

Elective surgical cricothyroidotomy in oral and maxillofacial surgery

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Abstract

Surgical Cricothyroidotomy is regarded as an emergency procedure today even though it has a good evidential record as an elective surgical airway. A misunderstanding of Jackson's landmark paper in 1921 has made the simple and safe procedure unpopular because of the fear of subglottic stenosis. We present the incidence of subglottic stenosis after surgical cricothyroidotomy, discuss evidence for elective surgical cricothyroidotomy, and suggest potential applications in oral and maxillofacial surgery.

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Introduction

Surgical cricothyroidotomy is a surgical airway technique in which an airway device is inserted into the trachea through an incision made at the cricothyroid membrane.¹

Today it is regarded as an emergency procedure^{2,3} and is recommended as the safest emergency surgical airway technique by the American College of Surgeons.² However, its role as an elective surgical airway is less commonly known, particularly by younger colleagues because of its controversial association with subglottic stenosis,^{1,4} its mandatory conversion,^{5–7} and indications for it as an elective and definitive airway.⁷

Two important questions are central to these controversies. Firstly, will surgical cricothyroidotomy lead to subglottic stenosis? Secondly, is there evidence in favour of elective cricothyroidotomy?

We report the incidence of subglottic stenosis after surgical cricothyroidotomy, discuss evidence for elective surgical

cricothyroidotomy, and suggest potential applications in oral and maxillofacial surgery (OMFS).

Why surgical cricothyroidotomy became unpopular

Surgical cricothyroidotomy was a variation of “high tracheostomy” (surgical airway placed above the thyroid gland), which was performed as an elective or emergency surgical airway in the 1920s.^{4,8} It became unpopular as an elective procedure after Chevalier Jackson reported 158 cases of subglottic stenosis from high tracheostomy in his 1921 landmark paper. Given such an alarming incidence of subglottic stenosis, he argued that high tracheostomy “should never be taught or done”; and when done, should be converted to a “low tracheostomy” as soon as possible.⁴ This teaching has been transmitted through generations of surgeons relatively unchallenged.^{1,8}

Since then, other reports have been published to support the incidence of subglottic stenosis after cricothyroidotomy.^{7,9–11} While earlier authors were against the procedure,^{9,10} later ones seemed to allow it for selected emergency cases,^{7,11} but tracheostomy became the de facto surgical technique whenever an elective airway was required.

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The crux of the matter therefore lies in the incidence of subglottic stenosis after the procedure.⁸

Incidence of subglottic stenosis after surgical cricothyroidotomy

We searched the database of the US National Library of Medicine, National Institutes of Health (PubMed) using the words “surgical cricothyroidotomy”, “coniotomy”, and “subglottic stenosis”, and retrieved and reviewed relevant prospective, retrospective studies and case reports describing the incidence of subglottic stenosis after surgical cricothyroidotomy (both elective and emergency).^{1,5–7,9–33} We excluded studies that reported surgical airway converted to tracheostomy as the controversy lies in cases that are not converted.

Collectively, out of 1916 cases of surgical cricothyroidotomy, 13 required treatment for subglottic stenosis, which gives an approximated collective incidence of 0.7%. If case reports on subglottic stenosis are excluded, the incidence is approximately 0.5%. This compares favourably with the incidence of serious complications of tracheostomy (8–24%),³⁴ or tracheal stenosis after tracheostomy (1–20%).¹³

The incidence of subglottic stenosis is much lower than previously feared and it should therefore not be a reason to condemn surgical cricothyroidotomy. The evidence does not support the popular belief that surgical cricothyroidotomy always results in the complication and requires a mandatory conversion to tracheostomy.^{6,14}

Evidence on elective cricothyroidotomy

Elective surgical cricothyroidotomy refers to the procedure when it is done in a non-emergency setting as a definitive airway until the patient is weaned and decannulated. The techniques used today usually follow the original one described by Brantigan and Grow¹ with some variations¹: incision at the cricothyroid membrane, dilatation of the surgical site, and insertion of the airway device.

Jackson misunderstood

From our review, it seems that Jackson has been misunderstood.^{1,8} In his original paper, high tracheostomy meant “in practice, division of the cricoid cartilage”, or “entering the airway through the first tracheal ring”.⁴ The patients reported had a surgical airway placed mainly because of laryngeal disease and many were children^{4,16}; in those days, tracheostomy (including high tracheostomy) was a common treatment for diphtheria. Furthermore, his patients came from many different surgeons whose technique and competency could not be verified.⁸

The modern surgical cricothyroidotomy, described by Brantigan and Grow in 1976,¹ is a different technique and is done under different circumstances. Instead of dividing the

cricoid cartilage, entering through the thyroid cartilage or first tracheal ring, the airway is accessed through an incision at the cricothyroid membrane. The patients reported were mostly adults with healthy larynges who had a surgical airway created for reasons not related to laryngeal problems^{31,32} unlike the children with laryngeal disease reported by Jackson.⁴ Some had a surgical airway placed for only a few days.¹⁵ Besides, the techniques used today, including the airway devices, cause less trauma to the laryngeal-tracheal complex than those used in Jackson’s day.⁶

The publications nevertheless point out that surgical cricothyroidotomy in children or in patients with unhealthy larynges caused by trauma,¹² prolonged intubation,^{12,35} or disease,^{4,36} will predispose them to subglottic stenosis. This could account for the incidence of subglottic stenosis in the 38 patients who had an airway device placed through an incision in the cricothyroid membrane in Jackson’s study.^{5,16,17}

Historical support

In 1973, Pierce et al.¹⁵ reported a series of 8 patients who had an elective surgical airway accessed through an incision made in the cricothyroid membrane. They were intubated for 10 days after cardiothoracic surgery without conversion to tracheostomy, and did not develop subglottic stenosis.

In a landmark paper in 1976, Brantigan and Grow¹ reported their series of 655 patients who did not develop subglottic stenosis after elective cricothyroidotomy. The patients were cannulated for up to 40 days (mean 7 days) and were examined at one year or at autopsy for incidence of subglottic stenosis. Boyd et al.¹⁶ followed with his retrospective study on 132 cases of elective cricothyroidotomy. He reported 2 cases of subglottic stenosis, which was attributed to a prolonged period of intubation before the procedure. The duration of cricothyroidotomy cannulation was between 2 and 98 days (mean 16 days) and was followed up for at least 6 months with endoscopic examination or by their general practitioner.

Evidential support

The low incidence of subglottic stenosis has led many others to perform surgical cricothyroidotomy electively and to decannulate their patients without conversion to tracheostomy.^{1,5,6,11,12,15–17,20–25,31,33}

From the review of these studies, patients were cannulated for about 13 days on average and for up to 270 days. The approximated collective incidence of subglottic stenosis after elective cricothyroidotomy was 0.4%, which again compares favourably with the incidence of complications or stenosis after tracheostomy.³⁴

Summary of evidence

The publications reviewed support the case for elective cricothyroidotomy. There is good evidence for a low

incidence of subglottic stenosis when elective cricothyroidotomy has been done and left in situ after a mean of approximately 13 days.

Compared with tracheostomy, the advantages are that it is a quicker procedure and is suitable for non surgeons. It has low complication rates, and the surgical site is isolated from the sternotomy wound.¹ It also avoids the complications of injury to deeper structures in tracheostomy, and makes early decannulation possible.¹⁷

The articles also suggest that conversion to a tracheostomy may carry additional risks and may therefore not be recommended.^{6,14,32}

The warning about subglottic stenosis from surgical cricothyroidotomy in contraindicated cases nevertheless remains valid.³⁶ In children and in patients with unhealthy larynges, subthyroid tracheostomy should be considered instead.

Some publications also warn about permanent and temporary changes in the voice^{1,21,22,37} which may distress patients.^{22,24} These range from a change in pitch to hoarseness,^{20,24} and may be attributed to an oversized airway device being inserted.^{22,38,39} The average dimensions of the cricothyroid window range from 5 to 12 mm (average 9 mm) vertically and from 27 to 32 mm (average 30 mm) horizontally.³⁸

In general, the studies published so far agree that the airway inserted should be no more than 9 mm^{22,38,39} although a larger sized tube has been noted to cause only minimal injury to the laryngeal cartilage.²⁰ We recommend that patients should be informed about the risk of changes in the voice when they give their consent, and they should be offered a tracheostomy if this is not acceptable.

Despite the multitude of papers that verify elective surgical cricothyroidotomy as safe, there are criticisms of poor study design, short follow-up, lack of consistent airway examination, and minimisation of identified complications.⁴⁰ To date, we know of no multicentre, large-scale randomised controlled trials and these are clearly necessary.

It is also interesting to note that no papers on surgical cricothyroidotomy have been published by oral and maxillofacial surgeons even though this is part of our core competency.

Application and consideration in oral and maxillofacial surgery

In our specialty, surgical cricothyroidotomy has potential applications in patients who require an elective or emergency surgical airway. It is indicated for head and neck oncology and trauma, and for infections that threaten the airway when a short interim surgical airway (which, in our experience, is usually less than a week) is needed.

The role of surgical cricothyroidotomy for patients who require a long-term surgical airway has been suggested in the literature. Studies cite absence of subglottic stenosis in

patients cannulated for up to 270 days,²³ but there is a lack of well designed verification studies. We recommend consideration of this procedure as an alternative to tracheostomy in patients with challenging neck anatomy, and in those who require a long-term surgical airway and are medically unfit for general anaesthesia, as it has been done successfully as a bedside procedure.⁵

Head and neck oncology

Surgical cricothyroidotomy is useful in head and neck oncology cases where postoperative airway distress may be anticipated. The simplicity of the procedure and superficiality of the cricothyroid membrane allows for reduction in surgery time and surgeon fatigue. It is also a useful alternative to tracheostomy and has the advantage of allowing the surgeon to avoid the serious complications of tracheostomy. It offers the flexibility for decannulation within a week if needed as there is no need to wait for the stoma to epithelialise.¹⁷ However, concerns about cross contamination of the surgical site with the neck dissection may limit the design of neck flaps. A tracheostomy sited lower down in the neck may be a better option if extensive bilateral neck dissection is necessary.

Trauma

Use of the procedure has been proved in trauma, particularly when an emergency surgical airway is needed. Published papers support delaying its conversion in a non-traumatised larynx until decannulation can be done safely. Conversion to tracheostomy should be considered whenever a contraindication is identified. In cases where intermaxillary fixation is needed or when nasal or submental intubation is not desired, it allows intraoperative and postoperative intermaxillary fixation without compromising the airway.

Infections that threaten the airway

When infections threaten the airway or there is impending respiratory failure, surgical cricothyroidotomy is useful as a simple and quick procedure that can be done at the bedside in the intensive care unit.²⁰ There is no need to wait for the tract to epithelialise, and the patient can be decannulated once the swelling resolves and the airway is not at risk.¹⁷

Subthyroid tracheostomy may still be preferred in cases of oropharyngeal infection, which potentially involves laryngeal tissues and predispose the patient to subglottic stenosis.

Conclusion

Surgical cricothyroidotomy has good historical and evidential support. It is also a versatile procedure that has many applications in oral and maxillofacial surgery. The simplicity and distance from critical deep structures make it an

attractive, alternative, elective surgical airway to tracheostomy or percutaneous airways.

The decision to choose between the various options ultimately depends on balancing the merits in each unique situation and the training of the clinician. Nevertheless, there is still a place for elective surgical cricothyroidotomy in the repertoire of the oral and maxillofacial surgeon.

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