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Non-invasive methods to maintain cervical spine position after pediatric tracheal resections



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ABSTRACT

Objectives: To present our experience with two methods of neck stabilization after pediatric tracheal resection with primary anastomosis as possible alternatives to the traditional chest-chin suture.

Methods: Children undergoing tracheal resection and/or cricotracheal resection with anastomosis under tension were placed in cervical spine flexion postoperatively with either a chest-chin (Grillo) suture, an Aspen cervical collar or Trulife Johnson cervical-thoracic orthosis (CTO). A retrospective chart review of tracheal resections performed between 2005 and 2016 was completed to evaluate the positive and negative factors associated with each neck flexion technique.

Results: Of the 20 patients, there were 13 patients with the Grillo suture, 4 with the Aspen collar and 3 patients with the Johnson CTO. There were 13 tracheal resection procedures and 7 cricotracheal resections, all of which had anastomosis under tension. One major anastomosis dehiscence was noted with the Grillo suture technique which required reoperation. Two patients with the Grillo suture experienced skin breakdown at the suture site. The Aspen cervical collar, which fixed the cervical spine and prevented lateral and rotational motion, was limited in several cases in that it placed the spine in slight hyperextension. The Johnson CTO provided the most support in a flexed position and prevented cervical spine motion in all directions. No anastomosis complications were noted with the Aspen collar or the Johnson CTO, however, several patients sustained minor cutaneous wounds.

Conclusion: In this series the Aspen cervical collar and Johnson CTO were used successfully as non-Grillo alternatives to postoperative neck stabilization in pediatric tracheal resections. Modifications to both devices are proposed to minimize cutaneous injuries and increase immobilization of the cervical spine in the desired flexed position. Although these devices appear to be safe and may be better tolerated, further innovation is needed to improve the design and fit of these devices.

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1. Introduction

Pediatric tracheal stenosis may result from post-intubation trauma, relapsing polychondritis, autoimmune disease processes, and benign and malignant tumors [1,2]. Among the various techniques used to treat pediatric tracheal stenosis (ie. CO₂ laser, microdebrider, stenting), segmental resection with primary end-to-end anastomosis is the treatment of choice [1,3,4]. Tracheal and

cricotracheal resections (collectively referred to as “tracheal resection” in this study) can be associated with postoperative anastomotic complications, such as dehiscence, as a result of undue tension at the anastomotic site secondary to extension or rotation of the neck [5].

In attempt to inhibit excessive cervical motion after tracheal resection procedures, previous reports have classically described placement of a suture from the chin to the chest at the level of the manubrium [5]. This so called “Grillo” suture can be painful and cause significant discomfort, scarring and keloid formation at its attachment sites, and can loosen or tear which may increase risk for dehiscence. Additionally, this technique does not limit lateral or

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rotational cervical spine motion which may increase torsional forces at the anastomosis [4,5]. With the intent of improving patient comfort and reducing tension at the anastomosis site, we report the use of a cervical collar (Aspen Medical Products, Irvine, CA) and a cervical-thoracic orthosis (Johnson CTO, Trulife, Jackson, MI) brace as alternative stabilization techniques.

The purpose of this article is to present our experience and discuss the positive and negative factors associated with the Aspen cervical collar and Johnson CTO, and examine their use as possible alternatives to the Grillo suture for postoperative neck stabilization in pediatric tracheal resections.

2. Methods

This study was approved by the Institutional Review Board at University of Oklahoma for a retrospective review of pediatric tracheal resections performed between 2005 and 2016. Inclusion criteria consisted of patients who were felt to have an anastomosis under tension requiring postoperative neck stabilization with either a Grillo suture, Aspen collar or Johnson CTO. All patients had a transcervical end-to-end tracheal anastomosis closure performed in an interrupted fashion utilizing 3–0 nonabsorbable size suture anteriorly and laterally, as well as 4–0 absorbable suture posteriorly. Tracheal stents were not used in any of the repairs, nor was fibrin tissue sealant or internal tension sutures placed at the anastomotic site. Furthermore, no patient required a superior or inferior tracheal release to mobilize the proximal and distal trachea after resection. After the anastomosis was completed, all patients had a leak test performed to 30 cm of water to ensure water-tight closure. Single stage repairs were performed in most patients with decannulation at the end of the procedure, if a tracheostomy tube was present. Majority of the patients were extubated in the operative room, however, the decision to extubate varied based on the comorbidities of the patient. Those patients not extubated on the table typically remained intubated for three days until the anastomotic swelling decreased. In these patients, pre-extubation endoscopy and bronchoscopy was not routinely performed. All patients received intraoperative and postoperative prophylactic antibiotic coverage with clindamycin for approximately one week to cover MRSA.

Our practice is to use the Grillo suture intraoperatively with a size 0 nonabsorbable polypropylene suture between the chin and manubrium, incorporating the periosteum at both sites. All patients who received the Aspen collar or the Johnson CTO were measured for proper fitment of the device preoperatively. Our standard protocol was approximately one-week duration of fixation. All patients were admitted to the pediatric intensive care unit postoperatively. Charts were reviewed for the entire hospital stay to note any complications which arose secondary to the neck immobilization

method such as cutaneous wounds or acute anastomotic dehiscence. Readjustments were made to the Aspen collar and Johnson CTO as necessary during the hospital course.

2.1. Aspen collar

The Aspen collar has five pediatric sizes that range to fit ages 1 month to 6 years. The device is made of a thin plastic frame that is lined with hypoallergenic open-cell foam padding (Fig. 1). The padding is removable by means of Velcro and the collar comes with a secondary pad set. It can be fit pre- or postoperatively and sizing is based on the patient's height and weight. The Aspen collar can be contoured in the patient room to achieve a more comfortable fit. Charges for the Aspen collar and fitting are \$138.

2.2. Johnson CTO

The Johnson CTO has three pediatric sizes that are categorically sized: infant, pediatric, and youth. The orthosis is made of polyethylene anterior and posterior thoracic panels, encapsulated occiput, contoured forehead strap to further limit anterior cervical spine motion, and is lined with foam padding (Figs. 2 and 3). Padding is also removable by means of Velcro and comes with a secondary pad set per our protocol. The orthosis can be fit pre- or postoperatively, however, preoperatively is preferred to allow time for desired modifications. Sizing is based on neck circumference and thoracic length, defined by the manufacturer as the distance from the mandible to the inferior edge of the anterior panel (Trulife, 2015). This endpoint should terminate between xiphoid and waist for a proper fit. Additionally, the orthosis has a posterior metal strut that attaches the occiput portion to the posterior panel. This can be contoured to flex the orthosis to maintain the necessary cervical flexion required after tracheal resection. The metal strut can be raised, lowered and formed to achieve the degree of cervical flexion. When donning the orthosis, cervical spine flexion should be maintained during log rolling to place the posterior panel and encapsulated occiput in position. The price of the Johnson CTO orthotic and fitting services is \$584.

To date, no insurance companies have denied coverage for either of these orthotic devices for the treatment of tracheal resection.

3. Results

A total of 20 patients were identified; 13 who underwent tracheal resection and 7 cricotracheal resections. Of these 20 patients, 13 had the Grillo suture, 4 fitted with the Aspen collar and 3 with the Johnson CTO (Table 1). Postoperative complications arose in three patients with the Grillo suture, one of which was major. Patient number 4 was a cognitively impaired child with tracheal



Fig. 1. Aspen cervical collar.

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