Chapter 23
Laryngeal Transplantation

Robert R. Lorenz and Marshall Strome

23.1 History

The concept of human laryngeal transplantation was first introduced into the literature in the 1960s, with experiments using the dog model by Boles, Ogura, and Silver. In 1969, Kluyskens attempted to treat a laryngeal cancer by transplantation. This transplant was subtotal, preserving recipient perichondrium to revascularize the donor organ without the use of vascular or neural anastomoses. The rapid recurrence of the tumor quashed interest in the procedure for nearly two decades.

In 1987, the senior author initiated a program to explore the potential of a total larynx transplant. The program focused on four issues crucial to successful transplantation: revascularization, reinnervation, rejection, and the ethical issues of transplanting an organ that some consider “nonvital.” Utilizing the rat as a model for laryngeal transplantation, the maximum tolerated ischemia time was determined, preservative solutions were investigated, stages of histological rejection were defined, and immunosuppressive regimens were evaluated. On January 4, 1998, a team lead by the senior author performed a total laryngeal transplantation in a man who had sustained severe laryngeal trauma in a motor vehicle accident.

23.2 The Human Laryngeal Transplant

The recipient was a 40-year-old man who had suffered a crush injury to his larynx and pharynx during a motorcycle accident 20 years earlier. Despite multiple attempts at another institution to reconstruct his larynx, he remained aphonie and tracheostomal dependent. The patient underwent extensive pretransplant counseling including psychiatric evaluation, speech pathology testing, and four interviews with members of the surgical team. All of those involved agreed that the patient understood the risks and his motivation was appropriate. The procedure was approved by the Institutional Review Board of the Cleveland Clinic Foundation. After a 6-month search, a 40-year-old man, who was brain dead from a ruptured cerebral aneurysm, was identified as a suitable donor. He met all of
the predetermined criteria for acceptance in regard to HLA matching (4 of 5) and serum virology.

During the donor organ harvest, the entire pharyngolaryngeal complex, including six tracheal rings and the thyroid and parathyroid glands, was removed (Fig. 23.1). The organ complex was stored in the University of Wisconsin solution during transport until revascularization 10h later. Prior to surgery, the recipient patient received cyclosporine, azathioprine, and methylprednisolone. After surgical exposure of the patient’s severely deformed laryngeal structures but prior to their removal, perfusion to the donor organ was reestablished. The donor’s right superior thyroid artery was anastomosed to that of the patient, while the proximal end of the donor’s right internal jugular vein was anastomosed to the patient’s right common facial vein. Blood flow through the transplanted thyroid gland, six tracheal rings, larynx, and pharynx was observed within 30min of clamp release.

A narrow field laryngectomy was performed leaving the thyroid lobes lateralized and the hyoid bone in place. Seventy-five percent of the donor’s pharynx was used to widen the patient’s stenotic pharyngo-upper esophageal complex. The donor laryngeal cartilage was sutured to the hyoid bone for laryngeal elevation. Five tracheal rings were needed to reach the patient’s tracheostoma. The left-sided anastomoses, which included the donor superior thyroid artery to the recipient superior thyroid artery and the donor middle thyroid donor vein to the recipient internal jugular vein, were then completed. Both superior laryngeal nerves were located and reanastomosed, but only the recipient’s right recurrent laryngeal nerve could be located for reinnervation.

![Fig. 23.1](See Color Plates)