Effects of Neck Dissection and Radiotherapy on Short-Term Speech Success in Voice Prosthesis Restoration Patients

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Summary: Objective. To compare the short-term speech success of voice prosthesis (VP) among patients who underwent total laryngectomy or total laryngectomy in combination with neck dissection and those who received postoperative radiotherapy.

Materials and Methods. Thirty-two male patients treated for laryngeal squamous cell carcinoma were included. Nine patients underwent total laryngectomy and 23 underwent total laryngectomy combined with neck dissection, and 17 of the 23 with neck dissection were managed with postoperative radiotherapy (45–75 Gy). All of the patients had indwelling intraoperative placement of the Provox VP (Atos Medical AB, Horby, Sweden; and Entermed BV, Woerden, The Netherlands) at the time of the primary tracheoesophageal puncture (TEP) completed in conjunction with total laryngectomy. Patients with pharyngoesophageal myotomy and pharyngeal plexus neurectomy were excluded. Patients' speech success was perceptually evaluated 3–4 weeks after the surgery and 3–4 weeks after the cessation of radiotherapy, using a 1–3 scale (1 = failure to develop speech (aphonia); 2 = communicate with short phrases only; and 3 = communicate with fluency and long sentences).

Results. No complications were noted with intraoperative prosthesis placement. No prostheses were dislodged in the postoperative period. Eighteen of 32 patients (56%) demonstrated successful speech (rating of 3). Nine patients (28%) demonstrated less successful speech (rating of 2). Five patients (16%) were found to be aphonic ($P > 0.05$). Of the nine patients who underwent total laryngectomy only, six were found to have successful speech (66.6%), one (11.1%) was found to have less successful speech quality, and two (22.2%) patients were aphonic ($P > 0.05$). Of the six patients who underwent total laryngectomy in combination with neck dissection, three had successful speech (50%), one (16.6%) had less successful speech, and two (33.3%) were aphonic ($P > 0.05$). Of the 17 patients who received postoperative radiotherapy, nine (52.9%) had successful speech, three (17.6%) had less successful speech, and five (29.4%) were aphonic ($P > 0.05$).

Conclusion. Neck dissection and postoperative radiotherapy have no significant influence on short-term speech success in VP restoration patients. Primary TEP should be preferred in patients who have laryngectomy in combination with neck dissection and/or will have postoperative radiation therapy, as it provides early and successful voice restoration without interfering with radiation treatment and avoids a second surgical intervention.

Key Words: Laryngectomy–Neck dissection–Radiotherapy–Voice prosthesis–Perceptual voice evaluation.

INTRODUCTION

Advanced stages of the larynx and pyriform fossa cancers require total laryngectomy and postoperative radiation therapy. Loss of verbal communication after total laryngectomy reduces the quality of life and leaves the patient severely handicapped.[1,2] Prompt and effective voice restoration is critical for these patients. Voice restoration using a tracheoesophageal puncture (TEP) has become the current treatment of choice for postlaryngectomy speech rehabilitation.[1,3,4] A puncture between the posterior wall of the tracheostoma and the upper esophagus just below the cricopharyngeus is surgically created, and a voice prosthesis (VP) is inserted into the puncture. The VP is a one-way silicone valve that preserves the patency of the puncture and allows air to be shunted from trachea into the esophagus during expiration when the tracheostoma is externally occluded by the patient. Air passes through the pharyngoesophageal segment, setting the mucosa in vibration, and a sound wave is produced from this new vibratory source. The acoustic signal of the sound wave can then be shaped by resonation in the oral cavity and articulation of the tongue, teeth, and lips. Various VPs have been used over the past two decades to restore speech. The Provox VP (Atos Medical AB, Horby, Sweden; and Entermed BV, Woerden,The Netherlands) is currently one of the most commonly used types of VPs.[5]

Placement of a VP during primary puncture procedure allows for immediate use of TEP speech even when neck dissection and/or radiotherapy are needed. TEP speech from secondary VP placement procedure delays voice restoration by 6 weeks after total laryngectomy and 6–8 weeks or until the peristomal skin has recovered after postoperative radiation therapy.[6,7] With regard to long-term speech success, no significant influence of postoperative radiotherapy and primary or secondary VP rehabilitation has been found on speech quality.[7–9] Long-term speech success rate varies between 60% and 90%.[10] Short-

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term speech success in patients undergoing prosthetic vocal rehabilitation is less well defined. Several factors may influence the short-term speech success by interfering with the voice source (the vibrating mucosa of the pharyngoesophageal segment) and air shunt. Radiation therapy may cause lack of wound healing because of tissue necrosis, scar formation, and vascular impairment and may deteriorate the pliability of the pharyngoesophageal mucosa.[8] Radiation therapy may also lead to edema and inflammation in the posterior esophageal wall and peristoma. Addition of a neck dissection to laryngectomy may cause further venous and lymphatic blockage, which may lead to increase of the distance between the pharyngoesophageal segment and the anterior wall, and between the posterior and anterior esophageal walls beneath the segment. Either alone or by combination, these factors may cause lack of effective pharyngoesophageal segment vibration necessary to create sound. Secondly, they may limit the air shunt into the esophagus, the necessary power supply for voice production, because of the embedding of VPs in the tracheal or pharyngeal wall. If these factors considerably influence the short-term speech success in laryngectomized patients, then secondary VP rehabilitation may be a preferential procedure for them. Therefore, the present study aimed at analyzing the effects surgical procedure (total laryngectomy alone or in combination with neck dissection) and postoperative radiation therapy have on speech success rate.

MATERIALS AND METHODS

A retrospective medical chart review of all patients who underwent total laryngectomy with Provox VP voice rehabilitation between August 2005 and August 2008 at Taksim Education and Research Hospital Department of Otolaryngology in Istanbul, Turkey, identified 35 patients. As pharyngeal constrictor myotomy or pharyngeal plexus neurectomy would be confounding factors that can have effect on speech success and would cause a heterogeneity in the study population, patients who underwent myotomy or neurectomy were excluded from the study. Patients with pharyngectomy and those who could not be perceptually evaluated in the first postoperative month were also excluded, leaving a total of 32 patients eligible for the study.

All of the 32 patients were males with a mean age of 54 years (ranging from 28 to 80 years). Nine patients underwent total laryngectomy only, and 23 patients underwent total laryngectomy combined with neck dissection. Pharyngeal closure was performed with a conventional two-layer, muscle closure technique. The indwelling VPs were inserted at the time of primary TEP in conjunction with total laryngectomy. Seventeen of the 23 patients with neck dissection were managed with postoperative radiotherapy. These patients were treated with a continuous course of radiotherapy with once-daily fractionation, and the dose per fraction was usually 2 Gy. The range of dose was 45–75 Gy, and the mean treatment time of the course was 46 days.

The rehabilitation program began at the initial visit and included patient and family education regarding care of the prosthesis and patient instruction regarding accurate finger occlusion of the prosthesis while the patient watches in the mirror. Each patient's speech success was perceptually evaluated at 3–4 weeks after the surgery or 3–4 weeks after the cessation of radiotherapy using a scale of 1–3 (Table 1). The parameters that make up this scale were rated on 3 points (1 = failure to develop speech (aphonia); 2 = less successful speech with only short sentences; and 3 = successful speech with fluency and long sentences). The perceptual evaluations were performed by authors E.G., M.F.G., and O.N.D. These authors are experienced in TEP speech rehabilitation and perceptual voice evaluation. To avoid interindividual variability, authors' consensus was required for each patient for the final decision, and this consensus could be achieved in all cases. Factors of speech success, including type of surgery (total laryngectomy alone or in combination with neck dissection) and postoperative radiotherapy, were investigated. One-way analysis of variance test was used for comparison, and the statistical analysis was carried out by Statistical Package for Social Sciences for Windows version 11.0 (SPSS Inc., Chicago, IL). Level of statistical significance was considered at $P > 0.05$.

RESULTS

No complications were noted with intraoperative prosthesis placement. No prostheses were dislodged in the postoperative period. By means of perceptual evaluation, 18 of 32 patients (56%) demonstrated successful speech (rating of 3; $P > 0.05$); nine (28%) demonstrated less successful speech (rating of 2; $P > 0.05$); and five (16%) were found to be aphonic ($P > 0.05$) (Table 2). Effect of types of surgery on speech success was investigated, and, of the nine patients who underwent total laryngectomy only, six were found to have successful speech (66.6%), one (11.1%) was found to have less successful speech, and two (22.2%) were aphonic ($P > 0.05$). Of the six patients who underwent total laryngectomy in combination with neck dissection, three had successful speech (50%), one (16.6%) had less successful speech, and two (33.3%) were aphonic ($P > 0.05$).

Effect of radiotherapy on speech success was examined. Seventeen patients received postoperative radiotherapy, and nine (52.9%) of these patients had successful speech, three (17.6%) had less successful speech, and five (29.4%) were aphonic ($P > 0.05$) (Table 2). During follow-up, seven of these 17 patients were found to have leakage of saliva through or around the VP, and four patients were found to have peristomal inflammation. Our results indicate that radiotherapy caused edema and erytema around the tracheostoma and increased

TABLE 1.
Perceptual Evaluation of Speech Success

Speech Success	Speech Score
Failure of development of speech	1 (aphonia)
Communicate with short phrases only	2 (less successful)
Communicate with fluency and long sentences	3 (successful)