Laryngotracheal reconstruction using iliac crest graft: an institutional experience

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Abstract The treatment of laryngotracheal stenosis has always been a challenge for otolaryngologists. Results of this operation is often not very satisfactory due to many reasons. Often modifications of available modality of treatment are required to suit a particular case. Many grafts have been used in single stage laryngeal reconstruction with varied results. With the help of two case reports we would like to emphasize on the utility and advantages of iliac crest graft for laryngotracheal reconstruction. The procedure for these reconstructions also highlights the importance of proper preoperative evaluation and planning for each case.

Keywords Laryngotracheal reconstruction · Iliac crest · Laryngotracheal stenosis · T-tube

Introduction

Laryngotracheal reconstruction following laryngeal stenosis is one of the most challenging operations of otorhinolaryngology. Often the results of these operations are not very satisfactory due to multiple factors. There have been many procedures and equal number of modifications for the treatment of laryngeal stenosis which in itself show that none of the procedures are standard and treatment options can vary according to the need of the patient. So, many a time, we have to improvise methods to suit a particular case. The goals of laryngeal reconstruction are the preservation or restoration of the critical functions of respiration, deglutition and phonation. To achieve these goals, the structure of the cricoid must be preserved or restored. Reconstruction of combined laryngotracheal stenosis requires complex techniques including resection and incorporation of grafts and stents. It can be performed as a single stage or multistaged procedure. Many grafts and stents have been described in the text and the choice mostly lies with the operator as no standard criteria have been fixed for the same. We at SGPGIMS are mostly using iliac crest graft for reconstruction of the laryngeal framework and with the help of two case reports described below we would like to emphasize upon its usefulness over other graft materials.

Case 1

A tracheostomized patient was referred to us with complains of difficult decannulation. He had received a deep cut injury over the neck following a road traffic accident and the wound had been repaired somewhere outside 3 years back. CT scan done at SGPGIMS showed subglottic stenosis with soft tissue around the stoma. Direct laryngoscopy on the other hand revealed complete obliteration of the laryngeal lumen just below the cords by soft tissue.

This patient had a long stenotic segment of about 2.5 cm hence a primary delineation of the stenotic segment

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with laryngeal drop followed by release of stenotic segment and end to end anastomosis with T-tube was planned. After having performed the laryngeal drop it was observed that the stenotic segment extended from the level of the cricoid to the tracheostome. For proper dissection and visualization a new stoma was fashioned two rings below the first one. Previous injury had caused complete obliteration of the lumen by granulations and subsequent fibrosis. Now a long vertical incision was given extending from the cricoid to the old stoma and the anterior tracheal wall was split open. The granulations and fibrosis were removed and a patent lumen was established (Fig. 1). The posterior tracheal wall was found to be intact. T-tube was placed in the lumen to maintain its patency and for expansion of the stenotic segment, re-modeled iliac crest graft was used. Graft was well-secured with prolene sutures to surrounding soft tissue and the wound was closed in layers ensuring a good soft tissue cover over the graft to facilitate its uptake (Fig. 2).

Case 2

A 16-year-old male presented with laryngotracheal stenosis of 3 years duration with similar complains of difficult decannulation. Laryngoscopic examination had shown

restricted mobility of vocal cords and a narrow glottic chink. CT scan neck was done, which revealed stenosis of laryngotracheal region. Cricoid was found fractured with multiple segments from anterior arch of cricoid being displaced towards the lumen. Three years after injury repeat CT scan and MRI neck were done in our institute. Stage 2–3 laryngotracheal stenosis of grade 3 to 4 (>70% to complete obstruction of tracheal lumen) of 5 cm segment was found on CT scan. Patient was on low tracheostomy since last 3 years and there was stenosis of stoma with surrounding fibrosis and tracheomalacia.

We repaired this case of complicated laryngotracheal stenosis by resection anastomosis of trachea and with subglottic remodeling. 3 cm of stenosed trachea was resected. Anterior arch of cricoid which was found crumpled and fibrosed was also resected and posterior cricoid plate was splitted in centre. Suprahyoid laryngeal release was done for tension free anastomosis. Postero-lateral wall of cricoid was sutured with healthy ring of trachea using continuous absorbable polydioxanone or polygluconate sutures. Stent made from T-tube was then advanced inside the reconstructed lumen from proximal end. Anterior segment of cricoid was repaired by keeping remodeled free iliac crest graft between two healthy edges of cricoid. Anterior cricotracheal anastomosis was done by using interrupted sutures with knots placed on the outside. Fibrin

Fig. 1 Showing patent laryngeal lumen with a silicone T-tube in the lumen

Fig. 2 Showing iliac crest graft in place secured with prolene sutures

glue was used to support the bone graft at its position and to avoid its displacement. Stent was secured into position by applying through and through prolene sutures from skin. Vascularised pedicle graft from strap muscles was kept over reconstructed laryngotracheal segment and wound was stitched in layers.

Discussion

Management of laryngotracheal stenosis is by resection and anastomosis either done primarily or by interposing a graft material. Dilatation of stenosis by dilators is no longer practiced. Many techniques of augmentation and dilation by a variety of grafting materials are available and are described by many authors for the correction of stenosis at the subglottic level [1, 2].

Fig. 3 Sagittal CT scan to show subglottic stenosis

Fig. 4 Sagittal CT scan showing iliac crest piece lying just anterior to the silicone T-tube

Reconstruction is a complex procedure and is often performed in multiple stages, however a single staged procedure has distinct advantages [3]. When the glottis is intact, segmental resection and cricotracheal or thyrotracheal anastomosis as a single stage procedure is found to be successful [4]. Mulliken and Grillo [5] reported that in tracheal stenosis more than half of trachea in adult can be resected and managed with primary anastomosis. However, Macchiarini et al. [6] found that resections greater than 4 cm of stenosed laryngotracheal segment were associated, despite the performance of release maneuvers, with a significantly higher incidence of anastomosis under tension and definite failure. They also feel larynx may sometimes topple over as it loses its anterior rigid support when anterior cricoid plate is removed along with long segments of trachea and recommended use of T-tubes in such cases to avoid laryngeal collapse and dysfunction.

In our cases, 5 cm segment of larynx and trachea was involved and due to fibrosis around the neck tissue and prior tracheostomy there was significant tracheomalacia which complicated the problem. In the second case the laryngeal lumen was completely compromised with granulations as a result of disruption of laryngeal framework in the accident. Monnier et al. (1993) [7] concluded that two tracheal rings must be kept intact between the anastomosis and the tracheostomy stoma site if one wishes to keep initial stoma otherwise entire stoma area should be resected with stenosed segment. Resection of 5 cm long segment of trachea and primary anastomosis in this case was not possible due to a long length of the stenosed segment. We therefore decided not to resect the tracheostomy site to avoid excessive tension at the anastomatic site.

We did tracheal resection of completely obliterated segment of trachea along with subglottic remodeling in these cases. In one case a thyrotracheal anastomosis was

Fig. 5 Axial CT scan showing iliac crest graft lying anterior to the T-tube

done whereas in the other patency was primarily achieved by removal of granulations followed by cricoid framework expansion. Thyrotracheal anastomosis also has significant postoperative morbidity and decreased success rate when compared with cricotracheal anastomosis [8]. Both the cases suprahyoid laryngeal release was performed to avoid tension at the repair site. Grillo [9] noted that dysphagia was significantly less often encountered after suprahyoid release in comparison with thyrohyoid release. Paris et al. (1990) [10] recommended postoperative use of Montgomery stent and anterior resection of cricoid in cases of tracheal stenosis with subglottic involvement. Silicone is a relatively non-irritating substance which can be used for long term in human body and provides a good medium for re-epithelization of the tracheal wall. So, stent made from Montgomery's silicone tube was used to support the reconstructed segment in both of our cases.

Surgical management of severe laryngotracheal stenosis is always challenging. For reconstruction and expansion of laryngeal framework homografts of skin, mucous membranes, perichondrium, bone and periosteum have been tried but all are frequently dislodged and also lead to recurrent granulation of non-epithelialized airway. Kambic et al. used epithelialized microvascular iliac crest flap for reconstruction of subglottic and upper tracheal stenosis and found it very helpful. We used free iliac crest graft remodeled in concave shape to reconstruct cricoid cartilage. In one of the cases fibrin glue was used to support the graft at its position.

Conclusions

In complicated long segment laryngotracheal stenosis, tracheal resection and subglottic remodeling with primary anastomosis can be an alternative approach.

Fibrin glue can be used to support free bone/cartilage grafts in laryngotracheal reconstructions.

In both the cases described above we used remodeled iliac crest graft for subglottic framework expansion. Iliac crest graft has following advantages over other graft material:

- a) By scarping its cancellous portion it can very well be remodeled in a concave shape which is ideal for reconstructing the circular lumen of the larynx.
- b) The harvesting of iliac crest graft is easy.
- c) The incision is cosmetically acceptable especially in cases of females.

The take-up rate of the graft is good.

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