

## Case Report

# Complete subglottic tracheal stenosis managed with rigid bronchoscopy and T-tube placement

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## ABSTRACT

Surgery is the preferred treatment modality for benign tracheal stenosis. Interventional bronchoscopy is used as a bridge to surgery or in instances when surgery is not feasible or has failed. Stenosis in the subglottic trachea is particularly a treatment challenge, in view of its proximity to the vocal cords. Herein, we describe a patient with complete tracheal stenosis in the subglottic region, which developed after prolonged intubation and mechanical ventilation. The patient developed recurrent stenosis despite multiple surgical and endoscopic procedures. We were able to manage the patient successfully with rigid bronchoscopy and Montgomery T-tube placement.

**KEY WORDS:** Airway stent, central airway obstruction, interventional pulmonology, rigid bronchoscopy, tracheal stenosis

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## INTRODUCTION

Tracheal stenosis is a troublesome complication resulting from prolonged endotracheal intubation. The reported incidence of postintubation tracheal stenosis and posttracheostomy tracheal stenosis ranges from 10–19% to 8–65%, respectively.<sup>[1–4]</sup> Tracheal resection and anastomosis are considered the best treatment option for benign tracheal stenosis, with more than 90% having a favorable outcome.<sup>[5]</sup> Endoscopic treatment options for tracheal stenosis include balloon dilatation, laser (or electrocautery) excision of the stenotic membrane, rigid bronchoscopic dilatation, and tracheal stenting.<sup>[6–8]</sup> These are used only as a bridge to surgical therapy or in cases deemed unfit for surgery or those who fail surgical management.<sup>[7,9,10]</sup> Herein, we describe a patient with complete subglottic stenosis who failed several surgical and endoscopic treatments, and was finally successfully managed with rigid bronchoscopy and placement of Montgomery T-tube.

## CASE REPORT

A 24-year-old man was referred to our facility for the management of subglottic stenosis. Three years ago, the patient had required endotracheal intubation followed by tracheostomy after sustaining head injury in a road traffic accident. Attempts at decannulation were unsuccessful as there was significant respiratory distress on removing the tracheostomy tube. Subsequent evaluation revealed the presence of subglottic stenosis located 0.5–1 cm from the vocal cords. Over the next 3 years, the patient underwent several procedures for the management of tracheal stenosis that included bougie dilatation, laser excision of the stenosis, cricoid split with cartilage graft placement, and surgical excision and repair of the stenosis. Unfortunately, all the attempts failed, and the patient continued to require a tracheostomy. The patient was then referred to our center for further management.

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Bronchoscopy showed complete occlusion of the trachea in the subglottic region, 0.5 cm below the vocal cords [Figure 1a]. Subsequently, the patient underwent rigid bronchoscopy under general anesthesia. With the tracheostomy tube *in situ*, the patient was intubated with a 6.5 mm tracheobronchoscope and the scope was positioned just above the subglottic stenosis. The membranous occlusion was gently negotiated with the help of a rigid forceps [Figure 1b], and a pin-hole opening was created [Figure 1c]. A controlled radial expansion balloon was inserted through this opening and serial balloon dilatation was performed (6 mm and 8 mm) [Figure 1d and e]. The 6.5 mm bronchoscope was then negotiated through the stenosis as the tracheostomy tube was removed. The patient was then intubated with an 8.5 mm tracheoscope, which was passed across the stricture further dilating it. A Montgomery T-tube (14 mm internal diameter) was deployed through the tracheal stoma under direct endoscopic vision. The patient was extubated after confirming the position of the T-tube [Figure 1f]. The patient was discharged after observation for 24 h. At 3-month follow-up, the patient was doing well.

## DISCUSSION

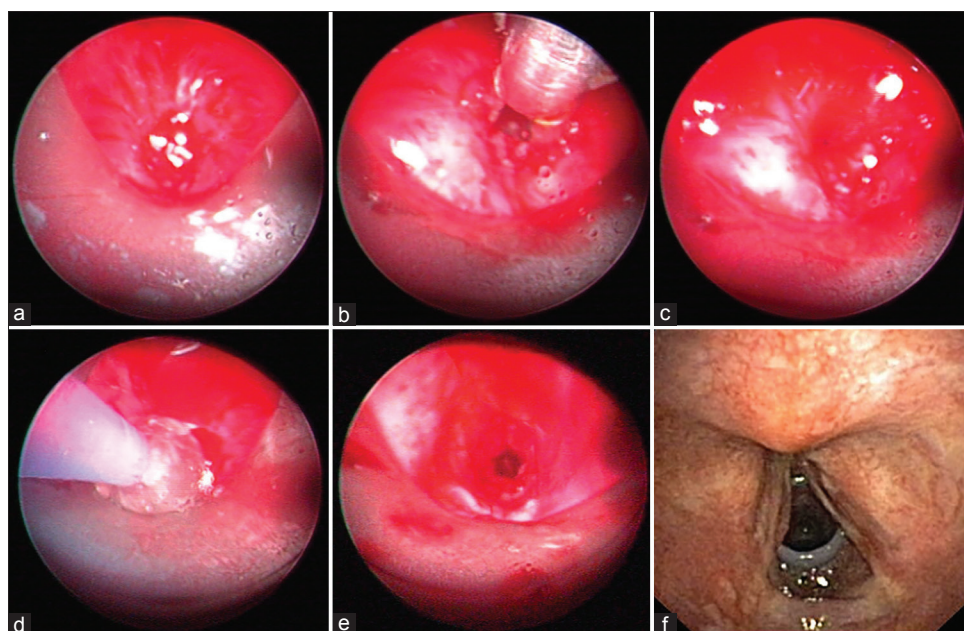
The index patient had failed multiple attempts (both surgical and endoscopic) at correction of the subglottic stenosis, which is considered the most challenging variety of tracheal stenosis due to its proximity to the vocal cords. When surgery is not feasible or has failed, most patients usually require a permanent artificial airway.<sup>[11]</sup> According to the Cotton-Myer classification, subglottic stenosis can be divided into four grades based on the amount of luminal obstruction as: Grade I (0–50%), Grade II

(51–70%), Grade III (>70% with any detectable lumen), and Grade IV (complete obstruction).<sup>[12]</sup> Our patient had complete tracheal stenosis (Cotton-Myer Grade IV) in the subglottic region, the most severe form of this condition.

Complete tracheal stenosis is an uncommon, extreme form of postintubation or posttracheostomy tracheal stenosis with only a few reported cases [Table 1]. Koitschev *et al.* and Lim *et al.* described the successful surgical management of this condition while Vandemoortele *et al.* described successful treatment with laser dissection, rigid bronchoscopic dilatation, and silicone stent or T-tube placement.<sup>[13–15]</sup> We used rigid bronchoscopy and chose the Montgomery T-tube in preference to a silicone stent.

Although a tracheostomy tube was bypassing the subglottic stenosis in our patient, there were several disadvantages including poor humidification of inspired air and the lack of phonation due to circumvention of the upper airway and larynx, respectively. In fact, the lack of speech was the prime reason the index patient desired the procedure. The T-tube (with the external arm occluded), allows passage of inspired air through the upper airway and larynx thereby preserving both humidification and phonation. A silicone tracheal stent could serve the same purpose, but it has certain disadvantages.

There is a high risk of displacement of the silicone stent when placed in the subglottic region. While techniques for external fixation of the straight silicone stent have been described, these techniques are not used routinely.<sup>[16,17]</sup> This inherent instability of the tracheal stent necessitates the use of stents with relatively larger diameter, which



**Figure 1:** Endobronchial image showing complete stenosis in the immediate subglottic region (a). Gentle negotiation of the stenosis with rigid forceps (b) with subsequent creation of a tiny opening (c). Balloon dilatation was then performed using the controlled radial expansion balloon (d), which led to dilatation of the stenotic segment (e). Endobronchial image showing the Montgomery T-tube in position (f)

**Table 1: Cases of complete tracheal stenosis reported in the literature**

Author (year)	Age/sex	Indication for tracheostomy	Tracheostomy type	Location of stenosis	Management
Vandemoortele <i>et al.</i> (2013) <sup>[13]</sup>	26/female	Prolonged mechanical ventilation	Surgical	35 mm below vocal cords	Endoscopic (laser dissection, dissection with rigid scissors, rigid bronchoscopic dilatation, and tracheal stent placement)
	63/male	Prolonged mechanical ventilation	Surgical	20 mm below vocal cords	Endoscopic (laser dissection, dissection with rigid scissors, rigid bronchoscopic dilatation, and T-tube placement)
	63/female	Prolonged mechanical ventilation	Surgical	25 mm below vocal cords	Endoscopic (laser dissection, rigid bronchoscopic dilatation, and T-tube placement)
Lim <i>et al.</i> (2007) <sup>[14]</sup>	32/male	Prolonged mechanical ventilation	Percutaneous	At the level of first or second tracheal ring	Surgical resection and end-to-end anastomosis and T-tube placement
Koitschev <i>et al.</i> (2003) <sup>[15]</sup>	17/female	Neurological deficits following surgery for cerebellar tumor	Percutaneous	Immediately above tracheostomy stoma	Surgical revision of tracheostomy
	33/female	Prolonged mechanical ventilation	Percutaneous	Immediately above tracheostomy stoma	Surgical resection and end-to-end anastomosis
Index case	24/male	Prolonged mechanical ventilation	Surgical	5 mm below vocal cords	Endoscopic (dissection with rigid forceps, rigid bronchoscopic dilatation, and T-tube placement)

stays in position by exerting circumferential pressure on the tracheal wall. With long-term use (likely lifelong in the index case), this increases the risk of granulation tissue formation, especially at the ends of the stent leading to airway obstruction. Finally, retention of secretions is a perpetual problem with the silicone stent. The unique design of the T-tube overcomes all these issues. The external limb of the Montgomery T-tube anchors the intratracheal part of the stent across the tracheostomy stoma and prevents its displacement. This permits the use of tracheal tubes with diameter relatively smaller than that of the trachea. Thus, the T-tube exerts minimal pressure, if any on the tracheal wall and granulation tissue formation is generally not a problem with its use. Suctioning of the intratracheal portion of the Montgomery T-tube is rarely required, but if needed, can be easily done through the external arm greatly reducing the risk of stent occlusion by secretions.

## CONCLUSION

The index case demonstrates the excellent results of interventional rigid bronchoscopy in challenging forms of tracheal stenosis like complete subglottic occlusion even in those who have failed several surgical therapies.

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## Conflicts of interest

There are no conflicts of interest.

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