

Original

Dental Erosion in Patients Undergoing Endoscopic Treatment for Esophageal Achalasia: A Cross-Sectional Study of Prevalence, Severity, and Clinical Characteristics

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Background: Reflux esophagitis is associated with dental erosion (DE). However, the relationship between esophageal achalasia and DE is unclear. Endoscopic treatment is effective for esophageal achalasia and is the standard treatment worldwide. This study evaluated DE prevalence and severity in relation to the clinical characteristics of patients undergoing endoscopic treatment for achalasia.

Methods: This cross-sectional study included 75 patients with achalasia who underwent endoscopic treatment. DE prevalence was evaluated using a modified tooth wear index. The presence of reflux esophagitis after endoscopic treatment was evaluated by using the Los Angeles (LA) classification, which is based on esophagogastroduodenoscopy images. DE prevalence and severity were assessed in relation to clinical characteristics, including proton pump inhibitor (PPI) medication and reflux esophagitis status after endoscopic treatment. Pearson's chi-square test was used to analyze DE prevalence and severity.

Results: Sixteen patients were categorized as having DE (21.3%), and most of these cases were mild. Age, sex, body mass index, the interval between endoscopic treatment and DE evaluation, achalasia type and distribution, endoscopic treatment type, and LA classification of reflux esophagitis did not differ significantly between patients with and without DE. However, PPI response/resistance and continuation/discontinuation significantly differed between patients with and without DE ($p < 0.05$).

Conclusions: PPI response/resistance and continuation/discontinuation might be associated with DE prevalence in patients with achalasia who underwent endoscopic treatment.

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Keywords: esophageal achalasia, dental erosion, endoscopic treatment, reflux esophagitis, proton pump inhibitor

Introduction

Esophageal achalasia is a motility disorder characterized by incomplete relaxation of the lower esophageal sphincter (LES) and absent or aberrant peristalsis in the esopha-

geal body^{1,2}. Although the annual incidence of achalasia is only 1 per 100,000¹, it is often misunderstood and interpreted as simple reflux esophagus³. General symptoms of reflux esophagitis are typically defined as heartburn

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Table 1 Study inclusion and exclusion criteria

Eligibility criteria
Inclusion criteria
Patients with achalasia who underwent endoscopic treatment
Patients with at least 20 natural teeth
Exclusion criteria
Patients younger than 18 years
Patients with PD before POEM
Patients using drugs known to reduce saliva secretion
Patients with high consumption of acidic drinks and foods
Patients with trismus or bleached or discolored teeth

PD: pneumatic dilation; POEM: peroral endoscopic myotomy.

and regurgitation. In atypical forms, extra-esophageal symptoms such as chest pain, dental erosion (DE), chronic cough, laryngitis, and asthma may occur. DE is defined as the chemical loss of mineralized tooth substance caused by exposure to acid not derived from oral bacteria⁴. Reflux esophagitis was recently reported to be associated with DE⁵; however, the association of esophageal achalasia with DE is unclear.

Effective clinical treatments for achalasia include pneumatic dilation (PD), laparoscopic Heller myotomy combined with partial fundoplication, and peroral endoscopic myotomy (POEM)^{6,7}. These treatment options differ in effect duration, invasiveness, and adverse event risk⁸. Although PD is a standard endoscopic treatment option for achalasia, its effectiveness tends to diminish over time, especially for younger patients⁹. Another standard endoscopic treatment is POEM, a minimally invasive procedure involving endoscopic cutting of the LES to improve esophageal emptying. POEM is recommended because of its clinical effectiveness and safety profile; however, reflux esophagitis after POEM has been reported¹⁰. While etiologic factors of esophageal achalasia do not affect oral diseases, reflux esophagitis after endoscopic treatment might be an acid-related factor associated with oral conditions such as DE.

In 2005, Moazzez et al.¹¹ reported that DE prevalence was 21.4% in patients with esophageal achalasia and suggested that esophageal motility disorder in patients with achalasia might influence DE development—for example, an obstructive esophagus causes food fermentation and regurgitation of fermented food causes DE. Hanisch et al.¹² reported few DE cases (4.8%); however, factors related to tooth structure damage were not discussed. Although there are several effective treatments for esophageal achalasia, none of the abovementioned dental studies evaluated DE prevalence and severity in relation to

patients' clinical characteristics, including the endoscopic treatment used and the prescribed medication (e.g., proton pump inhibitor [PPI]).

This study evaluated DE prevalence and severity in relation to the clinical characteristics of patients undergoing endoscopic treatment for achalasia. Because reflux esophagitis after endoscopic treatment is usually mild and diminishes over time¹³, clinical characteristics such as reflux esophagitis presence/absence, PPI response/resistance, and PPI continuation/discontinuation were also evaluated.

Materials and Methods

Study Design

This cross-sectional study conformed to the principles of the Declaration of Helsinki and was approved by the Ethics Committee of Nippon Medical School (approval number: B-2019-036)¹⁴. All participants provided written informed consent. This research adheres to the STROBE guidelines for cross-sectional studies, to ensure methodological adequacy.

Participants

We enrolled consecutive patients with achalasia in Nippon Medical School Hospital between April 2019 and March 2025. **Table 1** lists the eligibility criteria.

Clinical records were reviewed for findings from high-resolution manometry and esophagography and the following data were collected: achalasia type based on the Chicago 3.0 classification¹⁵, esophagography-based achalasia type and distribution, endoscopic treatment (PD or POEM) type, and post-endoscopic treatment reflux esophagitis status. Post-endoscopic treatment reflux esophagitis classified as A/B on the Los Angeles (LA) classification is considered mild and C/D as severe. Patients were excluded if they were receiving saliva-

reducing medications, such as antihypertensive agents (anti-adrenergic agents and adrenergic alpha-2 agonists), antidepressants, psychotropic drugs, or anticholinergic drugs. PPI-resistant reflux esophagitis was defined as a condition in which esophageal mucosal injuries do not heal (mucosal break) and/or reflux symptoms considered to be caused by reflux esophagitis are insufficiently mitigated even after PPI administration at a standard dose for 8 weeks. PPI continuation was defined as administration of standard-dose PPI every 2–3 months. Participants' individual dietary intake was recorded in detail on a written questionnaire¹⁶. The dietary history was used to exclude patients with extrinsic erosion and high consumption of acidic drinks and foods. The sample size was not calculated because this research is the first pilot study to evaluate DE prevalence in relation to the clinical characteristics of patients with achalasia who developed this rare condition. Another reason is that the annual incidence of esophageal achalasia is only 1 per 100,000³. Therefore, we included patients who had their first medical and dental evaluation for esophageal achalasia with endoscopic treatment experience and those who completed their medical and dental examination by the end of March 2025. Missing data were attributed to lack of information in the original medical records. These were documented as “non-evaluated” during high-resolution manometry and esophagography and “unknown” during analysis of PPI resistance and were then excluded from the statistical analysis.

DE

At 1 year after endoscopic treatment, participants underwent oral examination by one of two trained and calibrated dental examiners (YK/MI) who were blinded to any information on patient diagnosis and treatments for esophageal achalasia. Intra- and inter-examiner reproducibility was assessed for 50 different case examples, using Cohen's kappa as the measure of agreement. Kappa values for intra-examiner agreement were 0.98 (YK) and 0.97 (MI), and the value for inter-examiner agreement was 0.97 (YK/MI). A modified tooth wear index¹⁷ was developed according to the Smith and Knight Tooth Wear index (TWI)¹⁸ and the index of Fares and colleagues¹⁹. Dentin exposure scoring adhered to the TWI and used the color of the exposed lesion to represent depth and lateral spread. Changes to the enamel and dentin surface texture or anatomy were graded according to the following eight score categories: 0, no wear; 1, enamel loss affecting less than 10% of the scored surface

area; 2, enamel loss affecting between 10% and one-third of the surface area; 3, enamel loss affecting at least one-third but less than two-thirds of the surface area; 4, enamel loss affecting two-thirds or more of the surface area and no dentin exposure; 5, dentin loss affecting less than one-third of dentin thickness; 6, dentin loss affecting between one-third and two-thirds of thickness on the scored surface; and 7, dentin loss affecting two-thirds or more of thickness, with visible secondary dentin formation around the pulp chamber. Any changes resulting from buccal, occlusal/incisal, or palatal/lingual surface wear were recorded for all existing teeth except third molars. When the correct score was in doubt, the lower score was recorded. TWI scores of 1–4 were considered mild wear and 5–7 as severe wear. The score reflecting the most severe wear was noted for each patient for data analysis. In our previous study⁵, initial DE related to reflux esophagitis was observed mainly in maxillary incisors. Patients with achalasia who reported symptoms and/or reflux esophagitis after endoscopic treatment and had at least one maxillary incisor with a score equal to or greater than 2 were considered to have DE in this study. Additionally, specific oral findings of DE were evaluated^{5,20,21}.

Statistical Analysis

The prevalence, severity, and specific oral findings of DE in each group were analyzed using Pearson's chi-square test. Distributions of age and body mass index (BMI) were analyzed using the Shapiro–Wilk normality test. Subsequently, differences in age, BMI, and the interval between endoscopic treatment and DE evaluation were compared using the Kruskal–Wallis test and the Mann–Whitney *U* test. Variables such as high-resolution manometry-based achalasia type, esophagography-based achalasia type and distribution, post-endoscopic treatment LA classification of reflux esophagitis, PPI response/resistance, and PPI continuation/discontinuation were analyzed by the Pearson's chi-square test, Fisher's exact test, and Fisher–Freeman–Halton exact test, except for unevaluated cases. All statistical data were analyzed using SPSS Statistics 27.0 (IBM, Armonk, NY, USA), and the significance level was set at 0.05 with Bonferroni correction.

Results

Patient Enrollment

This study included 79 patients with achalasia who underwent endoscopic treatment. However, four were ex-

Table 2 Clinical characteristics of patients with or without dental erosion following endoscopic treatment for achalasia

Clinical characteristics	With DE (n=16)	Without DE (n=59)
Age, y, median (IQR)	54 (46–63)	55 (46–65)
Sex, male/female	8/8	28/31
BMI, median (IQR)	23.2 (20.9–24.5)	21.1 (19.5–24.4)
Interval between endoscopic treatment and DE evaluation, m, median (IQR)	13.5 (12.0–15.5)	14.0 (12.0–17.5)
High-resolution manometry		
Achalasia type*, type 1/type 2/type 3/non-evaluated	5/8/2/1	21/22/8/8
Esophagography		
Type, straight/sigmoid/non-evaluated	9/6/1	44/13/2
Dilation grade 1/grade 2/grade 3/non-evaluated	6/9/0/1	27/30/0/2
Endoscopic treatment, pneumatic dilation/POEM	5/11	29/30
Reflux esophagitis after endoscopic treatments		
LA Classification, LA-A/LA-B/LA-C/LA-D	6/9/1/0	1/1/0/0
PPI responsive/resistant/unknown	2/12/2 ^a	52/3/4 ^a
PPI continuation/discontinuation	11/5 ^b	13/46 ^b

*According to Chicago 3.0 classification.

^{a, b}Same superscript letter was statistically different ($p < 0.05$) by Mann-Whitney U test.

POEM: preoral endoscopic myotomy; IQR: interquartile range; LA: Los Angeles; DE: dental erosion;

PPI: proton-pump inhibitor; BMI: body mass index.

Table 3 Clinical characteristics, severity, and specific oral findings of dental erosion in patients with achalasia undergoing endoscopic treatment

Treatment procedure	PD (5)	POEM (11)
Clinical characteristics		
Interval between endoscopic treatment and DE evaluation, m, median (IQR)	14.0 (13.0–17.0)	13.0 (12.0–15.0)
Reflux esophagitis after endoscopic treatments		
LA Classification, LA-A/LA-B/LA-C/LA-D	3/2/0/0	3/7/1/0
PPI responsive/resistant/unknown	2/3/0	1/8/2
Severity of DE		
Mild (enamel) DE/Severe (dental) DE	5/0	9/2
Specific oral findings of DE		
C or L-shaped tooth wear including dental exposure on the palatal surfaces (only 13–23 are included) *	2 (40.0%)	5 (45.4%)
Concavities and cupping on the occlusal surfaces (only premolars and molars are included) **	0 (0%)	2 (18.1%)
Hypersensitivity (all teeth are included) ***	0 (0%)	2 (18.1%)

*According to Kitasako et al. ²² (2024); **According to Hammoudi et al. ²⁰ (2019); ***According to Gandara and Truelove ²¹ (1999).

PD: pneumatic dilation; POEM: preoral endoscopic myotomy; LA: Los Angeles; DE: dental erosion.

cluded because of PD treatment before POEM ($n = 2$), high consumption of acidic drinks and foods ($n = 1$), and discolored teeth ($n = 1$). Therefore, 75 patients were included in the final analysis.

Patient Characteristics

Of the 75 included patients, 16 were categorized as having DE (21.3%) (Table 2). Postoperative assessments after endoscopic treatment and DE evaluations were generally conducted at 1 year after the procedures. In some cases, the interval exceeded 1 year because of patient availabil-

ity or medical scheduling constraints (Tables 2 and 3). Age, sex, BMI, interval between endoscopic treatment and DE evaluation, high-resolution manometry-based achalasia type, esophagography-based achalasia type and distribution, endoscopic treatment type, and LA classification of reflux esophagitis did not significantly differ between patients with and without DE. However, significant differences in PPI response/resistance and PPI continuation/discontinuation were noted between patients with and without DE ($p < 0.05$).

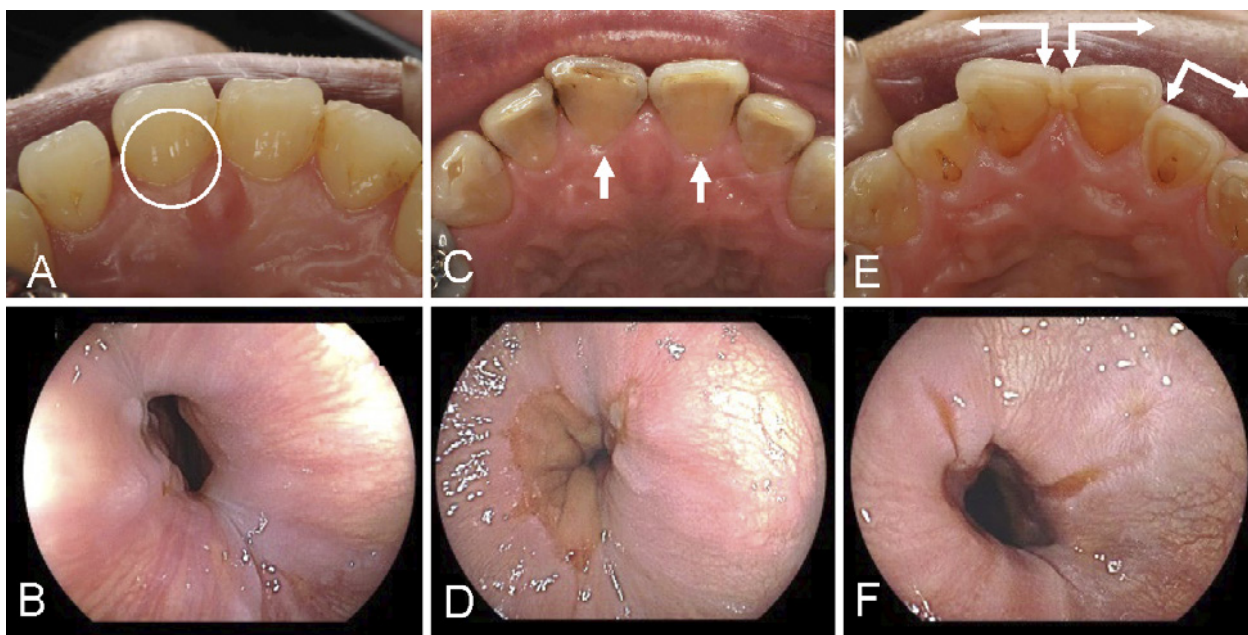


Figure 1 Representative oral photographs and endoscopic images

In a 54-year-old patient who underwent endoscopic treatment (PD), no DE was observed (A, B). No DE on the palatal surfaces of the maxillary incisors, remaining anatomically formed cingulum (white circle) (A), and no mucosal breaks (B) were observed. In a 47-year-old woman undergoing endoscopic treatment (POEM), DE was observed (C, D), as was mild reflux esophagitis (LA-A) and mild (enamel) tooth wear. Loss of convexity was observed on the palatal side of the maxillary incisors (C) (white arrows). Mucosal break was limited to the mucosal folds (D). In a 56-year-old man undergoing endoscopic treatment (POEM), DE was observed (E, F), as was mild reflux esophagitis (LA-B). Severe (dentinal) wear with specific oral appearance (L-shaped tooth wear, including dentinal exposure) was observed on multiple palatal surfaces of the maxillary incisor (white arrows) (E). Several mucosal breaks were limited to the mucosal folds (F).

DE: dental erosion; PD: pneumatic dilation; POEM: peroral endoscopic myotomy; LA-A or -B, Los Angeles classification grade A or B.

DE

Most of the 16 patients with DE had mild wear (Table 2). When comparing DE severity, wear was mainly mild (enamel) (Table 3). Of the 9 POEM cases, two (22.2%) had severe (dentinal) wear. Specific oral findings of concavities and cupping on the occlusal surfaces of premolars and molars—indicating that DE had spread throughout the entire oral cavity—were only detected in POEM cases. PD and POEM cases did not significantly differ (or were not analyzed because of the absence of cases) in DE severity, specific oral findings, LA classification, or PPI response/resistance.

In the DE group, the presence of palatal DE was the main oral finding in the maxillary incisor region (Figure 1C and 1E). Most DE cases exhibited mild wear (Figure 1C), and only two had severe wear (Figure 1E). A patient without DE showed no obvious wear on the palatal surfaces of the maxillary incisors (Figure 1A). In a patient with mild reflux esophagitis after endoscopic treatment (LA-B, Figure 1F), L-shaped wear with dentinal exposure was detected on multiple palatal surfaces of the maxil-

lary incisors (Figure 1E).

Discussion

Few studies have examined the association between esophageal achalasia and DE. To our knowledge, this is the first study to evaluate DE prevalence and severity in relation to clinical characteristics, including medication-related status such as PPI response/resistance and PPI continuation/discontinuation, among patients with achalasia who underwent endoscopic treatment.

Regarding the high-resolution manometry-based achalasia type and esophagography-based achalasia type and distribution, no significant difference was observed between patients with and without DE. All patients with DE exhibited reflux esophagitis after endoscopic treatment. Because DE usually develops gradually after prolonged exposure to gastric acid, the postoperative follow-up period may affect dental findings. In this study, DE was evaluated at a 1-year follow-up examination. Considering that post-endoscopic treatment reflux esophagitis and DE were identified at a 1-year follow-up evalu-

ation, an association might exist between these conditions. Identifying reflux esophagitis status after endoscopic treatment may be important when evaluating DE prevalence in patients with achalasia who underwent endoscopic treatment.

Moreover, patients with and without DE significantly differed in PPI response/resistance and PPI continuation/discontinuation. A recent multivariate analysis suggested that PPI resistance is a significant risk factor for DE in patients with reflux esophagitis²². Chronic acid exposure may result in DE; therefore, prolonged post-endoscopic treatment reflux esophagitis due to PPI resistance may have affected DE prevalence. Additionally, PPI continuation was significantly more common among patients with DE, indicating that DE was detected regardless of PPI continuation. Performing endoscopic treatment because of the insufficient effect of PPI continuation and detecting reflux esophagitis after endoscopic treatment could be important factors when evaluating DE prevalence.

Reflux esophagitis is a medical complication of endoscopic treatment for esophageal achalasia, although most cases are mild¹². In the present study, reflux esophagitis was detected in 14.7% and 31.7% of cases after PD and POEM, respectively. Although the prevalence of reflux esophagitis was previously reported to be significantly higher after POEM than after PD²³, the current study revealed no significant difference between PD and POEM in terms of clinical characteristics and the prevalence, severity, and specific oral findings of DE. In both PD and POEM patients with DE, reflux esophagitis after endoscopic treatment was mostly mild. Moreover, no significant difference in DE prevalence was observed in relation to endoscopic treatment type, and severe DE with a specific erosive finding was only observed in a single POEM patient with severe reflux esophagitis (LA-C). However, the presence of only one case of this type of POEM is a limitation of this study. Future clinical studies should include a larger sample comprising both PD and POEM cases with achalasia and should evaluate the influence of reflux esophagitis status after endoscopic treatment on DE severity and oral specific findings.

The most representative oral finding of DE was loss of convexity on the palatal side of maxillary teeth, which is consistent with the main finding of a previous study of the relationship between reflux esophagitis and DE⁵. Regurgitation of fluids from the pharynx into the oral cavity, and their subsequent expectoration, might make palatal surfaces more prone to DE. The palatal surfaces of

maxillary incisors are also affected by DE and have occlusal contact with opposing teeth (erosive tooth wear)⁴. Because maxillary incisors are important for mastication, the palatal DE of the maxillary incisors might result in occlusal dysfunction. Patients with achalasia exhibiting palatal DE may have diminished occlusal function, which could affect mastication²⁴. Dental professionals should promote better understanding of achalasia patients with decreased mastication performance and encourage the use of direct restorations, such as the resin composite technique, to repair eroded palatal surfaces of maxillary incisors.

This study had several limitations. A previous study¹¹ reported that fermented food (lactic acid) regurgitation in the esophagus caused DE in patients with achalasia but did not report patient clinical characteristics, including any endoscopic treatments. Owing to these mechanistic differences, directly comparing DE prevalence between previous and present studies may be inappropriate. The present study used a single-center cross-sectional approach to analyze a small sample size of patients with achalasia who underwent endoscopic treatment. Because esophageal achalasia is rare (annual incidence, 1 per 100,000)¹, comparing DE prevalence and severity in patients with achalasia and controls can be challenging. In addition, clinical approaches for esophageal achalasia vary by country, thus limiting the generalizability of our clinical findings. Without baseline dental data obtained before endoscopic treatment, we could not determine whether DE after treatment was new or present before the procedure. Therefore, a causal relationship between postoperative reflux findings and DE cannot be conclusively established. A prospective study involving baseline dental data and multiple centers with a large number of achalasia patients undergoing endoscopic treatment is necessary in order to confirm the present findings.

In conclusion, DE was observed in several patients with achalasia who underwent endoscopic treatment (21.3%), though most cases were mild. PPI response/resistance and PPI continuation/discontinuation might be associated with DE prevalence. Medical and dental professionals should promote better understanding of the possible influence of post-endoscopic treatment reflux esophagitis in patients with achalasia and its association with DE prevalence.

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Visualization: Y.K., Y.H., N.K., M.I., K.I.; Validation and supervision: Y.K., K.I.; Writing—original draft: Y.K., M.I., K.I.; Writing—review & editing: Y.K., T.T., M.K., E.M., Y.H., S.H., N.K., M.I., K.I., N.A. Funding acquisition and project administration: Y.K.; Data curation and resources: Y.K.

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References

- Pandolfino JE, Gawron AJ. Achalasia: a systematic review. *JAMA*. 2015 May 12;313(18):1841–52.
- Tuason J, Inoue H. Current status of achalasia management: a review on diagnosis and treatment. *J Gastroenterol*. 2017 Apr;52(4):401–6.
- Hamer PW, Holloway RH, Crosthwaite G, Devitt PG, Thompson SK. Update in achalasia: what the surgeon needs to know. *ANZ J Surg*. 2016 Jul;86(7-8):555–9.
- Schlueter N, Amaechi BT, Bartlett D, et al. Terminology of erosive tooth wear: consensus report of a workshop organized by the ORCA and the Cariology Research Group of the IADR. *Caries Res*. 2020 Jan 29;54(1):2–6.
- Kitasako Y, Tanabe T, Koeda M, et al. Patients with gastroesophageal reflux disease (both reflux oesophagitis and non-erosive reflux disease): prevalence and severity of erosive tooth wear and saliva properties. *J Oral Rehabil*. 2024 Feb;51(2):305–12.
- Inoue H, Minami H, Kobayashi Y, et al. Peroral endoscopic myotomy (POEM) for esophageal achalasia. *Endoscopy*. 2010 Apr;42(4):265–71.
- Goto O, Koizumi E, Higuchi K, et al. Cutting-edge technologies for gastrointestinal therapeutic endoscopy. *J Nippon Med Sch*. 2021 Feb 24;88(1):17–24.
- Wessels EM, Masclee GMC, Bredenoord AJ. An overview of the efficacy, safety, and predictors of achalasia treatments. *Expert Rev Gastroenterol Hepatol*. 2023 Dec;17(12):1241–54.
- Tanaka Y, Iwakiri K, Kawami N, et al. Predictors of a better outcome of pneumatic dilatation in patients with primary achalasia. *J Gastroenterol*. 2010 Feb;45(2):153–8.
- Nabi Z, Inavolu P, Duvvuru NR. Prediction, prevention and management of gastroesophageal reflux after per-oral endoscopic myotomy: an update. *World J Gastroenterol*. 2024 Mar 7;30(9):1096–107.
- Moazzez R, Anggiansah A, Botha AJ, Bartlett D. Association of achalasia and dental erosion. *Gut*. 2005 Nov;54(11):1665–6.
- Hanisch M, Wiemann S, Bohner L, Jung S, Kleinheinz J, Igelbrink S. Oral health-related quality of life in people with achalasia. *Medicina (Kaunas)*. 2020 Jun 11;56(6):286.
- Shiwaku H, Inoue H, Sato H, et al. Peroral endoscopic myotomy for achalasia: a prospective multicenter study in Japan. *Gastrointest Endosc*. 2020 May;91(5):1037–44.e2.
- Otsuka T, Matsuyama K. Nippon Medical School's ethical review processes for studies involving human subjects. *J Nippon Med Sch*. 2024 Apr;91(2):136–9.
- Kahrilas PJ, Bredenoord AJ, Fox M, et al. The Chicago classification of esophageal motility disorders, v3.0. *Neurogastroenterol Motil*. 2015 Feb;27(2):160–74.
- Moazzez R, Bartlett D, Anggiansah A. Dental erosion, gastro-oesophageal reflux disease and saliva: how are they related? *J Dent*. 2004 Aug;32(6):489–94.
- Kitasako Y, Sasaki Y, Takagaki T, Sadr A, Tagami J. Age-specific prevalence of erosive tooth wear by acidic diet and gastroesophageal reflux in Japan. *J Dent*. 2015 Apr;43(4):418–23.
- Smith BG, Knight JK. An index of measuring the wear of teeth. *Br Dent J*. 1984 Jun 23;156(12):435–8.
- Fares J, Shirodaria S, Chiu K, Ahmad N, Sherriff M, Bartlett D. A new index of tooth wear: reproducibility and application to a sample of 18- to 30-year-old university students. *Caries Res*. 2009;43(2):119–25.
- Hammoudi W, Trulsson M, Smedberg JI, Svensson P. Clinical presentation of two phenotypes of tooth wear patients. *J Dent*. 2019 Jul;86:60–8.
- Gandara BK, Truelove EL. Diagnosis and management of dental erosion. *J Contemp Dent Pract*. 1999 Nov;15(1):16–23.
- Kitasako Y, Momma E, Tanabe T, et al. Factors associated with prevalence and severity of erosive tooth wear in patients with reflux oesophagitis. *J Oral Rehabil*. 2024 Aug;51(8):1357–64.
- Ponds FA, Fockens P, Lei A, et al. Effect of peroral endoscopic myotomy vs pneumatic dilation on symptom severity and treatment outcomes among treatment-naïve patients with achalasia; a randomized clinical trial. *JAMA*. 2019 Jul 9;322(2):134–44.
- Fontijn-Tekamp FA, van der Bilt A, Abbink JH, Bosman F. Swallowing threshold and masticatory performance in dentate adults. *Physiol Behav*. 2004 Dec 15;83(3):431–6.