Sutureless vs Sutured Posterior Costal Cartilage Grafting in Laryngotracheal Reconstruction in Children

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Objective: To compare the postoperative course, complication rate, and decannulation rate in children who underwent either sutureless or sutured posterior costal cartilage grafting during laryngotracheal reconstruction (LTR).

Design: Retrospective chart review.

Setting: Tertiary care children’s medical center.

Patients: The study included children who required posterior costal cartilage grafting when undergoing LTR for subglottic stenosis between the years of 2000 and 2009 by the senior author (J.E.M.) and who had adequate records for review.

Main Outcome Measures: Postoperative complications, including the incidence of graft prolapse, restenosis or reobstruction requiring surgical intervention, and decannulation rate.

Results: Forty-nine children who underwent 52 procedures met the inclusion criteria for this study. All patients had grade III acquired subglottic stenosis and underwent double-staged LTR. Twenty procedures were performed with a sutureless posterior graft, and 32 were performed with suture placement. None of the 20 procedures that were performed with a sutureless graft had prolapse of the graft into the airway compared with 2 of 32 prolapsed posterior grafts (6%) that were sutured (P = .52). Eleven of 20 children (55%) with sutureless posterior grafts compared with 24 of 32 children (75%) who underwent sutured posterior grafts required endoscopic surgical intervention for restenosis or reobstruction (P = .22). Decannulation was achieved in 19 of 20 sutureless cases (95%) and in 28 of 30 cases (93%) in which sutures were placed (P = .56) after a single LTR and necessary endoscopic interventions occurring at 6.3 months and 4.9 months, respectfully (P = .42).

Conclusion: Sutureless posterior costal cartilage grafting in children with acquired grade III subglottic stenosis is an equally effective and secure technique compared with sutured posterior grafting during double-staged LTR.


Various surgical approaches are used to treat laryngotracheal stenosis in children. These approaches are often based on the type, maturity, and degree of stenosis. High-grade, firm, mature stenosis often requires an open surgical approach, with cartilage grafting necessary to create and maintain an adequate open airway. After Cotton described the use of cartilage grafting in open laryngotracheal reconstruction (LTR) in the 1970s, several other pioneers in airway reconstruction described the use and types of sutured and sutureless posterior grafting in LTR in the 1980s. Hof described a posterior graft that was stabilized with an intraluminal stent, while Zalzal described a classic sutured boat without flanges. Other authors described similar techniques in the 1990s, but, to our knowledge, only 1 study has compared the complications and outcomes of the sutureless posterior procedure with those of standard suturing techniques. Our current research sought to compare the postoperative course, complication rate, and decannulation rate between children who received a sutureless posterior cartilage graft and children who had their posterior graft sutured during LTR.

METHODS

Institutional review board approval was obtained for a retrospective chart review of patients with a diagnosis of subglottic stenosis or tracheal stenosis between 2000 and 2009 at a single tertiary care children’s hospital. Medical charts were analyzed to identify the patients who underwent LTR with a posterior costochondral graft alone or in combination with an anterior graft. A total of 116 charts were reviewed. The patients were included if (1) their medical charts contained complete operative and postoperative information, (2) they were younger than 18 years at the time of sur-
gery, and (3) they were operated on by the senior author (J.E.M.). Exclusion criteria included patients who had known immune diseases or who were receiving immunosuppressive agents, patients with systemic diseases, and patients with incomplete or no post-treatment follow-up information. Data collected during chart review include sex, age at time of reconstruction, grade of stenosis, method of posterior cartilage fixation, required postoperative interventions, and decannulation.

Children with laryngotracheal stenosis were initially evaluated with microlaryngoscopy and bronchoscopy during spontaneous ventilation. A Hopkins rod telescope was used for thorough evaluation at all levels of the airway. The airway was sized with progressively larger endotracheal tubes, as described by the Meyer-Cotton grading system. Reconstruction was delayed until the patients reached the appropriate size for rib grafting, the stenosis was mature, the pulmonary system was stable, and the patients were free of upper airway infections. Preoperative and postoperative antireflux medication was administered as part of the standard regimen, and a pulmonologist was consulted for optimization of pulmonary medications if necessary. Specific outcomes measured included the presence of granulation tissue or restenosis in the immediate postreconstructive period before decannulation, graft prolapse, and decannulation itself.

Laryngotracheal reconstructions were performed with anterior and posterior costal cartilage as previously described. The neck is opened and an inferior laryngofissure is performed, with care being taken not to divide the anterior commissure by using endoscopic visualization from above. The posterior lamina of the cricoid cartilage is then divided until fibers of the inferior constrictor can be identified. A fine-tip hemostat is used to splay the posterior cricoid cartilage to ensure adequate division. This hemostat is then used to separate the posterior cricoid cartilage in the area of the stenosis from the esophagus, creating a pocket. The defect is carefully measured to determine the size of graft needed. Costal cartilage is harvested in the standard fashion, leaving the posterior perichondrium next to the plural lining of the lung.

The sutureless posterior graft is carved so that there are cartilage flanges completely surrounding a boat-shaped graft and the perichondrium is facing intraluminally, as described by Zalzal and Cotton in 1986 for anterior grafting (Figure 1 and Figure 2). The flanges are then secured in the pocket that has been developed between the posterior cricoid and esophagus, thus “popping” it into place (Figures 3, 4, and 5). The cartilage grafts that were sutured in place in the posterior cricoid are carved in the same boat shape but without the flanges. In most sutured grafts, four 4-0 polyglactin 910 (Vicryl) simple interrupted su-

From 2000 to 2009, a posterior costochondral graft was placed during 69 LTRs in 62 patients who underwent open surgical correction by the senior author (J.E.M.). Eleven patients were excluded because of inadequate data in the medical charts. Two were excluded because of comorbidities leading to confounding data. No children with laryngeal webs or forms of laryngeal atresia were included. Therefore, 49 patients and 52 procedures were examined. All these
children had grade III subglottic stenosis, and none required complete laryngofissure for repair. Only the inferior one-third of the thyroid lamina was divided, with care being taken not to divide the anterior commissure of the glottic larynx by endoscopic evaluation from above during anterior surgical division. All 49 patients had existing tracheotomies and underwent a double-staged reconstruction, with an indwelling short stent placed for 2 to 4 weeks. Fifty-one procedures included both anterior and posterior grafts, while 1 case required only a posterior graft. In 32 operations, the posterior graft was fixed in place with sutures. In the remaining 20 operations, the posterior graft was carved with flanges and “popped” into place. The total male to female ratio was 1.2:1.0. The overall average age at the time of LTR was 32 months.

After stent removal, endoscopic interventions were performed as needed to optimize healing and patency of the airway. They included a variety of techniques in various children, with the use of either a laser or a microdebrider to remove granulation tissue, lysis of scars with Jackson laryngeal dilators or balloon dilation, and the application of mitomycin C in some cases, as previously described. Endoscopic surgical intervention for restenosis or reobstruction was statistically similar in children who had LTR with a sutureless posterior graft (11 of 20 [55%]) and children who had a sutured posterior graft (24 of 32 [75%]) (P = .22).

Also, 2 patients were noted to have prolapse of the posterior graft into the airway during these follow-up bronchoscopies. Both cases occurred in patients in whom the posterior graft was sutured into position, with 1 child undergoing the standard suture technique as described herein and 1 child having only 2 diagonal sutures placed rather than 4. Because of the sample size, there was no significant difference in graft prolapse between the groups (P = .52). Decannulation was achieved in 19 of 20 children (95%) in the sutureless group and in 28 of 32 children (93%) in the sutured group after the primary LTR and any necessary endoscopic interventions. There was no significant difference in decannulation rate between the sutureless and sutured groups (P = .56). The average time from LTR to decannulation was 5 months, occurring similarly in the children with sutured posterior grafts (4.9 months) and those with sutureless posterior grafts (6.3 months) (P = .42). It is the standard protocol of the senior author to delay decannulation during the fall and winter months in stable, patent postoperative airways, which may have lengthened the overall time to decannulation in both groups.

In 1978, Cotton described the technique of modern LTR, in which he described anterior costal cartilage graft interposition with or without silastic stenting. Both Hof and Zalzal expanded on these grafting techniques, with the use of posterior grafting. Today, LTR with cartilage grafting is the standard treatment for moderate to severe laryngotracheal stenosis. A posterior graft may be required when an anterior graft alone does not result in an adequately sized airway, especially when there is posterior or circumferential stenosis.

Traditionally, the posterior cartilage graft has been secured to the posterior cricoid lamina using suture fixation. This procedure is a time-consuming process, and studies have shown that trauma during surgery and suturing through the graft may increase the susceptibility to infection and subsequent failure. We constructed a boat-shaped sutureless graft with flanges, based on Cotton and Zalzal’s previous descriptions of anterior cartilage grafts, which Ward et al also described in their series in 1998. The senior author indiscriminately switched over to using a sutureless posterior graft in 2006 because of its use at other institutions, so all surgical reconstructions from 2000 through 2005 were performed with a sutured posterior graft, and all surgical cases from 2006 to 2009 were performed with a sutureless technique. While the study was not ideal for statistical comparison because the groups were not blindly randomized, there was no selection bias because the senior author did not “select out” any of the later reconstructions to perform the sutured technique for placement of the posterior graft.

Technically, there are considerations when deciding whether to perform a sutured or sutureless technique,
including the size of the surgical field, stability and matura-
ty of the cartilaginous framework, and thickness of the posterior scar. Because the average age of the chil-
dren in this study was 2½ years, and because a laryngo-
fissure was not performed in any of these children, the average size of the exposed laryngotracheal airway was roughly 2 cm anteriorly and 1.5 cm posteriorly. Suturing in a hole that small can be challenging, so using a sutureless technique may make the graft easier.

Suturing, however, may be advantageous in a soft ste-
nosis or a thick posterior scar because the graft may not “snap” into place in these conditions and the reconstruc-
tion could be destabilized. In all of the children in this study, we waited for the scar to mature completely so it would not be soft. For children with thick posterior scars, we were able to use the thick portion of the harvested rib to create a taller center “boat” graft whose intraluminal edge would then match the level of the thick posterior scar.

Although the sutureless posterior graft has become more commonly used over the last 2 decades, its safety, effectiveness, and complication rate have not been studied extensively. Rizzi et al6 recently compared complications in children who had sutureless posterior grafts with those in children who had sutured posterior grafts. Their reported category of complications included arytenoid prolapse, restenosis requiring reoperation, aspiration, graft migration, stomal bleeding, and air leak. They found statistically fewer complications in the children who had sutureless posterior graft compared with those who had a sutured one (9 of 31 vs 15 of 21; P = .01), with each group having 1 child who had graft migration.

We chose to look at the specific local subglottic complica-
tion rate and the rate of decannulation in these 2 groups. Arytenoid prolapse was not specifically addressed, although no supraglottic collapse interfered with decannula-
tion. In all 3 categories (decannulation rate, reinterven-
tion rate, and graft prolapse), the sutured posterior grafts and the sutureless posterior grafts performed equally (Table). It is interesting that more endoscopic interven-
tions were needed to maintain a patent airway in the sutured group. This finding certainly seems appropriate, as the polyglyactin 910 suture material necessarily left in the airway could cause an inflammatory reaction. Regardless of the posterior graft technique, aggressive use of endo-
scopic interventions as described previously22 allowed ex-
cellent decannulation rates after a single laryngotracheal reconstruction in these children with high-grade stenosis. In conclusion, compared with sutured posterior graft-
ing, sutureless posterior cartilage grafting in chil-
dren with acquired grade III subglottic stenosis is an equally effective and secure technique to use during double-
 staged LTR. However, when LTR is being performed in a child with laryngotracheal stenosis, it is important to tai-
lor the surgical technique to meet the challenges posed by the individual stenosis itself as well as the medical and so-
cial needs of the child and his or her family.

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rety of the data and the accuracy of the data analysis.

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