investigate which type of dentures can be removed by endoscope. We also investigated which sizes of dental foreign bodies are indicated for endoscopic removal.

2. Methods

This cross-sectional study was approved by the Ethical Review Board of Nagoya Ekisaikai Hospital (approval no. 2019-061), and written consent was obtained from patients. The study was conducted in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement guidelines for reporting observational studies. One hundred ninety-eight thousand three hundred twenty-four patients who visited the Emergency and Critical Care Center between January 2014 and December 2019. Patients who were diagnosed as having a dental FB by visual or X-ray examination among the patients with FB ingestion who visited our emergency center were the participants of this study. Thirty-two patients of 1054 related to dental FB. Therefore, in this study we analyzed 32 patients. We extracted all information from patients' electronic medical

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records (sex, age, medical history, cause, location, occurrence, nature of the FB, location of the retained FB, treatment, complications, outcome, time from accidental ingestion of an FB to consultation, size of FB). Concerning the method of measuring denture size, the maximum diameter of denture was measured. Predictor variable is sex, age, medical history, cause, location, occurrence, nature of the FB, location of the retained FB, treatment, complications, and outcome, time from accidental ingestion of an FB to consultation, size of FB. Outcome variable is possibility for endoscopic removal. About continuous variable, we assessed normality, and the distribution was normal for age, but not for residence time of FB. We used Fisher exact test to investigate statistically significant difference for categorical data. For continuous data, we plotted a receiver operating characteristic (ROC) curve, and determined the cutoff value. The relationship between the number of missing teeth and clasps and endoscopic removal was analyzed by Mann–Whitney test, and the relationship between the type of denture and endoscopic removal was analyzed by Fisher exact test. A *P* value of less than .05 was considered statistically significant data. Data were analyzed using EZR Ver.1.4.0 software (Saitama Medical Center, Jichi Medical University, Saitama, Japan) and Graphical user interface for R (R Foundation for Statistical Computing, Vienna, Austria).

3. Results

3.1. Patient characteristics

Of the total study patients, 14 were men and 18 were women (Table 1). Follow-up is done in 32 cases. Only those cases in which foreign bodies were confirmed by visual examination and X-ray removal were described as follow-up patients in this study in Table 1. The mean and standard deviation age was 74.5 ± 12.8 years. A total of 26 patients (80%) were aged 65 years. A total of 11 patients had cerebrovascular disease (34.4%), 4 had dementia (12.5%), 3 had aspiration pneumonia (9.4%), and 1 had Parkinson disease (3.1%). Cerebrovascular disease was the most common, and more than one-third of the patients had problems swallowing. The time for a medical examination was uncertain in 7 patients. In the remaining 25 patients, a large variation was observed in the time from the accidental ingestion of FB to medical examination, with a median and range of 2 (1–51) hours. In 2 of the 25 patients, the time from accidental ingestion of foreign objects to consultation ranged from 48 to 51 hours. Medical examination for accidental ingestion was delayed, possibly due to the absence of any subjective symptoms related to accidental ingestion of dentures in both patients, and the caregivers were unable to manage the dentures thoroughly. Of the 1054 patients with accidental ingestion, 32 were patients with accidental ingestion of dental FB (3.0%). Patient's chief complaint was accidental ingestion (10, 31.3%), catching in throat (10, 31.3%), feel having swallowed something (8, 25.0%), no subjective symptoms (4, 12.5%).

The most common chief complaints of the patients were ingestion and coughing, with 10 cases each. Accidental ingestion most commonly occurred in medical institution in 19 patients (59.4%), accounting for approximately half of the total number of patients. Accidental ingestion occurred at treatment in 11 patients (34.4%), meal in 10 patients (31.3%), and at unknown times in 11 patients (34.4%). The occurrence of accidental ingestion in 11 patients could not be identified. Twelve patients (37.5%) had dentures as FBs. Twenty patients (62.5%) had dental FB (except dentures). The FBs were retained in the

Table 1

Patient characteristics of 32 patients.

Characteristics	N/mean and standard deviation or median and range
Age (yr)	74.5 (38–98)
Gender	
Male	14 (43.8%)
Female	18 (56.2%)
Main complaint	
Accidental ingestion	10 (31.3%)
Catching in throat	10 (31.3%)
Feel having swallowed something	8 (25.0%)
No subjective symptoms	4 (12.5%)
Medical history	
Cerebrovascular disease	11 (34.4%)
Dementia	4 (12.5%)
Aspiration pneumonia	3 (9.4%)
Parkinson disease	1 (3.1%)
Others	27 (84.4%)
Residence time of FB (h)	2.0 (1–51)
Manifestations	
Accidental ingestion	19 (59.4%)
Loss of prostheses	5 (15.6%)
Accidental detection by imaging	4 (12.5%)
Unknown	4 (12.5%)
Occurrence site	
Medical institution	19 (59.4%)
Others	13 (40.6%)
Occurrence situation	
Treatment	11 (34.4%)
Meal	10 (31.2%)
Unknown	11 (34.4%)
Type of FB	
Denture	12 (37.5%)
Others	20 (62.5%)
Location of FB	
Bronchus	1 (3.1%)
Upper gastrointestinal tract	26 (81.3%)
Lower gastrointestinal tract	5 (15.6%)
Management	
Follow-up	15 (46.9%)
Endoscopic removal	14 (43.8%)
General anesthetic extraction	3 (9.3%)
Outcome	
Cured	21 (65.6%)
Unknown	11 (34.4%)

FB = foreign body.

following sites: bronchus in 1 patient (3.1%), upper gastrointestinal tract in 26 patients (81.3%), lower gastrointestinal tract in 5 patients (15.6%). In the present study, more than 80% of the patients had FB in the upper gastrointestinal tract.

Follow-up was performed in 15 patients (46.9%), endoscopic removal in 14 (43.8%), general anesthetic extraction in 3 (9.3%). Two out of the 3 patients who underwent general anesthetic extraction were resected during the process. In the third patient, the FB was extracted with forceps from the oral cavity under general anesthesia. In the present study, no obvious complications were observed. A patient who underwent endoscopic removal was reported. Figure 1 was the primary day cervicothoracic X-ray. The FB was in hypopharynx. Endoscopic removal was taken in Figure 2. The FB was denture, which had some clasps, bilateral type. Patients who underwent endoscopy, surgery, or other procedures or those in whom external drainage was confirmed by imaging evaluation were

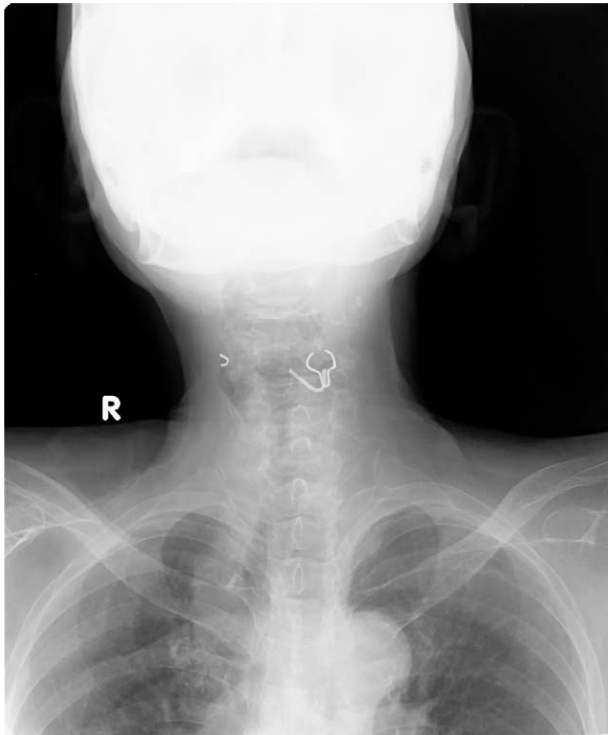


Figure 1. Foreign bodies were shown in upper gastrointestinal tract. Two clasps were confirmed.

considered cured. Patients in whom the FB could not be visually evaluated or imaged were considered to have unclear findings. Outcomes were cured in 21 patients (65.6%) and unknown in 11 patients (34.4%).

3.2. Risk factors related to endoscopic removal

Endoscopic removal was not associated with any factors (Table 2).

Table 2
Analysis of each factors for endoscopic removal.

factors	Endoscopic removal		P value
	Possibility (14)	P value	
Age			
<65	2	4	.672
≥65	12	14	
Gender			
Male	6	8	1.000
Female	8	10	
Manifestations			
Accidental ingestion	8	11	.052
Loss of prostheses	2	3	
Accidental detection by imaging	4	0	
Unknown	0	4	
Occurrence site			
Medical institution	10	9	.289
Others	4	9	
Occurrence situation			
Treatment	5	6	1.000
Meal	4	6	
Unknown	5	6	
Type of FB			
Dentures	6	6	.718
Others	8	12	
Location of FB			
Bronchus	1	0	.052
Upper gastrointestinal tract	13	13	
Lower gastrointestinal tract	0	5	

FB = foreign body.

3.3. Relationship between the size of the FB and endoscopic removal

The size of FB with dentures ROC curve cutoff was 43.3mm (sensitivity 83.3%, specificity 50.0%) (Fig. 3). The size of FB without dentures ROC curve cutoff was 13.6mm (sensitivity 100%, specificity 54.5%) (Fig. 4). Fisher exact test showed that statistical significance was not found in the cutoff size (Table 3).

3.4. Relationship between residence time of FB and endoscopic removal

We considered the cutoff residence time of FB to be 24 hours.^[4,10] However, Fisher exact test showed that the cutoff of the residence time of FB did not have a significant association with the risk of endoscopic removal (Table 4).

3.5. Relationship between and endoscopic removal

The relationship between the number of missing teeth and clasps and endoscopic removal was analyzed by Mann–Whitney test, and the relationship between the type of denture and endoscopic removal was analyzed by Fisher exact test. No significant differences were found in either of these (Table 5).

4. Discussion

As the population ages, the number of people with cerebral dysfunction, such as cerebrovascular disease and dementia, will increase. Elderly people with a history of these diseases have decreased cognitive function, decreased swallowing and cough reflexes, and delayed pharyngeal peristalsis, and are more likely

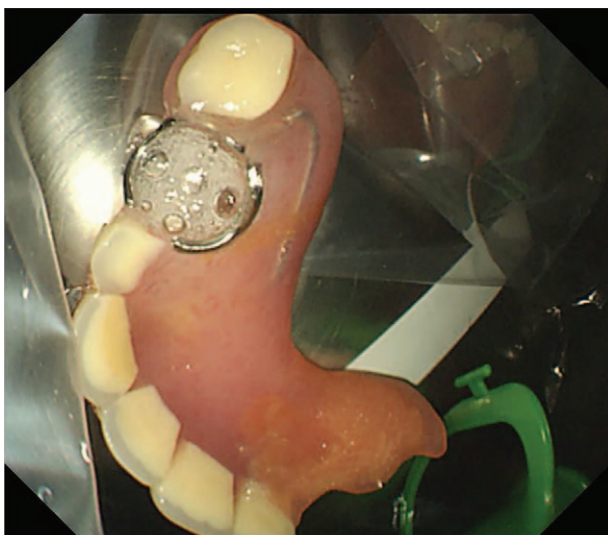


Figure 2. Foreign body was removed by endoscope. This denture was bilateral type with 2 clasps. One of 2 clasps were fractured from the roots.

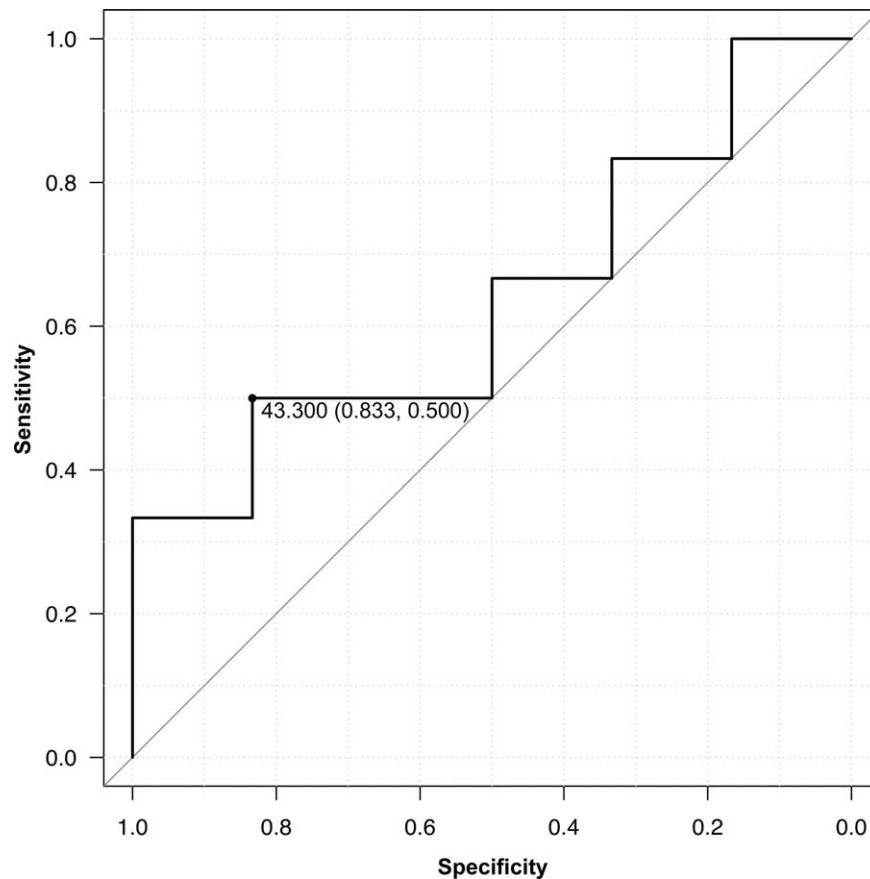


Figure 3. ROC curve analysis of screening tests for denture removing. The AUC of the ROC curve was 0.639. The cutoff value of the denture size was 43.3. AUC = area under the roc curve, ROC = receiver operating characteristic.

to experience ingestion or aspiration of FBs.^[11–13] Although many older adults wear dental prostheses, the presence or absence of subjective symptoms during withdrawal and the accuracy of handling may be inferior to that of younger people. Dental prostheses are often sharp and are associated with an increased risk of gastrointestinal complications. Some dentures and bridges are large, and treatment strategies may be difficult. Because composite resin is a radiolucent material among dental prostheses, the size of the actual prosthesis may be larger than the expected size, making diagnosis and treatment difficult.^[14] Endoscopic removal can ease the burden for patients. The purpose of our study was to investigate which type of dentures can be removed by endoscope. Concerning the patient's medical history, the cerebrovascular disease was the most common. Other patients had a medical history of dementia, aspiration pneumonia, Parkinson disease, and developmental disorders. Aspiration in healthy adults is mainly reported accidentally,^[15] but older adult patients with decreased activities of daily living, especially those with cerebrovascular disease, dementia, Parkinson disease, schizophrenia, disturbed consciousness, head and neck cancer, and amyotrophic lateral sclerosis, are at higher risk for daily aspiration and ingestion.^[16–19] These statistics show that cerebrovascular diseases were common among patients who had accidental ingestion of dental FB. Hence, care must be taken when treating these patients, and caregivers should undergo educational training related to the management of these patient groups.

Hashimoto reported that 61% of the patients had a FB retained in their stomach, which is similar to our results. According to the literature on dentures, retention of FBs in the esophagus is often reported.^[14] Several previous studies reported the position of denture retention,^[1,13,20] but no literature has reported on the exact size of the denture or its clasp. To clarify the relationship, the size of the dentures, their clasp, and the number of missing teeth are shown in Table 5. Concerning the method of measuring denture size, the maximum diameter of the denture was measured in 9 patients; in the remaining 3 patients, the size was recorded by consulting with the primary dentist. Except for 1 patient, dentures retained in the stomach, and small intestine had 2 or fewer artificial teeth, 2 clasps, and a unilateral denture. The dentures retained in the hypopharynx included 3 or more artificial teeth, 3 or more clasps, and bilateral dentures. In large dentures, the retractor and denture base were thought to have stagnated at the stenotic site before moving to the stomach. However, some patients had large dentures and lower gastrointestinal tracts, and some of them developed duodenal perforation due to the accidental ingestion of a 7-cm denture.^[21] Removable dentures can be mistakenly ingested, and even large dentures can be retained in the lower gastrointestinal tract, not only in small dentures with few teeth loss. Caries on the canines, periodontal disease, and clasp incompatibility can cause accidental denture ingestion and require early detection and treatment.

Aspiration pneumonia was observed in 1 patient in this study. The patient developed fever and cough the day after the loss of

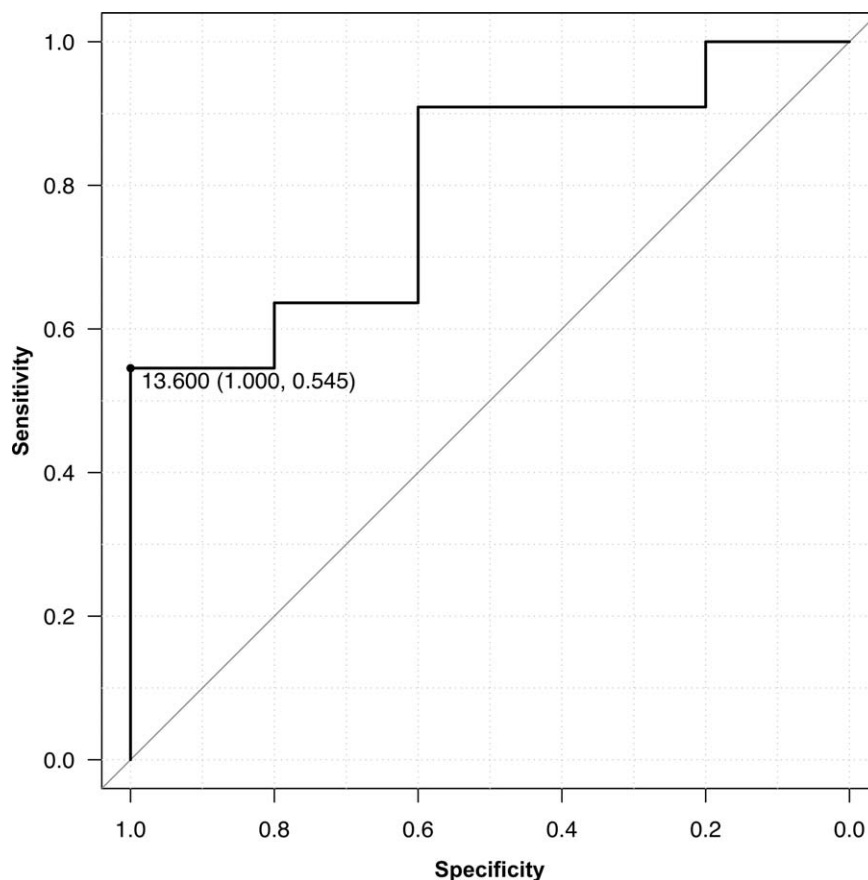


Figure 4. ROC curve analysis of screening tests for denture removing. The AUC of the ROC curve was 0.8. The cutoff value of the denture size was 13.6. AUC = area under the roc curve, ROC = receiver operating characteristic.

dentures, and a cervicothoracic X-ray was taken by a nearby physician, whereupon accidental ingestion of the denture was discovered. The patient was an older adult, had a history of cerebral infarction, and had few subjective symptoms of accidental ingestion of dentures; he was examined at a medical institution 2 days after the estimated onset. In this case, the patient developed dysphagia as a sequela of cerebral infarction and aspiration pneumonia due to the ingestion of ordinary meals or due to the occurrence of inapparent aspiration. However, aspiration pneumonia may have occurred due to the accidental ingestion of dentures. This finding suggests that early detection of denture loss and aspiration may prevent aspiration pneumonia in older adults and patients with poor subjective symptoms of aspiration, such as cerebral infarction and dementia. Accidental

ingestion of FBs should be considered as a differential diagnosis in patients with pneumonia symptoms such as pyrexia and cough, regardless of whether the patient complained of accidental ingestion. The incidence of complications due to the elapsed time after the accidental ingestion of FB was 11% for 24 hours, 52%

Table 3
Analysis of factors about size of FB for endoscopic removal.

Factors	Endoscopic removal		P value
	Possibility (11)	Impossibility (17)	
Size of FB (mm)			
Dentures			
<43.3	5	3	.545
≥43.3	1	3	
FB (except dentures)			
<13.6	2	3	1
≥13.6	6	5	

FB = foreign body.

Table 4
Analysis of factors about residence time of FB for endoscopic removal.

Factors	Endoscopic removal		P value
	Possibility (9)	Impossibility (16)	
Residence time of FB (h)			
<24	9	14	.52
≥24	0	2	

FB = foreign body.

Table 5
Analysis of factors about dentures for endoscopic removal.

Factors	Endoscopic removal		P value
	Possibility (6)	Impossibility (6)	
The number of missing teeth	1.5 (1.0–6.0)	2.0 (1.0–8.0)	.558
The number of clasp	2.0 (2.0–3.0)	2.0 (2.0–4.0)	.727
Type of denture			
Unilateral	3	4	1.000
Bilateral	3	2	

for 24 to 48 hours, and 60% for 48 to 72 hours. The incidence of complications increases after 24 hours or more from accidental ingestion.^[4,10] In this study, the elapsed time from accidental ingestion in 2 patients was 24 hours or more. However, in both patients, subjective symptoms after accidental ingestion were lacking, and the patient was unable to assume that a denture was present in the body; hence, the discovery was delayed. All were removed under general anesthesia, and the patient was discharged without complications.

There is no consensus on the treatment strategy for the accidental ingestion of FBs. According to the latest guidelines and consensus established by the American Society for Gastrointestinal Endoscopy, the North American Society for Pediatric Gastroenterology, Hepatology and Nutrition, and the European Society of Gastrointestinal Endoscopy, the primary treatment for FB ingestion is endoscopic management.^[22-24] The Gastroenterological Endoscopy Guideline states that endoscopic removal is indicated when an ineffective treatment poses a serious risk of

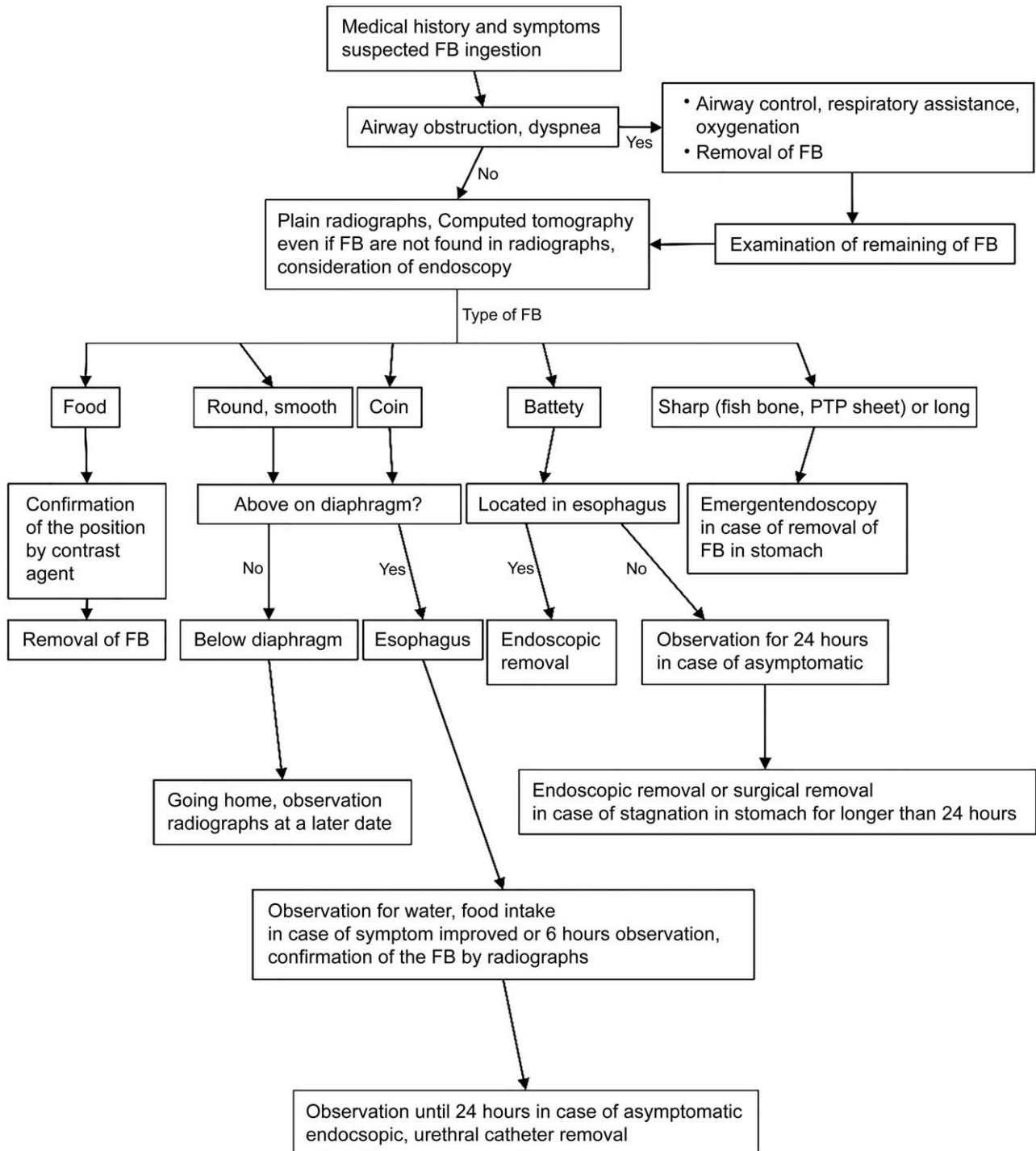


Figure 5. The algorithm for ingestion of foreign body.

adverse effects on the gastrointestinal tract^[25]; those that may damage the wall of the digestive tract, those that may possibly cause intestinal obstruction, and those which have substances containing toxic contents.

In our hospital, patients who accidentally ingested a FB were treated using the procedures shown in Figure 5. In the case of dental FB, crowns are considered to be coins, and dentures are regarded as sharp, and the procedures are followed. The more time since accidental ingestion occurred, the more likely that the FB moved from the stomach to the intestine. Six hours after accidental ingestion, the FB tends to move from the stomach to the intestine, and endoscopic removal becomes difficult.^[26] The size of the dentures and the presence of sharp retractors damage the surrounding tissues. In some cases, endoscopic treatment was possible at 30.0 mm.^[27] In others, endoscopic treatment was possible at 56.5 mm. In others, endoscopic treatment was difficult at 28.0 mm, making it challenging to decide the treatment plan according to the size of the denture. In our case, the cutoff of the size of FB (dentures) was calculated to be 43.3 mm using the Kaplan-Meier method. About endoscopic removal of FB (dentures) the results were low specificity and high sensitivity. Judging from the size of the FBs, endoscopic removal would be chosen in many cases. The most burdensome procedure for FB removal is laparotomy or thoracotomy, and if endoscopic removal is possible, the risk of surgical complications is low. In other words, even if the sensitivity is high, the increased choice of endoscopic removal is not in itself a problem; rather, it is an advantage for the patient that FB removal can be performed with fewer complications and invasion. About endoscopic removal of FB (without dentures), smaller foreign bodies do not need to be removed endoscopically and may be discharged spontaneously with follow-up observation, so we believe that endoscopic removal is more indicated for foreign bodies larger than the cutoff value. If the FB is discharged spontaneously during follow-up, there is little merit in performing endoscopic removal. Early detection and exploration of ingestion may not only be minimally invasive but also reduce complications.

This study has many limitations. Japan has a compulsory insurance system which all those living in Japan must be covered by some form of public insurance. Even this patients' burden is kept below the specified limits under the high-cost medical care benefit system, which compensates for excessive medical costs, people can visit a hospital easily. Of the 198324 presentations recorded at our center, 1054 (0.5%) were for a FB, only 32 (0.02%) were for a dental FB. It is possible that the number of target patients is smaller than the actual number because the subjects of the study were only those in which denture accidental ingestion was confirmed by imaging and visual examination. In other literature, the frequency of occurrence was as low as 0.0037%, and only 0.02% were reported in the present study.^[28] Statistical significance was not found, small sample size made the statistical power detect the difference.

5. Conclusion

Endoscopic removal of dental FB (dentures) was indicated for under 43.3 mm of the size of FB, and dental FB (except dentures) was indicated for more than 13.6 mm of the size of FB. There were no indications for endoscopic removal except for size.

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