

# Voice Restoration with Low Pressure Blom Singer Voice Prosthesis after Total Laryngectomy

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The main problem after total laryngectomy is permanent loss of voice. Current methods of vocal rehabilitation after total laryngectomy include development of esophageal speech, use of artificial larynx, tracheoesophageal shunt operations and more recently surgical restoration of the voice with prosthesis. Primary voice restoration using Blom- Singer voice prosthesis after total laryngectomy and pharyngeal myotomy was performed in 187 patients between October 1992 and July 2000. There were 184 male and 3 female patients of average age 63.7 years (range 42-76). Mean follow up period was 62 months. Satisfactory speech was achieved in 156 patients (83.5%). During the follow-up period, we experienced complaints of insufficient voice in 31 (16.5%) patients, due to partial spasm in 17 and total spasm in the pharyngoesophageal segment in 14. Furthermore, 24 (12.8%) patients preferred esophageal speech or electro larynx because of low socioeconomic level. The overall success rate was 70.7%. In this study the results of the surgical technique and prosthesis insertion, as well as the associated complications and socioeconomic levels of the patients, are discussed.

**Key Words:** Laryngeal carcinoma, total laryngectomy, prosthetic voice restoration

## INTRODUCTION

Loss of voice has been considering the major problem after total laryngectomy for laryngeal carcinoma since Theodore Billroth performed the first laryngectomy in 1873. The inability to speak disrupts routine interaction with others, and re-

sults in considerable economic, social and psychological changes for the patients. Failure to adjust often leads to permanent disability, social withdrawal, and even more serious consequences.<sup>1</sup> For this reason there have been several efforts for voice rehabilitation over the last 100 years. Voice rehabilitation techniques include esophageal speech, artificial larynx, tracheoesophageal shunt operations and more recently surgical restoration of voice with prosthesis.<sup>2-4</sup> One of the widely known native methods of alaryngeal speech is esophageal speech. The success rate of esophageal speech ranges from 30 to 80 percent, but these rates and the resultant quality of speech do not usually satisfy the patients and surgeons. Prosthetic voice restoration was first popularized by Blom and Singer.<sup>2-5</sup> Insertion of voice prosthesis via tracheoesophageal fistula has provided a higher quality of life to the patients with total laryngectomy as well as decreasing psychosocial problems. This procedure, which used to be performed as a primary operation, is now thought to be more successful and productive when done secondarily. For this purpose Hamaker, et al started the application of the primary voice restoration technique in 1985.<sup>6</sup> This technique has enabled patients to talk just after the operation without the requirement for an additional procedure. Higher success rates (80-90%) were reported.<sup>4,6-8</sup> And perceptual, acoustical, and temporal studies indicate that tracheoesophageal puncture (TEP) speech is closer to laryngeal than to esophageal speech.<sup>5,9</sup> This study reflects our experience with the surgical technique and prosthesis inserted in patients with primary voice restoration.

Received January 2, 2003

Accepted April 23, 2003

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## MATERIAL AND METHODS

Total laryngectomy and primary voice restoration were performed in 187 patients between November 1992 and July 2000 at the ENT Department of the University of Ankara. There were 184 (98.4%) male and 3 (1.6%) female patients of average age 63.7 years (range 42-76). All of the patients had an initial pathologic diagnosis of squamous cell carcinoma.

Pharyngeal muscle myotomy, wide stoma reconstruction, and tracheoesophageal fistula were done during the operation as described by Hamaker and Blom. Myotomy was performed in the posterior midline from the level of the puncture site to the level of tongue base. A straight, posterior myotomy incision was made by scalpel to the level of the submucosa. The entire length was incised with great care to avoid entering the lumen of the pharynx. If this occurred, it was repaired with 4/0 vicryl suture.

Tracheoesophageal fistula function was estimated before voice prosthesis insertion. A low pressure Blom-Singer voice prosthesis was inserted in the patients whom had fluent and intelligible communication at the postoperative 12-15<sup>th</sup> day. It was also inserted in disfluent patients. Speech therapy was initiated for all patients. The ability to sustain phonation without interruption for 10 seconds and to count easily from 1 to 15 was considered to be fluent speech. The patients were followed up in the first postoperative month,

every three months for the first year, and subsequently every six months.

## RESULTS

Fluent and comprehensive speech was achieved in 156 (83.5%) of 187 patients. Twenty-four of these patients (12.8%) preferred esophageal speech and utilization of electro larynx due to their inability to look after their prosthesis. In 17 patients (9%) disfluent and unsatisfactory speech was observed because of partial spasm in the pharyngoesophageal segment or hypertonicity. These patients preferred esophageal speech. Fourteen (7.5%) patients were aphonic due to complete pharyngoesophageal spasm and started to use electro larynx. In our series the overall success rate of prosthetic voice restoration after total laryngectomy was 70.7% (Table 1).

Mean pressure on the stoma measured by manometric evaluation was 15 cmH<sub>2</sub>O (ranging 12 to 30 cmH<sub>2</sub>O) in patients who had fluent speech and 55 cmH<sub>2</sub>O (ranging 40-70) in the disfluent or aphonic group (Table 2). The average life span of low pressure Blom Singer voice prosthesis was 98 days. Complications related with the technique were postoperative fistula in 8% of the cases, infection in 3% and hematoma in 2%. Granulation at the TEP site was seen in 9 (5%) patients and granulation tissue was cauterized chemically. Aspiration of the prosthesis occurred in 2 patients

**Table 1.** Voice Rehabilitation Results of Total Laryngectomy

Speech	Failure	Preferred Rehabilitation
Fluent (n=156)		
132 (70.6%)	(-)	voice prosthesis
24 (12.8%)	inability to look after the prosthesis	esophageal speech or electrolarynx
Disfluent or aphonia (n=31)		
17 (9%)	hypertonicity or partial	spasmesophageal speech
14 (7.5%)	complete spasm	electrolarynx

**Table 2.** Mean Stomal Pressure of Patients with Fluent Speech and Disfluent Speech

	Number of patients	%	Mean pressure (cm H <sub>2</sub> O)
Fluent speech	156	83.5	15 (12-30)
Disfluent speech or aphonia	31	16.5	55 (40-70)

**Table 3.** Complications of Tracheoesophageal Puncture and Voice Restoration with Low Pressure Blom Singer Voice Prosthesis

	Number of patients	%
Postoperative fistula	15	8
Infection	6	3
Hematoma	4	2
Granulation tissue	9	5
Aspiration of the prosthesis	2	1
Swallowing the prosthesis	3	1.5

and these prostheses were recovered bronchoscopically. Three patients swallowed their prostheses and these were recovered endoscopically (Table 3). Fungal colonization on the prosthesis was ultimately the main reason for valve deterioration that causes leakage of saliva and fluids through and around the prosthesis.

Follow up ranged from 4 to 96 months with a mean of 52 months. Eight patients from other cities were lost to follow up at the early stage. Fourteen patients died from distant metastasis and local recurrences.

## DISCUSSION

Some surgical details should be complied when voice restoration after total laryngectomy is planned. We believe that the most essential of these is pharyngeal muscle myotomy. Constrictor muscle myotomy forms the basis of prosthetic voice restoration. Myotomy can be done primarily or secondarily, but fewer complications result when the former is employed. Pharyngeal constrictor muscle myotomy done during primary voice restoration is easier and safer than during secondary, and the quality and fluency of the speech is satisfactory both for the patient and the physician. In several studies, it was reported that the quality of esophageal speech had increased when myotomy was done during total laryngectomy.<sup>10-13</sup> Pharyngoesophageal muscle myotomy increases the quality of esophageal speech, even though a prosthesis is not inserted. Myotomy renders longer maximum phonation time and longer speech at each inspiration. Nevertheless a discrepancy exists regarding the place of myotomy in voice restoration with prosthesis. Mean

pressure on the stoma measured by manometric evaluation was 15 cmH<sub>2</sub>O in patients who had successful myotomy and 55 cmH<sub>2</sub>O in the unsuccessful group. These results showed that hypertonicity or spasm persisted in the pharyngoesophageal segment in the event of unsuccessful myotomy. It is reported that the rate of pharyngoesophageal spasm is 28-55% after total laryngectomy without myotomy.<sup>11,12</sup> The reason why the patients could not tolerate the voice prosthesis is nonfluent speech due to partial spasm in the pharyngoesophageal segment or hypertonicity. According to us, myotomy is the most important feature determining patient satisfaction with the speech after prosthetic voice restoration.

The fact that spasm could not be observed in patients who had no myotomy during total laryngectomy, could be explained by the neurectomy of the nerves innervating the pharyngoesophageal segment. In our series the ratio of unsuccessful myotomy was 16.5%. Speech quality was increased by a program of esophageal speech education undertaken by the patients with spasm.

The morbidity rate was 15-43% in the voice restoration done by tracheoesophageal fistula.<sup>8,14-18</sup> In our series the morbidity rate was 18.7%. These complications were pharyngocutaneous fistula (8%), infection (3%), prosthesis migration to the trachea (1.1%), swallowing the prosthesis (1.6%) and granulation tissue around the puncture site (5%).

Initially, a 2.2 or 1.8 F Blom-Singer low pressure voice prosthesis was used after the determination of the length of fistula. The length of the fistula diminished in 152 patients one month postoperatively. Similar results were reported by Sasaki, et al.<sup>19</sup> This can be explained by postoperative, tracheoesophageal wall edema. Fistula length decreases when edema diminishes and the pro-

sthesis becomes oversized. This causes saliva leakage around the prosthesis and deteriorates the speech. Fistula length should be remeasured and a prosthesis of appropriate length should be inserted in order to prevent the saliva leakage. When measurement of the size of the fistula tract confirmed no further change then an indwelling low pressure voice prosthesis was inserted. Fungal colonization on the valve causes valve deterioration and is another reason for prosthesis substitution. Mean substitution time was 2-3 months for the low-pressure prosthesis, and 9-12 months for the indwelling prosthesis.

The socioeconomic level of the patients plays an important role in the use of the voice prosthesis.<sup>20,21</sup> Twenty-four (12.8%) patients who were unwilling to maintain periodic care of their prosthesis and who substituted it due to unfavorable socioeconomic conditions preferred esophageal speech or electro larynx. An indwelling prosthesis can be an alternative and enables long term speech without the need for frequent substitution of the prosthesis.

Patients with low socioeconomic level also have difficulty with valve use. However, patients who are professionals of speech consider a valve to be indispensable. The initial 30% usage rate for the valve decreased to 15% due to economical reasons and difficulties encountered during application.

In conclusion, primary voice restoration with pharyngeal myotomy should be considered as the gold standard for patients undergoing total laryngectomy.

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