

Glottic reconstruction by implant of homologous laryngeal cartilages

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Abstract

This paper describes a case of reconstructive laryngectomy in a patient with epidermoid carcinoma of the glottis. Reconstruction of the skeletal laryngeal architecture was carried out by implanting homologous cartilages, whilst the glottis was reconstructed with sternohyoid muscle. Laryngeal function was restored within 30 days of the operation.

Key words: Transplantation, homologous; Laryngectomy.

Introduction

The surgical oncology of the larynx is well documented in its ablative aspects, including radical resection. This has stimulated the concept of reconstructive surgery with the aim of restoring laryngeal function. The success of various operations used to fulfil this purpose (Majer and Rieder, 1959; Bronchalo and Camara, 1975; Pech *et al.*, 1984) often depend on prolonged rehabilitation treatment (Guerrier and Guerrier, 1972; Komorn *et al.*, 1973; Panje, 1981; Ogura *et al.*, 1982).

In 1987, Alvarez introduced a laryngectomy followed by implantation of homologous cartilages (thyroid and cricoid) for the reconstruction of a neo-larynx (Alvarez *et al.*, 1987). The greatest practical difficulty of this procedure is the range of legislative regulations in different countries concerning human transplants. For example, in Italy a decree, by personal permission from the Minister of Health, is required. In this paper we describe a successful reconstruction of a functioning larynx after total laryngectomy.

Materials and methods

Procedure for sampling and preserving laryngeal cartilages

Total laryngectomy is carried out on fresh cadavers (during the removal of other organs for transplantation and includes removal of the thyroid and cricoid cartilages together with the first tracheal ring. The surgical specimens are placed in sterile physiological solution with antibiotics for 30 minutes under sterile conditions in a laminar flow cabinet. After removing the perichondrium, the cartilages are placed in a 10 per cent solution of glycerol to protect against low temperature and then kept for 18 hours at 4°C and frozen slowly from -20° to -70°C. Samples preserved in this manner may be used for from 15 days to one year (Zalzal *et al.*, 1986).

The donor, a 34-year-old woman who died of cerebral haemorrhage, was hepatitis B and C and HIV negative.

Her blood group was O Rh negative and she was not affected by any neoplasm.

Patients suitable for this procedure should have large solid glottic tumours for which total laryngectomy is thought to be appropriate.

Case report

A 57-year-old man presented with a moderately differentiated epidermoid carcinoma of the larynx involving the right arytenoid, true vocal fold and ventricle, as well as, the anterior commissure and the anterior third of the left vocal fold.

Surgical procedure

The neck was bilaterally incised from the mastoid process to the suprasternal notch along the external margin of the sternocleidomastoid muscles. This incision permits a neck dissection as well as total laryngectomy.

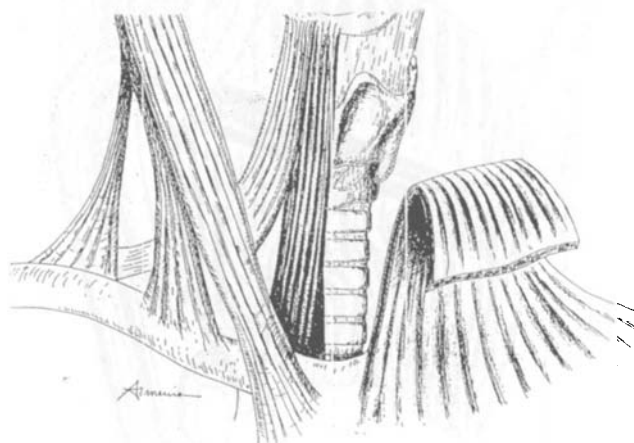


FIG. 1

Schematic representation of the muscular structures as prepared for reconstruction of the larynx.

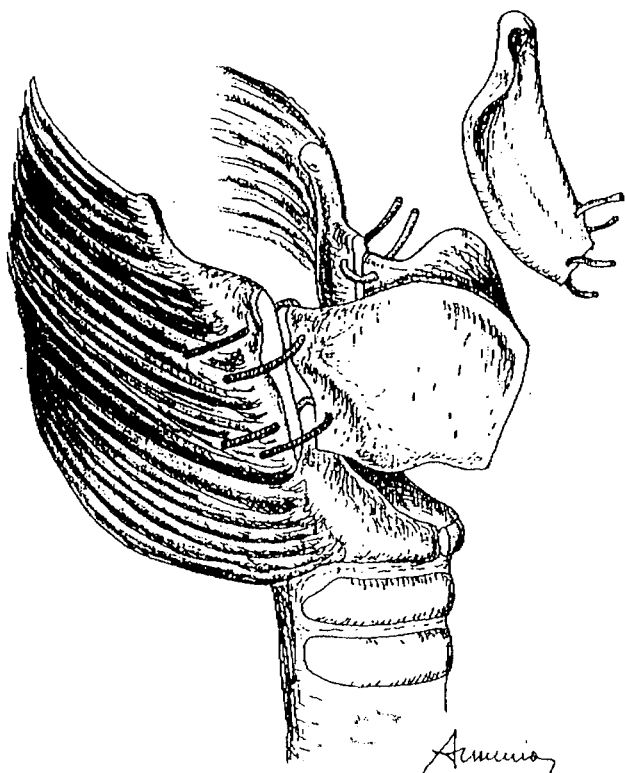


FIG. 2
Reconstruction of the laryngeal structure.

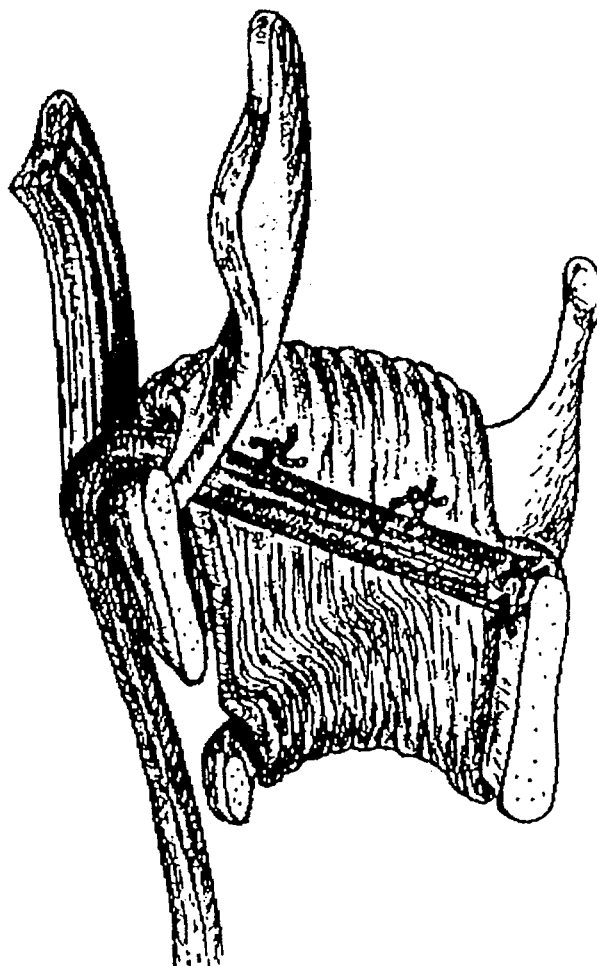


FIG. 4
Left side: linking of the new 'vocal fold' on the implanted portion of the cricoid.

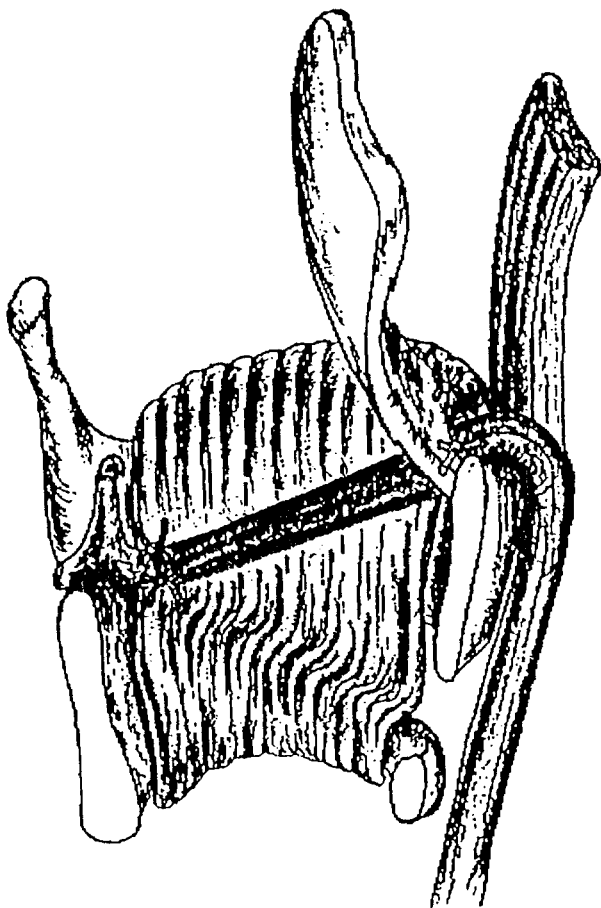


FIG. 3
Cut away view of the right side showing attachment of the new 'vocal fold' to the vocal process of the residual arytenoid.

The platysma muscle is divided in its midline to obtain two symmetrical halves. The same muscle is also divided in its superior part in the proximity to the hyoid bone and is kept ready for covering the homologous cartilage implant. The sternohyoid muscles are then detached from their superior insertion. The superior laryngeal artery and vein are ligated before penetrating the thyrohyoid membrane; care being taken to preserve the superior laryngeal nerve. A tracheotomy is then carried out at the level of the third tracheal ring. This stoma can be closed in about 30 days. The superior margin of the thyroid cartilage is identified and incised. The epiglottis is identified and divided at the level of its superior third.

The thyroid cartilage that is to be removed is cut on both postero-lateral aspects with a circular saw and removed, including the endolaryngeal tissues and therefore the neoplasm. If possible, 2-3 mm of the posterior border, with the insertion of the pharyngeal constrictor muscle, are saved. The extent of the tumour as determined intra-operatively by frozen section will determine whether total or partial excision of the cricoid ring is indicated (Figs 1 & 2).

The reconstruction begins with insertion of a metallic suture to fix the donor's cricoid ring to the remaining portion of the recipient cricoid ring in order to ensure continuity and integrity of the airway. The thyroid cartilages to be

implanted are trimmed to the correct size and attached to the recipient's remaining thyroid cartilage (as shown in Fig. 2). The newly placed cartilage is then covered with the two halves of the platysma muscle. Reconstruction of the neoglottis is made by using the sternohyoid muscles which penetrate across the superior incision of the thyroid cartilage into the endolarynx. They are fixed to the new anterior commissure and to the vocal process of the original arytenoid or to the cricoid ring (Figs 3 & 4). The superior third of the epiglottis is stitched to the thyroid cartilage of the donor larynx and the wound is closed, after insertion of a stent in the laryngeal lumen which is kept in place for 20 days.

In this case functional restoration of phonation and swallowing occurred within 30 days, after which endoscopic evaluation showed perfect re-epithelialization.

Conclusions

The partial or total substitution of the laryngeal architecture with homologous cartilage seems to be a good basis for performing laryngeal reconstruction after a total or subtotal laryngectomy (Alonso, 1961; Alvarez *et al.*, 1987). The fundamental purpose of this procedure is to re-establish the anatomical link between the various components of the larynx in order to achieve three objectives:

1. The establishment of the pharyngo-laryngeal continuity in order to allow normal respiration.
2. The restoration of sphincter function during deglutition.
3. The possibility of making an endolaryngeal vibration mechanism by which a sound similar to the normal human voice can be produced.

The use of homologous cartilages guarantees the continuity and structure necessary to retain the laryngeal lumen, without the fear of necrosis from an immune reaction.

The sphincteric function during swallowing is guaran-

teed by the action of the constrictor pharyngeal muscles which having their natural insertion, with other muscles, allow the continued vertical movement of the larynx. These muscles are also responsible for the harmonic synchronization of swallowing.

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