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Superiorly-based turnover skin flap: Pediatric tracheocutaneous fistula closure

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ABSTRACT

Objective: To present a novel superiorly-based turnover skin flap for the primary repair of pediatric tracheocutaneous fistula closure, and to determine the efficacy and safety of this tracheocutaneous fistula turnover flap primary closure technique.

Subject and methods: This retrospective review analyzed one surgeon's (DJK) pediatric tracheostomy decannulation methods and results, specifically relating to the development of tracheocutaneous fistulas, over a fourteen-year period, from October 2002 through June 2016. The review furthermore examined a turnover flap technique for the primary closure of tracheocutaneous fistulas described herein.

Results: Over the period of study, 57 patients were decannulated, of whom 31 (54%) developed a tracheocutaneous fistula. Mean duration of tracheostomy in patients who developed a tracheocutaneous fistula following decannulation was forty-two months compared to thirteen months in patients who did not. Duration of decannulation was an independently significant variable ($P < .001$) in tracheocutaneous fistula development while gender, age at tracheostomy and age at decannulation were not ($P > .05$). Of the 31 patients who developed a tracheocutaneous fistula, 30 (97%) elected to pursue tracheocutaneous fistula closure using the turnover flap technique described in this study. Mean time from decannulation to tracheocutaneous fistula repair was 132 days. All tracheocutaneous fistulas were successfully closed. There were no perioperative or postoperative complications and no patient required subsequent hospitalization or surgical revision.

Conclusions: The turnover technique presented is simple, straightforward, reliable, safe, and effective with excellent cosmetic results.

1. Introduction

The development of a tracheocutaneous fistula (TCF) is a common, well-documented sequela to the chronic use of tracheostomy tubes in children. Common indications for pediatric tracheostomies include subglottic stenosis, craniofacial syndromes, prematurity, bronchopulmonary dysplasia, and neurologic illnesses [1]. Due to the chronic nature of these conditions, tracheostomy tubes in the pediatric population are commonly in place for prolonged periods of time. Carron et al. [1] demonstrated an average duration of almost two years in a series of 204 pediatric tracheostomy patients. This duration is likely higher than in the adult population, in which tracheostomies are frequently done for the management of respiratory failure in the setting of acute illness. When tracheostomy tubes have been present for 16 weeks or longer, the incidence of TCF can be as high as 70% [2]. In the pediatric population, incidence rates of persistent tracheocutaneous fistula after decannulation range from 3% to 49% [2–4]. Persistence of the fistula can lead to irritation of surrounding skin, mucopurulent secretions, problems with phonation, increased aspiration risk, difficulty swimming, and breathing problems in children with decreased pulmonary function. Due to the high prevalence of TCF in the pediatric population following decannulation, care of the pediatric otolaryngology patient requires knowledge concerning their surgical management.

Surgical management of tracheocutaneous fistulas can be divided into primary closure or healing by secondary intention. With either a primary closure or secondary intention technique, the mature tracheocutaneous fistula tract must either be excised from the skin down to the tracheal lumen, or freshened using cautery. Secondary intention allows healing of the tracheal defect to occur effectively and safely from the luminal surface outward; however, the scar cosmesis cannot be controlled and this often leads to an unsightly wound. Primary closure requires precise re-approximation of wound edges to enable more cosmetic closure as well as to ensure a watertight and airtight seal postoperatively. At our institution, one pediatric otolaryngologist (DJK) has reliably used the same primary closure technique for fourteen years.

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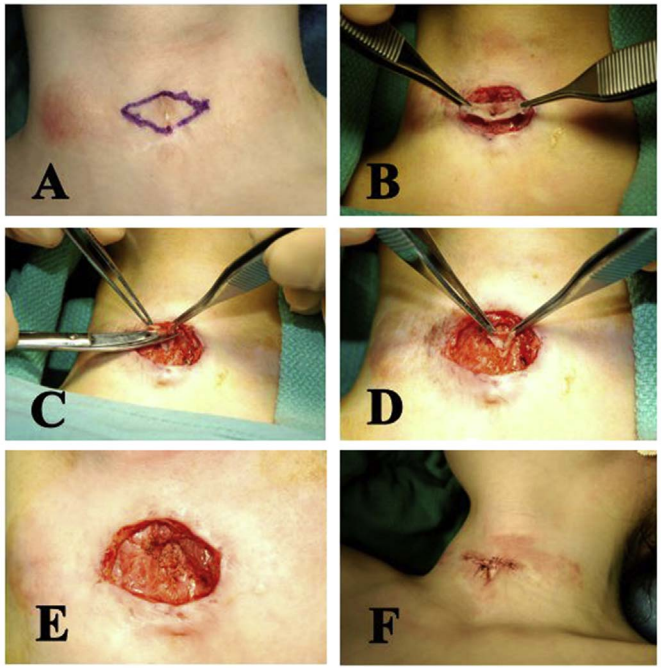

Fig. 1. Intraoperative findings. (A) The elliptical, spindle-shaped incision is created horizontally around the TCF. (B) Dissection is carried circumferentially around tract. (C) Lateral and caudal walls are trimmed. Triangular shaped section is preserved from superior portion of dissection creating a hinged skin flap. (D) Depiction of superiorly-based skin flap. (E) The superiorly-based turnover skin flap is sutured in five positions with 4-0 Vicryl, anchoring it to the caudal and lateral margins. Epithelial surface of the flap covers the open defect in the trachea. (F) Rubber band drain is placed. Platysma layer closed followed by dermal and superficial skin layer closure.

The purpose of this study was to demonstrate our findings with a simple primary closure technique for tracheocutaneous fistulas that is safe and effective with excellent cosmesis.

2. Methods

After Institutional Review Board approval, a retrospective review was conducted of all patients who were decannulated over a fourteen-year period, from October 2002 through June 2016. Study subjects included all patients less than 18 years old at the time of decannulation and repair. There were no exclusion criteria for these patients. Inpatient and outpatient records of these patients were analyzed for the following variables: gender, indication for tracheostomy, age at tracheotomy, age at decannulation, duration of tracheostomy, time from decannulation to fistula closure, operative duration, postoperative complications and need for revision.

All patients were repaired in the operating room under general anesthesia (Fig. 1). Perioperative antibiotics were provided. The fistula repair method involved a spindle-shaped incision around the TCF tract. Dissection was carried circumferentially around this tract down to the anterior wall of the trachea (Fig. 2). The caudal and lateral walls of the TCF tract were then resected, but the strip of the cephalic wall of the TCF tract was preserved. Next, this remaining strip of TCF tract was trimmed to the appropriate length and used as a turnover flap (Fig. 3). The turnover flap was then folded in, so that its skin would serve as a new inner lining for the repaired trachea. The superiorly-based turnover skin flap was sutured in five positions with 4-0 Vicryl to anchor it to the caudal and lateral margins of the tracheal defect (Fig. 4). The wound was then flushed with normal saline while the anesthesiologist provided a Valsalva movement, to rule out a leak. A thin rubber band drain was then placed on top of the tracheal closure and sutured to the skin. The strap muscles on either side of the repair were mobilized and closed tension-free using absorbable suture. The platysma muscle was

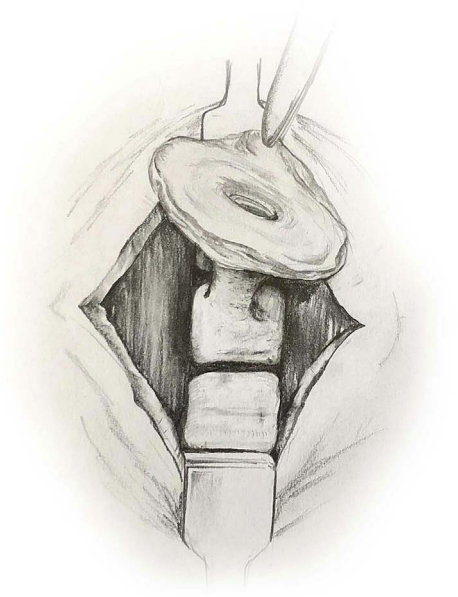

Fig. 2. Dissection of fistula tract.

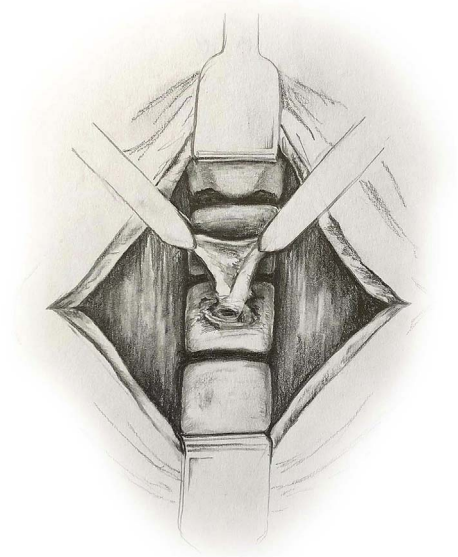

Fig. 3. Superiorly-based rectangular skin flap.

then closed over this, and then the dermal and superficial skin layers were closed. All patients were observed overnight in a pediatric ward with continuous pulse oximetry. The following morning, the wound was checked for signs of subcutaneous air and the drain was removed. Patients were discharged without antibiotics and were seen in follow up approximately two weeks after discharge.

3. Results

From October 2002 through June 2016, fifty-seven pediatric patients were successfully decannulated at our institution under the direct care of the senior author (DJK). Of this total number, thirty-one patients (54%) developed a persistent tracheocutaneous fistula during the study period. The mean duration of tracheostomy in the patients who developed TCF was forty-two months and the minimum trach duration in this group was seven months. The mean duration of tracheostomy in decannulated patient who did not develop TCF was 13 months with a