

# Laser Cricopharyngeal Myotomy Treatment Of Zenker's Diverticulum And Closure Of The Incision With Titanium Clips; Not A Guarantee Of Avoiding Mediastinitis

M Henry, H Walters, P Arullendran

## Citation

M Henry, H Walters, P Arullendran. *Laser Cricopharyngeal Myotomy Treatment Of Zenker's Diverticulum And Closure Of The Incision With Titanium Clips; Not A Guarantee Of Avoiding Mediastinitis*. The Internet Journal of Otorhinolaryngology. 2021 Volume 20 Number 1.

DOI: [10.5580/IJORL.56029](https://doi.org/10.5580/IJORL.56029)

## Abstract

The mainstay of treatment for Zenker's diverticulum is stapling of the pharyngeal bar. In the past the standard treatment was open diverticulectomy. Recently a variety of endoscopic techniques, both rigid and flexible, have become more popular. We have developed a novel technique for closure of the incision after endoscopic laser cricopharyngeal myotomy. The closure is performed with titanium clips, and we would like to share our experience. The main risk of this procedure is perforation with secondary mediastinitis. The aim of closing the mucosal incision is to reduce this risk and to safely shorten the return to a normal diet.

## Methods:

We present our case series of 14 patients at the Sunderland Royal Hospital that have undergone surgery between 2018 and 2020 with our technique and analyse the outcomes.

## Outcomes:

All patients had achieved improvement in their symptoms as measured by the EAT-10 questionnaire. Just prior to completion of the article a patient developed a retropharyngeal abscess They were included within our data in the interest of full disclosure.

## Conclusion:

This method of closure initially showed promise in reducing the risk of complications, however it is not a guarantee for prevention as one patient developed a postoperative collection. This is the nature of surgery. There is also a learning curve to applying titanium clips, the technique can be more difficult if there is excessive bleeding or friable mucosa.

## INTRODUCTION

Zenker's diverticulum has an incidence of 2 cases per 100,000 in the UK affecting males 1.5 times more than females, and afflicting persons in the 6th to 8th decade of life(1)(2). It is an acquired condition, thought to be due to increased pressures in the pharynx. Under the stress of the increased pressure the pharyngeal mucosa protrudes through an area of natural weakness, Killian's dehiscence. This is created by the lack of overlap of the muscles of the inferior constrictor, consisting of the obliquely oriented thyropharyngeus and the transversely oriented crico-pharyngeus (3)(4)(5).

This pathology affects patients' quality of life, for this reason it is important to have an assessment of the patient's swallowing preoperatively and post operatively. For this we use the EAT-10 questionnaire. The Eating Assessment Tool-10 (EAT-10) score is a validated measure of swallowing difficulty. The questionnaire consists of 10 questions relating to the quality of their swallowing with a grade of 0 to 4 assigned to each question, with a possible score range of 0-40. Any score greater than 3 is considered abnormal (6)(7).

**Figure 1**

**OBJECTIVE:**  
EAT-10 helps to measure swallowing difficulties. It may be important for you to talk with your physician about treatment options for symptoms.

**A. INSTRUCTIONS:**  
Answer each question by writing the number of points in the boxes. To what extent do you experience the following problems?

<p><b>1 My swallowing problem has caused me to lose weight.</b></p> <p>0 = no problem 1 2 3 4 = severe problem</p> <input type="text"/>	<p><b>6 Swallowing is painful.</b></p> <p>0 = no problem 1 2 3 4 = severe problem</p> <input type="text"/>
<p><b>2 My swallowing problem interferes with my ability to go out for meals.</b></p> <p>0 = no problem 1 2 3 4 = severe problem</p> <input type="text"/>	<p><b>7 The pleasure of eating is affected by my swallowing.</b></p> <p>0 = no problem 1 2 3 4 = severe problem</p> <input type="text"/>
<p><b>3 Swallowing liquids takes extra effort.</b></p> <p>0 = no problem 1 2 3 4 = severe problem</p> <input type="text"/>	<p><b>8 When I swallow food sticks in my throat.</b></p> <p>0 = no problem 1 2 3 4 = severe problem</p> <input type="text"/>
<p><b>4 Swallowing solids takes extra effort.</b></p> <p>0 = no problem 1 2 3 4 = severe problem</p> <input type="text"/>	<p><b>9 I cough when I eat.</b></p> <p>0 = no problem 1 2 3 4 = severe problem</p> <input type="text"/>
<p><b>5 Swallowing pills takes extra effort.</b></p> <p>0 = no problem 1 2 3 4 = severe problem</p> <input type="text"/>	<p><b>10 Swallowing is stressful.</b></p> <p>0 = no problem 1 2 3 4 = severe problem</p> <input type="text"/>

Patients present with a wide range of symptoms, the most common being dysphagia, regurgitation, halitosis, cough, aspiration and chest infections (1)(8). The gold standard for diagnosis is a barium swallow, which will clearly demonstrate the retention of contrast in a pouch and can also demonstrate cricopharyngeal hypertrophy (9).

Many treatment options exist, these include open excision of the diverticulum with an open cricopharyngeal myotomy and excision of the pouch, transoral stapling and transoral cricopharyngeal myotomy. The literature has shown that minimally invasive techniques have similar success rates in terms of symptom improvement or resolution as open techniques with the added benefit of less associated morbidity and mortality (10).

There are two important aspects to treatment. First, to perform an adequate cricopharyngeal myotomy, which is performed by a CO2 laser in our institution. The second is to minimise the risk of perforation.

## **SURGICAL TECHNIQUE**

At the Sunderland Royal Hospital from January 2018 to April 2019 we have performed 13 sequential cases. A cricopharyngeal myotomy was performed endoscopically with a CO2 laser and attempted closure with titanium clips. All cases were done by one consultant. All cases are performed under general anaesthesia using a laser safe endotracheal tube with laser safety precautions in place for all theatre staff. A rigid oesophagoscopy is initially

performed to identify and assess the pouch, after which a Weerda bivalve diverticuloscope is placed. The microscope with the laser attachment is then positioned with the cricopharyngeal bar visualized. The AcuPulse Duo CO2 laser (Lumenis Ltd, Yokneam, Israel) is then used to perform a cricopharyngeal myotomy. Laser settings are 10 watts, superpulse, on repeat with a linear cutting setting. Ethicon Ligaclips (Ethicon Endo-Surgery, LLC, Guaynabo, Puerto Rico, USA) titanium clips are then used to approximate the mucosal edges, a laryngoforce ii clip forceps (Karl Storz SE & Co. KG, Tuttlingen, Germany) is used to apply the titanium clips. All patients undergo NGT insertion under direct vision intraoperatively. Where satisfactory mucosal closure has been achieved the patient is kept nil by mouth overnight and started on liquid diet on day one graduated to liquidised diet on discharge. If there is incomplete closure patients are fed via the NGT and kept nil by mouth. Per oral is started with clear liquids on day 2 or 3, depending on clinical confidence in closure of the perforation. Patients are then advanced to a liquidised diet and discharge home that day, if no symptoms or signs of perforation. Patients were then followed up at approximately 3 months and asked to complete a post-operative EAT-10 questionnaire.

## **Technique for application of Titanium clips.**

It is difficult to apply the clips when operating down the Weerda diverticuloscope. The access to manipulate the clips into the right place requires some practice. The initial laser incision is longitudinal, and in line with the lumen of the oesophagus. However, the incision is closed in a transverse plane to facilitate widening of the lumen. The application of the first clip is the most important. The distal mucosal edge is gently grasped with a microlaryngoscopy basket forceps or straight graspers and advanced to the opposing edge. While the edges are apposed the clip is applied.

Approximation of the edges can be facilitated by reducing the tension on the oesophagus, by adjusting the Weerda blades. Sometimes it is easier to hold the forceps in an inverted or upside-down fashion to facilitate an adequate view when applying the clip. Subsequent clips are progressively easier to apply.

Case of previous failed endoscopic stapling, with persistent cricopharyngeal bar.

**Laser Cricopharyngeal Myotomy Treatment Of Zenker's Diverticulum And Closure Of The Incision With Titanium Clips; Not A Guarantee Of Avoiding Mediastinitis**

**Figure 2**

Image of bar viewed through the Weerda bivalve diverticuloscope. (previous stapling clips are just visible)



**Figure 3**

Image of cricopharynx following laser cricopharyngeal myotomy and division of the bar



**Figure 4**

Image of complete closure with Titanium clips



**Table 1**

Patient	Age	Gender	ASA	Aspiration	Previous Procedure	Type of Previous Procedure	Complications	MGT	Length of Stay (Days)	Pre-Op EAT Score	Post-Op EAT Score	Post-Op EAT Score Timing
1	72	F	2	No	Yes	Laser	Difficult access, small breach to lacer, no leak on contrast swallow immediately post-op	No	1	14	0	at 3 months
2	84	M	2	No	Yes	Balloon dilatation	-	Yes	1	33	0	at 1 month
3	70	F	3	No	Yes	Laser	-	Yes	3	16	3	at 1 month
4	71	F	2	No	No	-	-	Yes	1	25	2	at 3 months
5	86	M	2	No	Yes	Diagnostic endoscopy	-	Yes	1	22	1	at 1 month
6	59	M	2	No	Yes	Diagnostic endoscopy	Failed closure with Steiner clips, Tisseel used	Yes	4	20	0	at 3 months
7	76	M	2	No	Yes	oesophago scopy	-	Yes	1	24	1	at 1 month
8	58	M	2	No	Yes	Laser	Failed closure with Steiner clips, Tisseel used	Yes	3	11	6	at 6 months
9	74	F	3	No	No	-	-	Yes	1	16	1	at 1 month
10	73	F	2	No	Yes	Stapling x2	Failed closure with Steiner clips, Tisseel used	Yes	3	32	10	at 5 months
11	74	F	2	No	No	-	Partial closure with Steiner clips, completed with Tisseel	Yes	3	20	2	at 2 months
12	73	F	2	No	Yes	Oesophagoscopy and dilatation x 2	Partial closure with Steiner clips, completed with Tisseel	Yes	2	32	4	at 6 months
13	72	F	3	No	No	-	-	Yes	4	26	0	at 1 month
14	53	F	3	No	Yes	Balloon dilatation	Retropharyngeal abscess	Yes	4	24	0	at 1 month

A total of 14 patients were consented for the procedure, 5 of whom were male and 9 were female. Most patients were in their 8th decade of life with an average age of 71.6 years, and most had age-related comorbidities, the average ASA score being 2.14. Patients were asked to complete an EAT-10 questionnaire before and after the procedure, the average decrease in the EAT-10 score was 20.2.

At the time of writing the paper 13 patients had successfully undergone this procedure with Steiner clip closure with no major complications encountered. Minor complications had been encountered in 6 cases. The most common issue was difficult closure with the titanium clips in which case Tisseel (Baxter Healthcare Ltd, Norfolk, UK) had to be used to assist with closure. The most common predisposing factor to incomplete closure was friable mucosa which would not hold the titanium clips. One patient's procedure was

complicated by a small fascial breach, however no evidence of a leak was demonstrated on a contrast swallow that was performed in the immediate postoperative period. This was a first-time procedure for 9 patients, while 3 patients had previous laser crico-pharyngeal myotomies, 1 patient had undergone two prior stapling procedures and 1 patient had a previous unsuccessful balloon dilatation.

Just prior to submitting for publication our fourteenth patient had a major complication, re-presenting on the 4th postoperative day with a retropharyngeal abscess requiring return to theatre, drainage and washout via an external approach. They had a subsequent 4-day admission, kept nil by mouth and fed via NGT for 24 days. In order to provide a clear and honest picture of our experiences this report was re-written to include this data.

This increased the average hospital stay from 2.15 to 2.28 days (range 1-4 days). Despite experiencing this complication the patient has recovered well and has had no further problems, their EAT-10 score had reduced from 24/40 preoperatively to 0 at 1 month post procedure, and they have now been discharged.

No patients have had recurrence of pouches or worsening of symptoms in a 6 month follow up period.

## **DISCUSSION**

In a review by Parker et al (11) a comparison was made of stapling to carbon dioxide laser, the main advantage of CO2 laser is the improved swallow function and reduced repeat procedure rate. This is attributed to the ability of the CO2 laser to do a complete myotomy. The stapling technique invariably leaves a residual cricopharyngeal bar, which can continue to cause symptoms. However, the stapling technique is extremely effective at sealing the oesophageal perforation. As a result, the procedure is far safer with a quicker return to oral feeding and shorter inpatient stay.

Early reports of the use of CO2 laser, describe the incision being left open. Patients were then fed parenterally, and perioperative antibiotics used to reduce the risk of mediastinitis. Inpatient stays tended to be about a week (12)(13).

The issue of whether it is important to close the incision was addressed by Anagnostos(14) . The authors compared 2 groups of patients, those with incisions left open, and those closed by sutures. They concluded there was no significant difference. However, they also kept patients nil by mouth for

about one week (range 3-17 days). It seems evident that the longer you keep someone nil by mouth post operatively, the less chance of the complications of perforation (15).

However, keeping elderly patients nil by mouth for several days can be quite arduous. The ideal solution would be a laser technique with complete division of the bar with a reliable wound closure or a staple gun that can ensure a complete myotomy. The latter has yet to be invented. Various attempts have been attempted at the former. Others have described Metal U clips (16), Tisseel (17) and sutures (14), but achieving a reliable seal is difficult and there were still reports of the complications of perforation.

For full disclosure, following the completion of this series we have since recorded one major complication when a patient developed a retropharyngeal abscess after re-presenting on the 4th post-operative day and required a return to theatre for drainage and washout via an external approach. They had a subsequent 4-day admission, IV antibiotic administration, hyoscine topical patch and kept nil by mouth and fed via NGT. NGT feeding continued for 20 days after discharge, at which point a water-soluble contrast swallow demonstrated no leak and normal diet was cautiously reintroduced. Intraoperatively during the cricopharyngeal myotomy there were no issues noted and a good closure had been achieved with clips. There were no factors in the past medical history (asthma, fibromyalgia, depression) or the immediate post-operative period that would have raised alarm for the potential to develop a leak or post-operative collection. The patient made a full recovery, and had a good functional outcome with a reduction in EAT-10 score from 24 preoperatively to 0 at follow-up. Perforation, leak and infection are recognised complications of this procedure (11), and the number of cases performed at this unit having undergone titanium clip closure is still small. It is therefore difficult to demonstrate if this single complication is directly related to the use of closure with titanium clips with any statistical significance. Larger case numbers and ongoing audit of complication rates should add weight to the further analysis of postoperative outcomes.

## **CONCLUSION**

Our technique is novel and attempts to increase the reliability of closure. It is only a small case series and initially seemed to show promise. The disadvantages are that there is a learning curve to applying titanium clips. The technique can be difficult if there is excessive bleeding or

friable mucosa. The advantages are that it appears to be a safe technique with minimal risk. In general patients have shorter hospital stays and faster recovery. A larger study number and further research should eventually demonstrate if this method of closure shows any added benefit of statistical significance.

We wrote the paper with the intention of demonstrating a technique that might shorten recovery times and length of stay, and additionally reduce the risk of retropharyngeal abscess and mediastinitis. However, just prior to publication one patient developed such a complication despite having a straightforward procedure. This is the nature of surgery. Instead of shelving the paper we felt it was important to still describe our technique and to highlight that it is not a guarantee of preventing serious complications.

## References

1. Siddiq MA, Sood S, Strachan D. Pharyngeal pouch (Zenker's diverticulum). *Postgrad Med J* [Internet]. 2001 Aug ;77(910):506–11. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/11470929>
2. Bizzotto A, Iacopini F, Landi R, Costamagna G. Zenker's diverticulum: exploring treatment options. *Acta Otorhinolaryngol Ital* [Internet]. 2013 Aug;33(4):219–29. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/24043908>
3. D'Ugo D, Cardillo G, Granone P, Coppola R, Margaritora S, Picciocchi A. Esophageal diverticula. Physiopathological basis for surgical management. *Eur J Cardiothorac Surg* [Internet]. 1992 ;6(6):330–4. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/1616729>
4. Cook IJ, Blumbergs P, Cash K, Jamieson GG, Shearman DJ. Structural abnormalities of the cricopharyngeus muscle in patients with pharyngeal (Zenker's) diverticulum. *J Gastroenterol Hepatol* [Internet];7(6):556–62. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/1283083>
5. Cook IJ, Gabb M, Panagopoulos V, Jamieson GG, Dodds WJ, Dent J, et al. Pharyngeal (Zenker's) diverticulum is a disorder of upper esophageal sphincter opening. *Gastroenterology* [Internet]. 1992 Oct ;103(4):1229–35. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/1397879>
6. Belafsky PC, Mouadeb DA, Rees CJ, Pryor JC, Postma GN, Allen J, et al. Validity and Reliability of the Eating Assessment Tool (EAT-10). *Ann Otol Rhinol Laryngol* [Internet]. 2008 Dec ;117(12):919–24. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/19140539>
7. Bartlett RS, Moore JE, Thibeault SL. Temporal Analysis of Factors Associated with EAT-10 in Outpatients with Oropharyngeal Dysphagia from a Tertiary Care Clinic. *Dysphagia* [Internet]. 2018 Aug 20;33(4):457–67. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/29353401>
8. Siboni S, Asti E, Sozzi M, Bonitta G, Melloni M, Bonavina L. Respiratory Symptoms and Complications of Zenker Diverticulum: Effect of Trans-Oral Septum Stapling. *J Gastrointest Surg* [Internet]. 2017 Sep 3;21(9):1391–5. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/28470561>
9. Carucci LR, Turner MA. Dysphagia Revisited: Common and Unusual Causes. *RadioGraphics* [Internet]. 2015 Jan ;35(1):105–22. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/25590391>
10. Keck T, Rozsasi A, Grün PM. Surgical treatment of hypopharyngeal diverticulum (Zenker's diverticulum). *Eur Arch Oto-Rhino-Laryngology* 2010 Apr 28 ;267(4):587–92
11. Parker NP, Misono S. Carbon dioxide laser versus stapler-assisted endoscopic Zenker's diverticulotomy: A systematic review and meta-analysis. *Otolaryngol - Head Neck Surg (United States)*. 2014;150(5):750–3.
12. Knekt PP, De Jong PC, Van der Schans EJ. Endoscopic treatment of the hypopharyngeal diverticulum with the CO2 laser. *Endoscopy*. 1985;17(6):205–6.
13. Benjamin B, Innocenti M. Laser treatment of pharyngeal pouch. *Aust N Z J Surg* [Internet]. 1991 Dec [cited 2019 Dec 1];61(12):909–13. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/1755771>
14. Anagnostos A, Feyka M, Gostian AO, Lichtenstein T, Henning TD, Guntinas-Lichius O, et al. Endoscopic laser-assisted diverticulotomy without versus with wound closure in the treatment of Zenker's diverticulum. *Eur Arch Oto-Rhino-Laryngology*. 2014;271(4):765–70.
15. Plzák J, Zábrodský M, Lukeš P. Zenker's diverticulum: carbon dioxide laser endoscopic surgery. *Biomed Res Int* [Internet]. 2014; 2014:516231. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/24729975>
16. Dale OT, Mackeith S, Burgess CA, Rourke TJ, Winter SC, Corbridge RJ. Functional outcomes following endoscopic laser cricopharyngeal myotomy with mucosal repair. *Eur Arch Otorhinolaryngol* [Internet]. 2014 Jun ;271(6):1631–4. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/24337898>
17. Lawson G, Remacle M, Jamart J, Keghian J. Endoscopic CO2 laser-assisted surgery for cricopharyngeal dysfunction. *Eur Arch Oto-Rhino-Laryngology*. 2003 Oct;260(9):475–80.

**Author Information**

**M. Henry**

Sunderland Royal Hospital  
England

**H. Walters**

Sunderland Royal Hospital  
England

**P. Arullendran**

Sunderland Royal Hospital  
England