

Endoscopy International Open

Peroral Endoscopic Myotomy as a treatment for Killian–Jamieson diverticulum (KJ POEM)

Redeat L Assefa, Michael Bejjani, Amit Mehta, Apurva Shrigiriwar, Farimah Fayyaz, Yuto Shimamura, Haruhiro Inoue, Francesco V Mandarino, Francesco Azzolini, Steven P Bowers, Zhen Li, Carlos Robles-Medranda, Martha Arevalo, Vinay Dhir, Gianluca Andrisani, Alina Tantau, Michael Lajin, Kartik Sampath, Mouen A Khashab.

Affiliations below.

DOI: 10.1055/a-2399-7464

Please cite this article as: Assefa R L, Bejjani M, Mehta A et al. Peroral Endoscopic Myotomy as a treatment for Killian–Jamieson diverticulum (KJ POEM). *Endoscopy International Open* 2024. doi: 10.1055/a-2399-7464

Conflict of Interest: The following author disclosed financial relationships:

M. A. Khashab: Consultant for Boston Scientific, Olympus America, Medtronic, Apollo Endosurgery, Pentax, and GI Supply; royalties from UpToDate and Elsevier.

Inoue H: Advisor for Olympus Corporation and Top Corporation. He has also received educational grants from Olympus Corporation and Takeda Pharmaceutical Co.

All other authors disclosed no financial relationships.

Abstract:

Background: Killian–Jamieson diverticulum (KJD) is a rare type of esophageal diverticulum that occurs in a specific area called the Killian–Jamieson space. While surgery has been the conventional treatment for symptomatic KJD, minimally invasive endoscopic techniques, particularly Killian–Jamieson per-oral endoscopic myotomy (KJ-POEM), have emerged as an alternative. The aim of the study is to evaluate the effectiveness and safety of KJ-POEM in treating KJD.

Methods: This is an international, multicenter, retrospective study that included patients who underwent KJ-POEM for symptomatic KJD during the period between 10/16/2018 and 4/12/2023. The primary outcome was clinical success, defined as a complete or near-complete resolution of symptoms (i.e., a post-procedure Kothari–Haber Score ≤ 2). Secondary outcomes were technical success (defined as successful completion of all procedural steps), rate and severity of adverse events, total procedure duration, and symptom recurrence during follow-up.

Results: A total of 13 patients (mean age 65.23 years, 6 are female) with KJD, and a mean pre-procedure Kothari–Haber Score of 6 (SD 2.16), underwent KJ-POEM across 10 participating centers. Clinical success and technical success were achieved in all cases (100%) with a mean post-procedure Kothari–Haber Score of 0.91 (SD 0.99). There were no adverse events and no cases of injury to the recurrent laryngeal nerve. The mean length of the hospital stay was 1.09 (SD 0.74) days. Mean follow up time was 9.41SD (10.07) months post-procedure. There was no post-procedure symptom recurrence in all patients.

Conclusion: KJ-POEM is a safe and effective alternative treatment option for symptomatic KJD with excellent short/mid-term outcomes.

Corresponding Author:

M.D. MPH. MSc. Redeat L Assefa, Johns Hopkins University, Gastroenterology, 1800 Orleans St, 21218-2625 Baltimore, United States, rassefa3@jh.edu

Affiliations:

Redeat L Assefa, Johns Hopkins University, Gastroenterology, Baltimore, United States

Michael Bejjani, Johns Hopkins Hospital, Gastroenterology and Hepatology, Baltimore, United States
Amit Mehta, Johns Hopkins, Gastroenterology, Baltimore, United States
[...]
Mouen A Khashab, Johns Hopkins Hospital, Director of Therapeutic Endoscopy, Baltimore, United States



This article is protected by copyright. All rights reserved.

Accepted Manuscript

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

BACKGROUND

Killian-Jamieson diverticulum (KJD) is a rare form of esophageal diverticulum that occurs in a specific region of the esophagus known as the Killian-Jamieson space. Unlike other types of esophageal diverticula, such as the Zenker's diverticula (ZD) which typically occur in the upper part of the esophagus above the cricopharyngeal muscle, Killian-Jamieson diverticula originate on the anterolateral wall of the cervical esophagus below the cricopharyngeal muscle. Most patients with KJD are asymptomatic; however, some patients may develop symptoms like those in ZD such as globus sensation, halitosis, dysphagia, regurgitation, cough, epigastric pain, and rarely hoarseness [1]. While surgical intervention has traditionally been the mainstay of treatment for symptomatic Killian-Jamieson diverticula, endoscopic techniques have emerged as a minimally invasive alternative. Although per-oral endoscopic myotomy is an effective treatment for ZD (Z-POEM), its role in the management of KJD (KJ-POEM) is not well defined. There is limited published data on KJ-POEM for the treatment of KJD, with only a few case reports/case series available in the literature [2-9]. Because of the proximity of KJD to the recurrent laryngeal nerve, safety concerns have been raised about KJ-POEM. The aim of this study is to assess the efficacy and safety of KJ-POEM for the treatment of KJD.

METHODS

This is an international, multi-center, retrospective study that included 11 centers from six countries including Romania, Italy, Ecuador, Japan, India, and the United States. The study was approved by individual institutional review boards at all participating centers.

Patients who underwent KJ-POEM for symptomatic KJD between 10/16/2018 and 4/12/2023 were enrolled in the study. The diagnosis of KJD was based on results of a barium swallow test and/or computerized tomography (CT) scan that were confirmed endoscopically.

The patients' symptoms were quantified using the Kothari-Haber Score. This scoring system is mainly used for Zenker's diverticulum (ZD) and is based on seven parameters, including dysphagia, weight loss, regurgitation, halitosis, cough, hoarseness, and pneumonia [10]. It ranges from a minimum of 0 and a maximum of 16 points, with higher scores indicating more severe symptoms. Patient dysphagia scores were collected from chart reviews of clinical follow-ups.

Patients were identified using center-specific endoscopic or billing databases. Electronic records were reviewed to capture the following variables: demographic data, dysphagia score, additional symptoms (aspiration, choking, halitosis, regurgitation, weight loss, and others), imaging findings, prior surgical or endoscopic interventions, type of KJ-POEM technique used, total procedure duration, clinical success, technical success, type of knife and number of clips used, length of hospital stay, symptom recurrence at follow-up, adverse events with severity graded according to the American

Society for Gastrointestinal Endoscopy (ASGE) lexicon [11], and follow-up duration. None of the participants in this study have been included in another publication.

KJ-POEM Technique

Informed consent was obtained from all patients before KJ-POEM was performed. All KJ-POEMs were carried out by therapeutic endoscopists with patients under deep sedation or general anesthesia. Most procedures were done under general anesthesia instead of deep sedation to reduce the risk of aspiration. Exceptionally, in some centers and certain cases, deep sedation was done due to patient preference, mainly for those with very low comorbidities. The gastroscope was advanced to the previously identified location of the KJD in the patient's esophagram or CT scan. Similar to the Z-POEM technique, a submucosal bleb was created, and an incision was made in the mucosal lining of the septum. Through the initial mucosal incision, the submucosal fibers were dissected, and the endoscope entered the submucosal space. Following submucosal tunneling on both sides of the septum, the myotomy/septotomy was performed, and the septum that separates the diverticulum and the esophageal proper was dissected down to the base. A complete myotomy was performed extending beyond the distal extent of the diverticulum to ensure complete dissection and prevent recurrence. We identified the end point of myotomy when the muscular septum thins to the expected esophageal muscle layer width.

Following the initial cut of the myotomy, a split between the diverticular and esophageal muscles becomes apparent. The esophageal muscle is cut until the diverticular muscle is completely incised. The precautions taken to avoid leaks, perforation, and injury to surrounding structures, particularly the recurrent laryngeal nerve, included frequent submucosal injection during tunneling to assess methylene blue staining luminally at the base of the diverticulum, gentle blunt dissection as the muscular septum thinned, focused dissection at the base of the myotomy, slow and careful tunneling/myotomy, and avoiding tunneling/myotomy beyond the bottom of the diverticulum. Finally, the mucosal incision was closed with through-the-scope clips ([Figure 1A-E](#)).

The approach involves a longitudinal incision along the septum, followed by diverticulum tunnel dissection and myotomy. The differences, as mentioned in the above question, include extra-luminal inspection during tunnel injection and dissection. In Z-POEM, dissections are performed slightly further down compared to KJ-POEM to avoid potential recurrent laryngeal nerve injury, which can make KJ-POEM more challenging. Using a smaller diameter cap and occasionally employing underwater tunneling might help overcome some of these challenges. They have the same technique. The only differences are the different location of diverticula and septum, and the theoretical risk of recurrent laryngeal nerve injury.

Post-procedure, the patients were admitted to the hospital and kept nil per os (NPO) overnight. On post-operative day 1, a barium esophagram was

performed as a routine test to make sure no leak was detected. The patients were then started on a soft diet and treated with oral antibiotics for a couple of days. The patients were kept on a soft diet for 1-2 weeks before starting a normal diet. Follow up appointments were made 2-4 weeks post-procedure to assess the patients' clinical response and to evaluate for any potential delayed adverse events.

Outcomes

The primary outcome was clinical success (defined as a complete or near-complete resolution of symptoms (i.e., a post-procedure Kothari-Haber Score ≤ 2). Patients who did not achieve clinical success at follow-up were considered to have "clinical failure." Patients who attained clinical success at the initial follow-up visit but had recurrence of symptoms at later visits were classified as having "clinical recurrence." Secondary outcomes included technical success (defined as successful completion of all procedural steps), rate and severity of adverse events (per ASGE lexicon) [11], total procedure duration, and symptom recurrence during follow-up.

Statistical Analysis

Continuous variables are presented as the mean (SD). Categorical data are presented as number (percent). The dysphagia score was analyzed as a continuous variable. Paired student's t test was used to compare pre- and post-procedure results. P-value of <0.05 was considered statistically

significant. All statistical analyses were conducted using STATA version 18.0 (StataCorp LLC, College Station, TX, USA).

RESULTS

A total of 13 patients (mean age 65.23 [SD 11.41] years; 6 females) underwent KJ-POEM during the study period (Table 1). The most common presenting symptoms at the time of diagnosis were dysphagia (n=13,100%) and regurgitation (n=13,100%). Mean duration of symptoms was 3.30 (SD 2.69) years. Mean Kothari-Haber score at baseline was 6 (SD 2.16). None of the patients had prior treatment for esophageal diverticulum or a history of antiplatelet therapy. American Society of Anesthesiologists (ASA) physical status classification of the patients ranged from I to III. Mean ASA score was 1.0 (SD 0.57). The mean size of the diverticula was 21.68 mm (SD 9.61).

A total of 8 patients (61.54%) underwent over-the-septum diverticulotomy, while 5 patients (38.46%) underwent proximal submucosal tunneling diverticulotomy. The mean total procedure time was 42.92 (SD 21.78) minutes. The mean number of clips used for mucosal closure was 4 (SD 1.58). The most common type of knife used was triangular tip knife (Olympus; Tokyo, Japan) in 6 (46.15%) patients.

Primary and Secondary Outcomes

Clinical and technical success was achieved in all (100%) cases with a mean post-procedure Kothari-Haber Score of 0.91 (SD 0.99). There was a

significant reduction in the Kothari-Haber Score after KJ-POEM ($p < 0.001$; Table 2; [Figure 2](#)). There were no adverse events and no cases of injury to the recurrent laryngeal nerve. The mean length of hospital stay was 1.09 (SD 0.74) days. Mean follow up time was 9.41 SD (10.07) months post-procedure. There was no post-procedure symptom recurrence in all patients.

DISCUSSION

Because of the rarity of the condition and limited number of reported cases, the optimal management of KJD has not been adequately reported. Currently, available endoscopic techniques include Direct Septotomy [6,7], tunneling diverticulotomy (tunnel starting in the hypopharynx proximal to the septum of the diverticulum) [5,6,7], and ultra-short tunnel technique (tunnel at the septum of the diverticulum) [12].

One retrospective review by Modayi et al. examined the outcomes and complication rates of direct and tunneling diverticulotomy (with hypopharyngeal tunnel or ultra-short tunnel) in 13 patients with KJD [12]. Results showed a 92% (12/13) clinical success rate with complete symptom resolution. They reported no incidence of bleeding, mediastinitis, or sign of Recurrent Laryngeal Nerve (RLN) injury. In 2019, Haddad et al. reported a literature review of 68 KJD cases, of which only 10 had an endoscopic procedure. The endoscopic approaches compromised a variety of techniques such as flexible endoscopic diverticulotomy and rigid endoscopic laser diverticulotomy. Of the 10 endoscopic procedures, 2 cases of recurrence

were reported. One was managed with transcervical surgery and the other with repeat endoscopic surgery [13].

More recently, there have been published case reports on the efficacy of endoscopic management of KJD, particularly KJ-POEM [2-9]. All the case reports showed promising clinical outcomes with no complications. Our study shows similar safety and efficacy results of KJ-POEM, with a clinical success rate of 100% and no reports of symptom recurrence. There were only 2 reports of remaining diverticula after KJPOEM, both asymptomatic. There were no moderate or severe adverse events.

The retrospective observations presented in this study carry some expected limitations. Being a multicenter study, there is an inherent variability in techniques and follow-up protocols across multiple centers/providers. The sample size was also relatively small, attributed to the infrequent incidence of symptomatic KJD and the novelty of KJPOEM procedure.

Even though endoscopic approach was historically avoided due to concern for RLN injury [14-21], KJ-POEM has gained significant traction in recent times [22-24]. KJ-POEM appears to be promising as a novel therapeutic avenue for managing KJD. This study cohort includes more direct septotomy - KJ-POEM case experiences compared to other studies, which stands out as a notable strength of this investigation.

In conclusion, this study suggests that KJ-POEM is a safe and effective alternative treatment option for symptomatic KJD with excellent long-term outcomes and minimal symptom recurrence. Further prospective studies

involving larger patient cohorts and longer follow-up periods are warranted to comprehensively assess its long-term effectiveness in comparison to other treatment modalities.



References

1. Alnimer L, Zakaria A, Piper M. Killian Jamieson diverticulum: a rare cause of dysphagia. *Cureus* 2021; 13(3).
2. Félix C, Barreiro P, Rodrigues J, Mendo R, O'Neill C, Chagas C. A rare case of bilateral Killian-Jamieson diverticula treated endoscopically. *Endoscopy* 2022; 54(06): E283-E284.
3. Lee CK, Chung IK, Park JY, Lee TH, Lee SH, Park SH, et al. Endoscopic diverticulotomy with an isolated-tip needle-knife papillotome (Iso-Tome) and a fitted overtube for the treatment of a Killian-Jamieson diverticulum. *World J Gastroenterol* 2008; 14(42): 6589.
4. Sanders D, Murray T, Donnellan F. Endoscopic management of Killian-Jamieson diverticulum. *VideoGIE* 2019; 4(8): 364-365.
5. Shimamura Y, Fujiyoshi MRA, Fujiyoshi Y, Nishikawa Y, Ono M, Owada K, et al. Per-oral endoscopic myotomy as treatment for Killian-Jamieson diverticulum. *DEN Open* 2022; 2(1): e27.
6. Tanaka I, Shimamura Y, Inoue H, Azuma D, Ushikubo K, Yamamoto K, et al. Feasibility and safety of per-oral endoscopic septotomy for Killian-Jamieson diverticulum: a case series with video. *Digestive Endoscopy* 2023. Advance online publication. <https://doi.org/10.1111/den.14738>.
7. Tang SJ, Tang L, Chen E, Myers LL. Flexible endoscopic Killian-Jamieson diverticulotomy and literature review (with video). *Gastrointest Endosc* 2008; 68(4): 790-793. <https://doi.org/10.1016/j.gie.2008.01.005>
8. Yang D, Draganov PV. Endoscopic Killian-Jamieson diverticulotomy using a scissor-type electro-surgical knife. *Endoscopy* 2018; 50(07): E175-E176.
9. Yun PJ, Huang HK, Chang H, Lee SC, Huang TW. Endoscopic diverticulotomy with a stapler can be an effective and safe treatment for Killian-Jamieson diverticulum. *J Thorac Dis* 2017; 9(9): E787.
10. Kothari TH, Kothari S, Bittner K, Ullah A, Kaul V. The “Kothari-Haber” scoring system: a prospective evaluation of pre-and post-procedure outcomes for patients undergoing endoscopic myotomy for Zenker’s diverticulum. ***Gastrointest Endosc* 2018; 87(6): AB289-AB290.**
11. **Cotton PB, Eisen GM, Aabakken L, et al.** A lexicon for endoscopic adverse events: Report of an ASGE workshop. *Gastrointest Endosc* 2010; 71: 446-454.
12. Modayil RJ, Zhang X, Ali M, Das K, Gurram K, Stavropoulos SN. Endoscopic diverticulotomy for Killian-Jamieson diverticulum: mid-term outcome and description of an ultra-short tunnel technique. *Endosc Int Open* 2022; 10(01): E119-E126.
13. Haddad N, Agarwal P, Levi JR, Tracy JC, Tracy LF. Presentation and management of Killian Jamieson diverticulum: a comprehensive literature review. *Ann Otol Rhinol Laryngol* 2020; 129(4): 394-400.

14. Ataka R, Tsunoda S, Goto S, Nishigori T, Hisamori S, Obama K, et al. Killian-Jamieson diverticulum safely resected using a manual intraoperative neural monitoring system: a case report. *Surg Case Rep* 2020; 6(1): 1-5.
15. Chang YC, Chi CY, Lee CJ. Rigid endoscopic LASER diverticulotomy for lateral pharyngoesophageal diverticuli: cases presentation and discussion. *Eur Arch Otorhinolaryngol* 2016; 273: 4637-4642.
16. Howell R, Tang A, Allen J, Altaye M, Amin M, Bayan S, et al. Killian Jamieson Diverticulum, the Great Mimicker: A Case Series and Contemporary Review. *Laryngoscope* 2022.
17. Jeismann VB, Bianchi ET, Szachnowicz S, da Costa Seguro FCB, Tustumi F, Duarte AF, et al. Surgical treatment of Killian-Jamieson diverticulum: A case report and literature review. *Clin Case Rep* 2019; 7(7): 1374.
18. Kim DC, Hwang JJ, Lee WS, Lee SA, Kim YH, Chee HK. Surgical treatment of Killian-Jamieson diverticulum. *Korean J Thorac Cardiovasc Surg* 2012; 45(4): 272.
19. Kohei S, Satoru M, Tanaka T, Haruhiro H, Masahiro F, Fumihiko F, et al. Surgery for Killian-Jamieson diverticulum: a report of two cases. *Surg Case Rep* 2020; 6(1).
20. Kurahashi Y, Hojo Y, Nakamura T, Kumamoto T, Nakanishi Y, Ishida Y, et al. Endoscopic observation of the palisade vessels in Killian-Jamieson diverticulum was useful for diagnosis and surgical treatment: a case report. *Surg Case Rep* 2020; 6: 1-4.
21. Oh J, Norris A, Artigue M, Kruger J, Norris AE. Killian-Jamieson Diverticulum: Management of a Rare Esophageal Diverticula. *Cureus* 2021; 13(9).
22. Saito T, Ogawa T, Kurahashi S, Okamoto H, Gonda H, Matsumura T, et al. A novel Killian-Jamieson diverticulectomy using a thyroid gland flap: a case report. *Surg Case Rep* 2020; 6(1): 1-5.
23. Stavropoulos SN, Ali MF, Zhang X, Das KC, Modayil RJ. Endoscopic direct and tunneling diverticulotomy techniques for Killian Jamieson diverticulum: Report of twelve cases. *Gastrointest Endosc* 2019; 89(6): AB180. <https://doi.org/10.1016/j.gie.2019.03.124>.
24. Zakaria A, Barawi M. Endoscopic treatment of Killian-Jamieson diverticulum using submucosal tunneling diverticulotomy technique. *VideoGIE* 2020; 5(11): 525-526.

Table 1. Baseline, procedural details and post-procedure KJ-POEM outcomes

Baseline characteristics	n=13
Age, mean (SD), years	65.23(11.41)
Female sex, n (%)	6 (46.15)
ASA PS classification (I/II/III), n	2/9/2
Prior Treatment, n (%)	0 (0)
Symptom duration, mean (SD), years	3.30 (2.69)
Size of Diverticulum, mean (SD), mms	21.68(9.61)
Position (left/ right/ mid), n	6/4/3*
Pre-procedure Kothari Haber score, mean (SD)	6 (2.16)
Procedure characteristics	
Technical success, n (%)	13 (100%)
KJ-POEM Technique, (n, %)	
Direct Septotomy	8(61.54%)
Tunnel starting in hypopharynx	0 (0)
Tunnel starting at septum	5(38.46)
Length of Tunnel/ Septotomy, mean (SD), cm	2.11 (1.19)
Number of clips used, mean (SD)	4 (1.58)
Total procedure duration, mean (SD), minutes	42.92(21.78)
Type of knife used, (n, %)	
T-type Hybrid Knife	6(46.15)
I-Type Hybrid Knife	4 (30.76)
Triangular Tip Knife	3 (23.07)
Intraprocedural adverse events, n (%)	0(0)
Post-procedure outcomes	
Length of hospital stay, mean (SD), days	1.09 (0.74))
Delayed (< 30 days after the procedure) adverse events, n (%)	0(0)
Post-procedure Kothari Haber score, mean (SD)	0.91(0.99)
Length of Post-procedure NPO time, mean (SD), hours	19.07 (8.02)
Clinical success (number, %)	13 (100)
Follow-up period, mean (SD), months	9.41(10.07)

Table 2. Pre and post-KJ-POEM Kothari-Haber Score

Variable	Pre-KJ-POEM, Mean (SD)	Post-KJ-POEM, Mean (SD)	<i>p-value</i>
Kothari Haber score	6 (2.16)	0.91(0.99)	<0.001

- One patient had bilateral diverticula, one on left, and one on right side.

Figure Legend

Figure 1. Killian-Jamieson peroral endoscopic myotomy (KJ-POEM) technique. **A)** Submucosal injection is performed over the septum. **B)** Mucosal incision is performed (along the blue dashed line). **C)** Submucosal tunneling is performed until the septum is reached, and the septum is completely exposed as submucosal dissection is carried out on either side of the septum. **D)** Complete myotomy; **E)** Mucosal closure using through-the-scope clips.

Figure 2. Pre and post-procedure Kothari-Haber Scores.







