

# Time trends and endoscopic management of foreign body ingestion in upper GI tract: An analysis of 1152 cases in China

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## Research Article

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# Abstract

**Background:** Foreign body ingestions are encountered in the clinical practice and sometimes require endoscopic management. However, time trends and epidemiology of these cases have not been fully clarified. If seasons and festivals like Chinese New Year have an effect on the occurrence is poorly described.

**Methods:** We enrolled consecutive 1152 foreign body ingestion cases in our endoscopic center from 2009 to 2020. Case records were reviewed for demographic data, foreign body type and location, outpatient or hospitalization, adverse events and dates. Annual time trends and seasonal variation were analyzed as well as influence of Chinese New Year on the incidence. Clinical features of these cases were demonstrated.

**Results:** The overall success rate was 99.7% and adverse events rate was 2.4%. There was an uptrend in the annual frequency of food foreign body ingestion endoscopic extraction from 0.65 in 2009 to 8.86 in 2020 per 1000 patients of esophagogastroduodenoscopy ( $r=0.902$ ,  $P<0.001$ ). And the frequency of the endoscopic extraction had a significant increase in winter ( $P<0.001$ ) and during Chinese New Year celebratory season ( $P=0.003$ ). Inpatient( $OR=5.656$ ,  $P<0.001$ ), jujube pits( $OR=18.306$ ,  $P=0.009$ ) and age  $\geq 60$  years( $OR=2.979$ ,  $P=0.007$ ) were risk factors of perforation and fistula.

**Conclusions:** The annual frequency of endoscopic foreign body extraction in the upper gastrointestinal tract present an uptrend from 2009 to 2020. We should enhance the publicity about the danger of foreign body ingestion. Chinese New Year celebratory season and the winter may be the high-incidence period. Inpatient, jujube pits impaction and age  $\geq 60$  years may indicate higher risk of severe complications.

## Introduction

Foreign body ingestions (FoBIs) are encountered in our clinical practice, especially in the emergency<sup>[1, 2]</sup>. In the United States, adult FoBIs had increased in incidence from 3 to 5.3 per 100 000 persons over the time period of 2000 to 2017 based on a national estimate which eliminated food related FoBIs<sup>[3]</sup>. According to a single center study, the annual incidence of esophageal foreign body impactions requiring endoscopic treatment had raised from 15 episodes in 2002 to 100 in 2009<sup>[4]</sup>. Besides, seasonal variation in the occurrence of acute esophageal bolus impaction was observed<sup>[5]</sup>. However, time trends and epidemiology focus on food related FoBIs are poorly described. These cases are usually associated with fish and animal bone ingestions which predominantly exist in the eastern countries<sup>[6, 7]</sup>.

When it comes to the influence of holidays or festivals, Shuja et al reported that esophageal food impaction is more likely to occur on American holidays and national athletic events and is related with large meals<sup>[8]</sup>. Wu et al thought that esophageal FoBIs are prone to happen on weekends and holidays than weekdays<sup>[9]</sup>. Reeves et al found that the maximum ingestion frequency of Christmas FoBIs by children is correlated with the Christmas holiday<sup>[10]</sup>. Tan et al found that during Chinese New Year in

Singapore the incidence of phytobezoars increases connected with the ingestion of large quantities of high fibrous foods<sup>[11]</sup>. So we had the hypothesis that during the Chinese New Year celebratory season, the frequency of FoBIs would increase due to the alteration of diet.

Generally, 10–20% of FoBIs need non-operative intervention and 1% or less will require surgery<sup>[12,13]</sup>. Since the first report in 1972 on the removal of a foreign body with a flexible endoscope by McKechnie et al<sup>[14]</sup>, it has been confirmed by multiple large cohorts using endoscopy as the treatment of upper gastrointestinal(GI) FoBIs with a success rate greater than 95%, a morbidity rate less than 5%, and associated mortality reported as 0%<sup>[15–20]</sup>. We concentrated on the endoscopic extraction of upper GI foreign bodies to understand the application of endoscopic management in our clinical practice as well as to demonstrate the incidence tendency of FoBIs in some extent. Besides, clinical features and risk factors of major complications were summarized.

## Materials And Methods

A retrospective study was conducted on endoscopic extraction of foreign body in the upper GI tract performed from January 1, 2009 to December 31, 2020 in the digestive endoscopy center of Wuhan Tongji Hospital. Besides specific compliant, foreign body should be corroborated by radiographic investigations before the operation to identify the impacted location and complications. After evaluating the condition, patients would be referred to surgery if the foreign body cannot be accessed by endoscopy or there has been obvious perforation. Case records were reviewed from the endoscopy center database for demographic data, foreign body type and location, outpatient or hospitalization, adverse events and dates. Consecutive cases of upper GI tract foreign body endoscopic extractions during the 12 years were divided into “food foreign body ingestion group” and “nonfood foreign body ingestion group” by the nature of foreign bodies. Clinical characteristics were compared between the two groups by  $X^2$  test. Risk factors of major complications including perforation and fistula were analyzed by logistic regression analysis.

Then, the number of foreign body endoscopic extraction per 1000 esophagogastroduodenoscopy(EGD) investigations was calculated to reduce the impact of quantity of hospital visits. There were 394 893 EGD during the study period in all. Annual amount of EGD was in the range of 28 000 to 39 000 except for the 14 680 of year 2020. Aggregate amount of EGD for each month fluctuated from 25 000 to 37 000. Seasons were defined by calendar dates:1) spring, March 1 to May 31; 2) summer, June 1 to August 31; 3) autumn, September 1 to November 30; 4) winter, December 1 to February 28 of the following year (including the days which were defined as “Chinese New Year group” below). For food and nonfood foreign body extraction, a trend analysis across the years was performed using the Spearman Correlation test and seasonal variation was examined by  $X^2$  test.

To clarify the effect of Chinese New Year on FoBIs and reduce seasonal influence, removals performed in January and February were selected and divided into “Chinese New Year group” and “other day group” by the date. A single Chinese New Year celebratory season was defined as a 15-day block including

temporally linked days from 1 week leading up to Chinese New Year and the week following Chinese New Year (the first day of lunar January). The frequency of foreign body endoscopic removal in the two group was compared with Mann-Whitney U test.

All statistical analyses were performed using SPSS Statistics software version 20 (IBM, Armonk, NY, USA). A  $P < 0.05$  was considered statistically significant.

## Results

### Clinical characteristics

From 2009 to 2020, there were entirely 1152 cases of foreign body endoscopic extraction in the upper GI tract. Among them, 7 cases were found no foreign body during the process. There were 4 cases that failed to remove the foreign object. The success rate was 99.7%. 2 cases had fish bones impacted in the level of arcus aortae of the upper thoracic esophagus and the patients were referred to surgery. 1 case was because of denture incarceration. 1 case was a child who ingested slithery global part of toys and the object dropped off into the nasal cavity.

988 cases belonged to food FoBIs (fish bones, animal bones, food bolus, jujube pits and well-shaped undigested food) and 157 cases belonged to nonfood FoBIs (toiletries, utensils, metals, dentures, etc.).

Of those cases reported, food FoBIs accounted for 86.3%. In this group, the ratio of females was slightly higher (50.6%,  $n = 500$ ) and the average age was  $52.31 \pm 15.60$  years old. 698 of them were outpatients (70.6%). Cervical esophagus was the most often impacted area (40.1%,  $n = 396$ ) and upper thoracic esophagus was the next (23.5%,  $n = 232$ ). Fish bone was the dominating type (54.9%,  $n = 543$ ) and then was the food bolus (16.6%,  $n = 164$ ). The proportion of animal bones ( $n = 124$ ) was 12.6%. Jujube pits ( $n = 56$ ) consisted 5.7% of all food FoBIs. 165 patients (16.7%) were found concomitant GI disease, including esophageal diseases like carcinoma ( $n = 40$ ), stenosis ( $n = 30$ ) and anastomotic stricture ( $n = 65$ ) and gastric diseases such as carcinoma ( $n = 5$ ), pyloric stenosis ( $n = 3$ ), etc. Figure 1 exhibits three cases of bones and jujube pits impaction among the enrolled cases. (Fig. 1 Endoscopic images showing: (A) the sharp fish bone impacted in the esophagus (20cm from the incisors) and extracted by the forceps, causing perforation (B) the jujube pits impacted in the esophagus (15cm from the incisors) and extracted by the forceps, causing perforation (C) the jujube pits impacted in the gastric antrum and extracted by the basket.)

Nonfood FoBIs ( $n = 157$ ) made up 13.7% of all the cases reported. Different from the food FoBIs, the majority of nonfood FoBIs occurred in males (66.9%,  $n = 105$ ,  $p < 0.001$ ) and stomach was the most frequent impacted location (56.1%,  $n = 88$ ,  $p < 0.001$ ). Similar to the food kind group, most of them were outpatients (74.5%,  $n = 117$ ,  $p = 0.344$ ). The average age was  $41.16 \pm 19.78$  years old, younger than the other group ( $p < 0.001$ ). Most of the patients were not diagnosed suspected GI disease. Mental diseases were not described in the records. There had been coins, dentures, diverse parts from metallic materials or toys, toiletries, utensils, accessories, magnets and batteries, etc. Totally, 172 patients were found

associated GI diseases during the extraction (15%). Table 1 demonstrated the characteristics of food and nonfood FoBIs respectively. Table 2 showed the numbers of different type of foreign bodies.

Table 1  
Clinical characteristics of patients

	Food FoBI	Nonfood FoBI	P
<b>Gender</b>			< 0.001
male	488(49.4%)	105(66.9%)	
female	500(50.6%)	52(33.1%)	
<b>Average age(years old)</b>	52.31 ± 15.60	41.16 ± 19.78	< 0.001
<b>Visit approach</b>			0.344
outpatient	698(70.6%)	117(74.5%)	
Inpatient	290(29.4%)	40(25.5%)	
<b>Location</b>			< 0.001
Epiglottis	25(2.5%)	5(3.2%)	
Cervical esophagus	396(40.1%)	19(12.1%)	
Upper thoracic esophagus	232(23.5%)	18(11.5%)	
Middle thoracic esophagus	125(12.7%)	4(2.5%)	
Lower thoracic esophagus	78(7.9%)	7(4.4%)	
Stomach	92(9.3%)	88(56.1%)	
Duodenum	40(4.0%)	16(10.2%)	
<b>Underlying GI disease</b>	165(16.7%)	7(4.5%)	< 0.001

Table 2  
Foreign body types and numbers

	<b>Foreign body type</b>	<b>No.</b>
<b>Food related foreign body</b>	Fish bone	543(54.9%)
	Other animal bones	124(12.6%)
	Food bolus	164(16.6%)
	Shaped undigested food	101(10.2%)
	Jujube pits	56(5.7%)
<b>Nonfood foreign body</b>	coins	10
	denture	14
	Medical supply	3
	details	29
	Packaged tablet	7
	key	4
	lighter	19
	toothpick	7
	toothbrush	8
	razer	2
	stationery	3
	accessory	6
	battery	2
	utensils	3
	metal	18
	magnets	3
	glass	4
	scissor	1
	needle	10
	Coat hanger	1
hair	3	

## Time trend and seasonal variation

In total, there were 2.5 cases of food FoBI endoscopic extraction per 1000 patients of EGD investigations. For nonfood FoBI extraction, the frequency was 0.4 per 1000 patients of EGD. There was an uptrend in the annual frequency of food FoBI endoscopic extraction per 1000 patients of EGD during the study period. ( $r = 0.902$ ,  $P < 0.001$ ) Over the 12-year time frame of the study, the annual frequency of food foreign body endoscopic extraction increased from 0.65 in 2009 to 8.86 per 1000 patients of EGD in 2020. By contrast, there was no significant change in the annual frequency of nonfood FoBI endoscopic extraction ( $P = 0.111$ ) (Fig. 2). (Fig. 2 Food foreign body ingestions (FoBIs) versus nonfood foreign body ingestions, 2009 to 2020; the annual frequency of foreign body endoscopic extraction per 1000 patients of esophagogastroduodenoscopy (EGD) over the study years. While food FoBIs was demonstrated by Spearman Correlation test to have a significant uptrend ( $r = 0.902$ ,  $P < 0.001$ ), nonfood FoBIs did not demonstrate a significant trend ( $P = 0.111$ )).

For seasonal variation, the frequency of food FoBI endoscopic extraction per 1000 patients of EGD had a significant increase in winter ( $P < 0.001$ ), while there was no significant difference among the other three seasons ( $P = 0.840$ ). By contrast, there was no seasonal variation in nonfood FoBI endoscopic extraction ( $p = 0.451$ ) (Fig. 3) (Fig. 3 Food foreign body ingestions versus nonfood foreign body ingestions, 2009 to 2020; seasonal variation of the frequency of foreign body endoscopic extraction per 1000 patients of esophagogastroduodenoscopy (EGD)).  $\chi^2$  test showed a significant increase during the winter ( $P < .001$ ) and no significant change in the other three seasons ( $P = 0.840$ ) in food FoBIs. There was no significant seasonal variation in nonfood FoBIs ( $P = 0.451$ )).

And the proportion of different types of food foreign body changed with the season. ( $P = 0.046$ ) (Fig. 4) The ratios of bones and well-shaped undigested food (distinguished from food bolus) were higher in the winter (bones: 69.7% versus 65.0%, 66.0%, 68.2%; well-shaped undigested food: 13.3% versus 8.4%, 7.1%, 10.5%). The proportion of jujube pits was higher in the spring (8.4% versus 5.7%, 4.5%, 4.5%). (Fig. 4 Food foreign body and seasons, 2009 to 2020; The proportion of different kinds of food foreign body changed with seasons.  $\chi^2$  test showed that the ratios of bones and well-shaped undigested food were higher in the winter than the other three seasons. ( $P = 0.046$ )).

## Impact of Chinese New Year

In the January and February of the study period, there were totally 213 cases of upper GI foreign body endoscopic extraction. 76 cases were in the Chinese New Year celebratory seasons (totally 180 days) and 137 cases occurred in the other days of these months (totally 531 days). The frequency of foreign body endoscopic extraction demonstrated a significant increase in the 15-day block surrounding Chinese New Year than the other days of January and February by Mann-Whitney U test ( $P = 0.003$ ).

## Risk factors for complications

There were 6 cases leading to a fistula due to the sharp objects including animal bones(n = 2), fish bones(n = 2) and jujube pits(n = 2). 5 cases involved esophagus and 1 case was in the stomach. Meanwhile, 22 cases were diagnosed perforation and treated with titanium clip and drainage tube. The reason included fish bones(n = 15), jujube pits(n = 4), animal bones(n = 2) and toothbrush(n = 1). Most of them influenced the esophagus (n = 19). The overall ratio of adverse events was 2.4%. Major complications included fistula (0.5%) and perforation (1.9%). Inpatient(OR = 5.656, P < 0.001), jujube pits(OR = 18.306, P = 0.009) and age ≥ 60 years(OR = 2.979, P = 0.007) indicated the high risk of severe complications. Results are presented in Table 3.

Table 3  
Factors that were associated with increased risk of perforation and fistula

Variables	OR	95%CI	P
Inpatient(vs. outpatient)	5.565	2.500-12.392	< 0.001
Jujube pits(vs. other objects)	18.306	2.062-162.526	0.009
Age ≥ 60years(vs.<60 years)	2.979	1.348–6.584	0.007

## Discussion

In this study, we demonstrated the annual time trends of endoscopic foreign body extraction by two groups over a 12-year frame as well as seasonal variation. As we know, it is the first research that concentrates on the time trends and influence of Chinese New Year on foreign body ingestion in our area.

To minimize the influence of patient volume undergoing endoscopy in the center, we used the number of EGD investigation as denominator. So we could discover that the obvious increase in the frequency of endoscopic foreign body extraction from 0.65‰ in 2009 to 8.86‰ in 2020 for food type. Although the incidence rates were not population based, the total number of EGD performed in our endoscopic center was up to 390,000. It may suggest the increasing application of endoscopy in the removal of upper GI tract, or it mirrored the uptrend of food related foreign body ingestion while the nonfood group showed a lower and basically constant incidence as 0.27–0.56‰. The uptrend reminded us the lack of public education about the harm of foreign body ingestion. There is still a lot to do to hinder these avoidable episodes.

The previous report showed an increase of annual incidence of EGD performed for esophageal foreign body from 15 to 100 episodes over a 8-year time frame<sup>[4]</sup>. In our research, the annual incidence changed from 24 episodes in 2009 to 148 episodes in 2020. But the effect of hospital visit cannot be ignored.

Then, our study exhibited a significant seasonal variation between winter and the other three seasons in food FoBIs. And bones and well-shaped undigested food consisted a higher proportion in the winter. It may partly explain the increased frequency of food FoBIs requiring endoscopic extraction in winter. Dietary habits could change with the weather. In cold days, hot soup made by fish or chickens are

consumed more frequently. In Chinese culture, these kinds of food usually will not be cooked with the bones removed first.

In the same way, dietary customs are part of cultural identity and vary based on culture, religious beliefs, countries, and dates. Chinese New Year is a traditional festival celebrated by ethnic Chinese to welcome the beginning of spring. In current society, it is attached the meaning of reunion called “TuanYuan” in Chinese. People always make lots of efforts to prepare the feast to entertain the family members which takes more accessibility to the food with bones or having a large meal without moderation. Alcohols make it harder to distinguish those bones. In this way we can see the increased frequency of endoscopic extraction for FoBIs during the festival than other normal days. The frequency of foreign body endoscopic extraction demonstrated a significant increase in the 15-day block surrounding Chinese New Year than the other days of January and February. So the winter and Chinese New Year celebratory season may be the high-incidence period of foreign body ingestion.

Shuja et al reported that the likeness of esophageal food impaction has a 10-fold increase in the adults undergoing emergent EGD during periods celebrating cultural holidays and national athletic events compared with the periods not associated with these events<sup>[8]</sup>. Lili Wu et al reported that the occurrence of esophageal foreign body ingestion is 2.75 per day on holidays, 1.46 per day on weekends, and 0.91 per day on weekdays<sup>[9]</sup>. Comparing with similar studies, the frequency per day of FoBIs in ours is lower due to different object of study.

Comparable to the other studies from eastern countries, bones are the dominant part of foreign body ingestion. Besides, our research reflected that the food related foreign body ingestion differentiates greatly from nonfood related kind in the sex ratio and average age of patients. For food FoBIs (mainly consisting of bones and jujube pits), the average age of patient was 52 years old and esophagus was the most often impacted location. According to the high-risk age, time and foreign body type, we can promote the danger of foreign body ingestion more specifically. Impaction longer than 24 hours, located in the cervical esophagus and sharp-pointed objects are commonly known as the risk factors of life-threatening adverse events<sup>[15, 21, 22]</sup>. Our study suggested that inpatient, jujube pits and age  $\geq 60$  years may indicate higher risk of severe complications.

The overall success rate was 99.7% and ratio of adverse events was 2.4% that only including fistula formation and perforation. The proportion of GI disease was 15% taking malignance as a dominating part, different from western countries where eosinophilic esophagitis were the majority of concomitant GI diseases<sup>[1]</sup>.

The limitation of our study: this was a single-center study based on a retrospective design. And the incidence was not based on a national population. We used the amounts of patients undergoing EGD to minimize the impact of population size. But multi-center study based on a national population is demanded to estimate the burden. In addition, we only enrolled the foreign body ingestion cases of upper

GI tract excluding the patients visiting for other department such as GI surgery. That was based on the low rate of requiring surgery for GI foreign body ingestion (no more than 1%).

## **Conclusions**

In conclusion, considering the uptrend of food related foreign body ingestion requiring endoscopic treatment, we should enhance the publicity about the risk of foreign body ingestion especially in the winter and surround the Chinese New Year. For mid-aged or older people, they should pay more attention while eating food with bones or jujube pits.

## **Declarations**

### **Ethics approval and consent to participate**

The ethics approval for the study was approved by the Ethics Committee of Tongji Hospital of Tongji medical college, Huazhong University of Science and Technology. Ethics approval number is TJ-IRB20210819. All procedures followed were in accordance with the ethical standards of the Ethics Committee of Tongji Hospital of Tongji medical college, Huazhong University of Science and Technology in Wuhan, China.

The full name of the committee which waived the consent for the study is the Ethics Committee of Tongji Hospital of Tongji medical college, Huazhong University of Science and Technology.

### **Consent for publication**

Not applicable.

### **Acknowledgement**

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### **Availability of data and materials**

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

### **Competing interests**

The authors declare that they have no competing interests.

### **Funding**

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### **Authors' contribution**

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas, took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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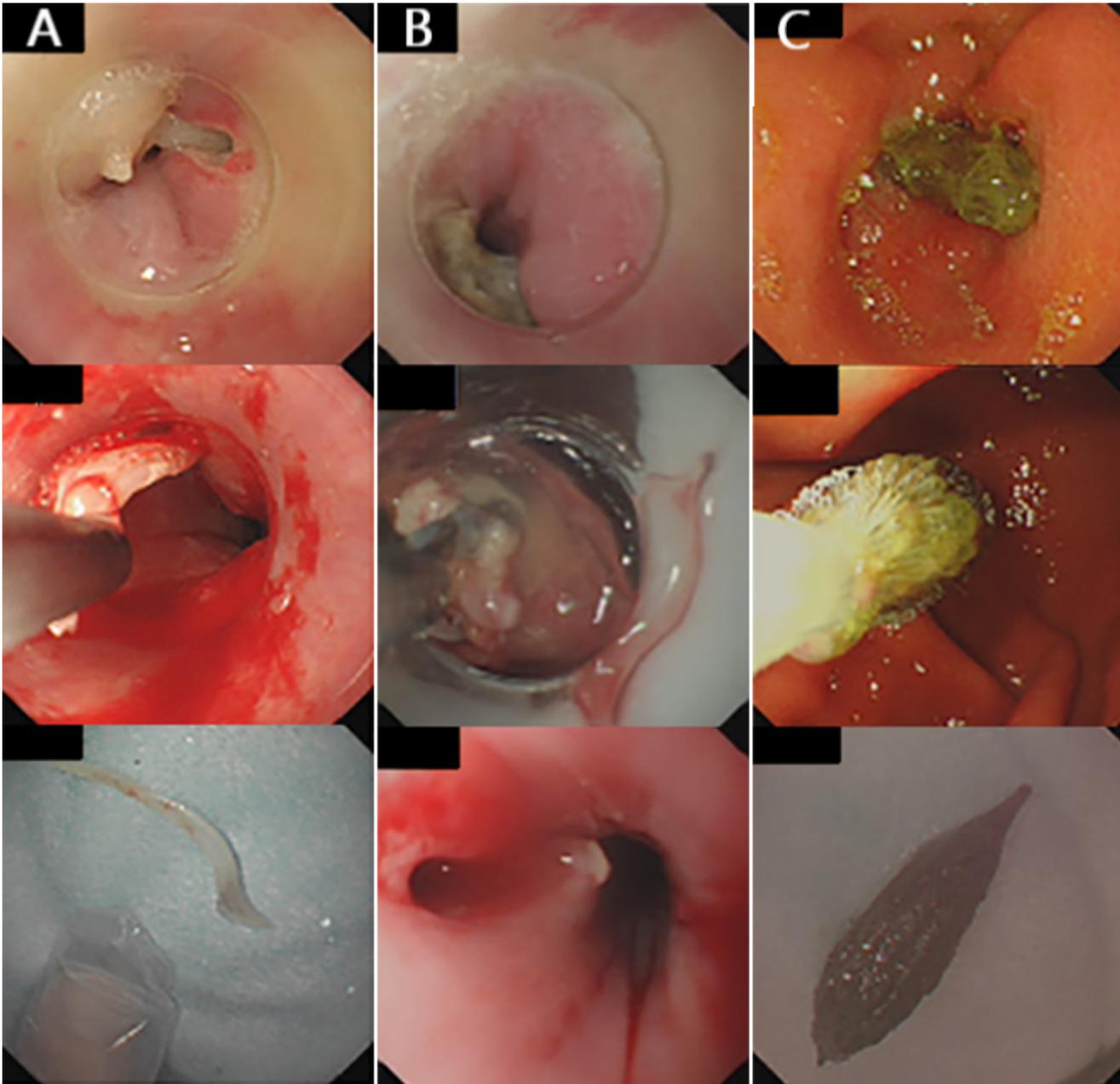
No applicable.

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## Figures



**Figure 1**

Endoscopic images showing: (A) the sharp fish bone impacted in the esophagus (20cm from the incisors) and extracted by the forceps, causing perforation (B) the jujube pits impacted in the esophagus (15cm from the incisors) and extracted by the forceps, causing perforation (C) the jujube pits impacted in the gastric antrum and extracted by the basket.

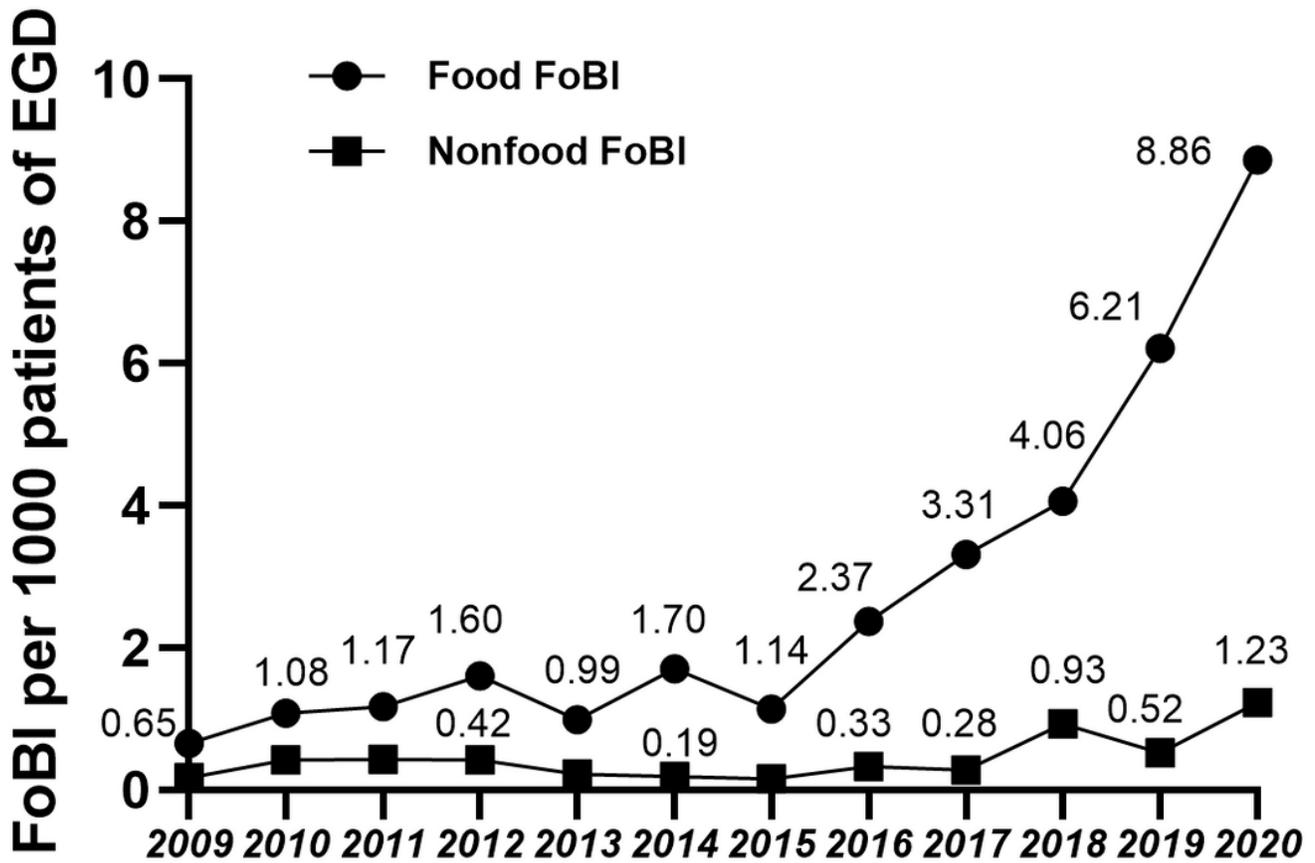


Figure 2

Food foreign body ingestions(FoBIs) versus nonfood foreign body ingestions, 2009 to 2020; the annual frequency of foreign body endoscopic extraction per 1000 patients of esophagogastroduodenoscopy (EGD) over the study years. While food FoBIs was demonstrated by Spearman Correlation test to have a significant uptrend ( $r=0.902$ ,  $P<0.001$ ), nonfood FoBIs did not demonstrate a significant trend ( $P=0.111$ ).

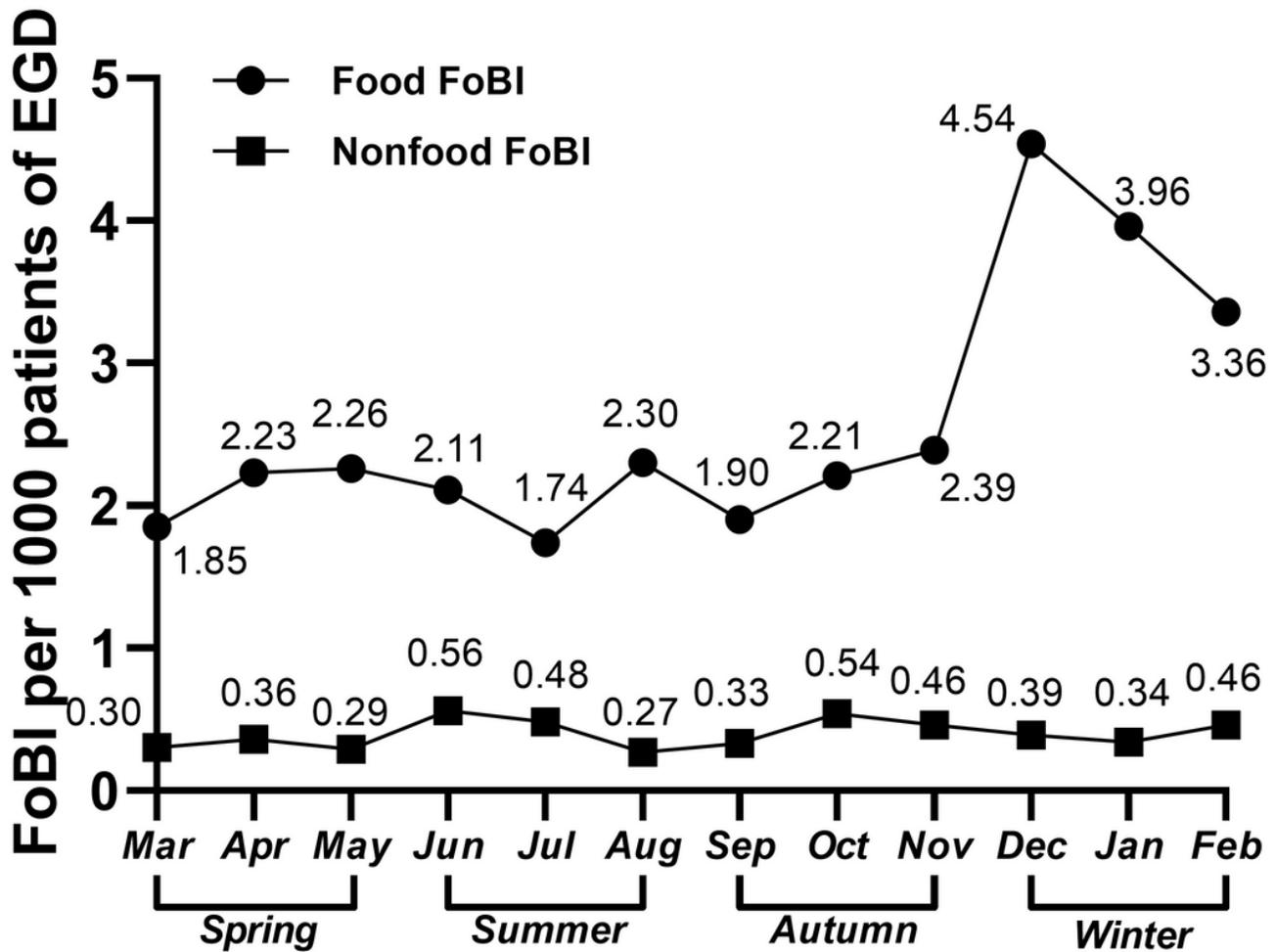


Figure 3

Food foreign body ingestions versus nonfood foreign body ingestions, 2009 to 2020; seasonal variation of the frequency of foreign body endoscopic extraction per 1000 patients of esophagogastroduodenoscopy (EGD). test showed a significant increase during the winter( $P<.001$ ) and no significant change in the other three seasons( $P=0.840$ ) in food FoBIs. There was no significant seasonal variation in nonfood FoBIs ( $P=0.451$ ).

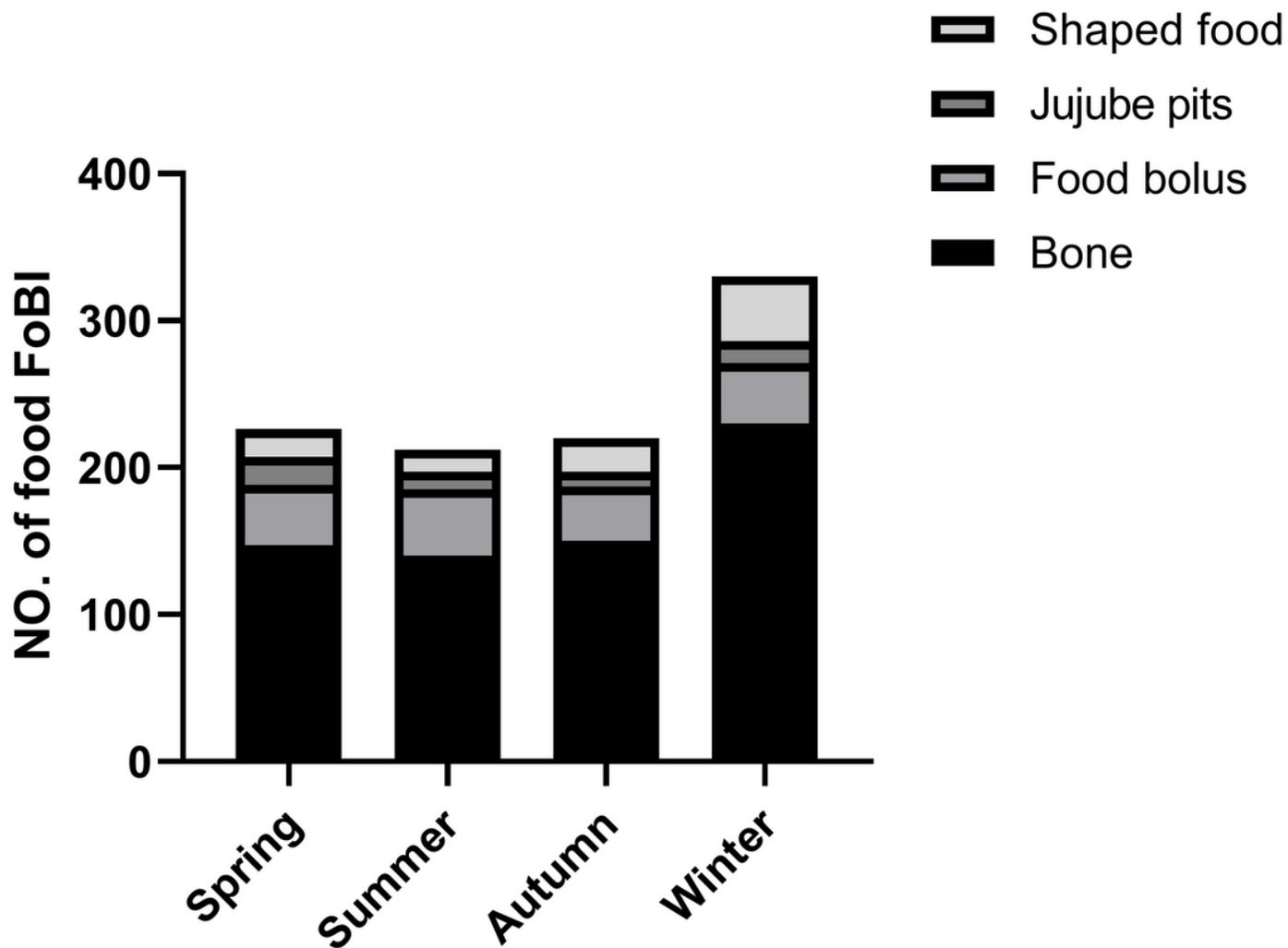


Figure 4

Food foreign body and seasons, 2009 to 2020; The proportion of different kinds of food foreign body changed with seasons. test showed that the ratios of bones and well-shaped undigested food were higher in the winter than the other three seasons. (P=0.046)