Custom Made Acrylic Tracheal Stent for Tracheal Stenosis

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Abstract The purpose of stenting for tracheal lesions varies from palliation, to cure, to stabilization while a reconstructive effort heals. This article describes a technique of fabricating customised acrylic tracheal stent for a patient with tracheal stenosis. Custom made acrylic tracheal stent described in this article facilitates easy manipulation during surgery and is cost effective when compared to pre fabricated silicone or other metallic stents.

Keywords Acrylic · Tracheal stent · Stenosis · Biocompatible

Introduction

The word stent is derived from Charles R. Stent, a British dentist who practiced in the late 19th century [1]. In current practice, the word stent refers to material that supports some form of tissue against collapse. Laryngeal and tracheal stents are solid or hollow absorbable or nonabsorbable tubes of various shapes, sizes, and materials. Stents are used as primary treatment for lumen collapse, to stabilize a reconstructive effort of the larynx or trachea and to prevent collapse. Montgomery in the 1960s developed his famous T-tube [2]. It is silicone prosthesis in a T-shape, that is

placed via a tracheostomy to maintain a open airway. Dumon and Bauer, in the 1970s, modified Montgomery's T-tube by cutting off the end and making it a long cylinder and placing it via an endoscope [3, 4].

Tracheal stenosis can be idiopathic or result from trauma including accidents, chemical exposure, and intubation. Sometimes tracheal stenosis may be a symptom of Wegener's granulomatosis. Tracheal stenosis causes the lumen to compromise and leads to airway obstruction. Laryngeal and tracheal stents are hollow absorbable or non absorbable tubes of various shapes, sizes, and materials [3, 4]. A stent can be placed to maintain the airway lumen following debridement to counteract collapse or edema. Alternatively, stents can be placed to compress any lesion extending into the trachea or bronchi, without the need for debulking [5].

This article describes technique for fabrication of custom made acrylic tracheal stent for patient with tracheal stenosis resulting from prolonged intubation on ventilator.

Clinical Report

A 46-year-old man presented with a history of road traffic accident resulting in head injury and was on ventilators for 7 days. He presented to the department of ENT with complaint of difficulty in breathing and biphasic stridor. Radiograph of soft tissue neck lateral view was taken showing stenotic segment in cervical trachea, just below the cricoid cartilage. Initially tracheostomy was performed to secure the airway. Definitive treatment would be placement of tracheal stent to maintain the patency of air way lumen.

Socioeconomic status of the patient was a constraint for usage of pre fabricated commercially available silicone tracheal stent or T tube. So it was decided to go for a

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custom made cost effective heat polymerised acrylic tracheal stent. The material has proven biocompatibility.

Endotracheal tube of 8 mm internal diameter was selected to act as scaffold to determine the internal diameter of the acrylic stent. A polyether impression material (Impregum, pentasoft, 3M ESPE, St. Paul, USA) is mixed as per the manufacturer's instructions and was loaded inside the tube to maintain the internal diameter of the tube while flasking. Before the material gets polymerised a stainless steel wire of 17 gauge was incorporated into the impression material so that the whole assembly is stabilized in the mold easily while flasking. A modelling wax was softened and added around the tube to obtain the in external diameter of the endotracheal tube. A two-piece split mold of waxed up endotracheal tube was fabricated with dental stone (Dentstone; Pankaj Industries, Mumbai, India) for further processing (Fig. 1). Flasking and de-waxing of the wax up was done. Stainless steel inserted into the polyether core of endotracheal tube maintains the mold space around the tube after wax boil out. Packing was done with heat polymerized clear acrylic resin (DPI Heat Cure acrylic Resin Dental Products of India Ltd, New Delhi, India). After processing, finishing and polishing of

Fig. 1 Split mould with wax model

Fig. 2 Final acrylic tracheal stent

the prosthesis was done (Fig. 2). A semi lunar shaped hole was created in the middle of the stent so that tracheostomy tube could be easily inserted through it (Fig. 3). Two fine holes were placed in the lateral wall of the stent to facilitate suturing. The prosthesis was inserted to reconstruct the stenosed tracheal segment (Fig. 4). Tracheostomy tube was then inserted into the semilunar hole provided in acrylic stent.

Discussion

Heat polymerised acrylic prostheses have been used for soft and hard tissue replacement from several years. They have proven biocompatibility when they are in contact with vital tissues [6]. In present article heat polymerized acrylic stent was used instead of silicone T tube for replacement of stenosed tracheal segment. Advantages of acrylic stent over commercially available silicone stents are, prostheses made

Fig. 3 Tracheostomy tube inserted through acrylic tracheal stent

Fig. 4 Surgical placement

up of acrylic are equally biocompatible as silicone prostheses. Rigidity of acrylic tracheal stents aids in effectively maintaining the patency of extremely stenosed tracheal segment when compared to soft silicone counter parts. One of the disadvantages of acrylic tracheal stents is difficulty in insertion of the stent into the trachea during surgery because of its rigidity [2]. Lack of horizontal arm in the present acrylic stent (straight tube) provides ease in surgical placement when compared to rigid acrylic T tubes. Acrylic stent described in the present article facilitates customization in diameter and length depending on clinical situation of patient and surgeons requirements. Low fabrication cost and proven biocompatibility of Acrylic tracheal stents, when compared to commercially available stents justifies their usage in treating tracheal stenosis in such economically compromised patients.

Conflict of Interest None.

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