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Improved Tracheoesophageal Prosthesis Sizing in Office-Based Tracheoesophageal Puncture

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Objectives: Tracheoesophageal puncture (TEP) for postlaryngectomy speech is increasingly being performed as an office-based procedure. We review our experience with office-based TEP and compare outcomes with those of operating room–based TEP. Our hypothesis was that office-based TEP results in improved prosthesis sizing, reducing the number of visits dedicated to prosthesis resizing.

Methods: A retrospective chart review was performed of all patients who underwent secondary TEP at our institution from 2001 to 2008. The primary dependent measure was the change in the length of the voice prosthesis. We also evaluated the number of visits made to the speech-language pathologist for resizing before a stable prosthesis length was achieved, and the number of days between voice prosthesis placement and the date a stable prosthesis length was observed.

Results: Thirty-one patients were included in this study. There was a significant difference in prosthesis length change between patients who had office-based TEP and patients who had operating room–based TEP ($p < 0.001$). In addition, the office-based cohort required fewer visits to the speech-language pathologist for TEP adjustments before a stable TEP length was achieved ($p < 0.001$).

Conclusions: Voice prosthesis sizing was better in patients who had office-based TEP than in patients who had operating room–based TEP. This outcome is likely due to the lesser degree of swelling of the tracheoesophageal party wall in the office-based procedure.

Key Words: laryngectomee, tracheoesophageal speech, voice prosthesis.

INTRODUCTION

Tracheoesophageal speech is typically the most effective and preferred method by which speech can be achieved in an alaryngeal patient, because functional esophageal speech is difficult to attain and electrolarynx speech sounds unnatural.[1] To achieve tracheoesophageal speech, a tracheoesophageal puncture (TEP) is surgically created at the level of the tracheostoma and a voice prosthesis is inserted through the fistula into the esophagus. Secondary TEP traditionally has been performed in the operating room (OR). After the TEP is created in the OR, a rubber catheter is inserted through the fistula and the patient then visits a speech-language pathologist (SLP) 3 to 5 days later to have the voice prosthesis inserted. The delay between the TEP procedure and voice prosthesis placement is typically chosen to allow the fistula to mature. In addition, several revisions of prosthesis size are typically necessary to achieve stable tracheoesophageal prosthesis length, because the tracheoesophageal party wall thickness fluctuates as postoperative swelling resolves.[2,3]

Recently, office-based unsedated transnasal esophagoscopy has become possible with the development of small-diameter flexible endoscopes with working channels that can be passed through the nasal cavity to the esophagus and stomach.[4] This has allowed for the possibility of office-based unsedated TEP.[5-9] In performing in-office TEP, a transnasal esophagoscope is used to view the esophageal lumen and specifically the tracheoesophageal party wall site on which the puncture will be performed.[5] The fistula is created surgically, and a voice prosthesis is placed immediately. We have adopted this technique at our institution, as we find distinct advantages to office-based secondary TEP, including a shorter procedure time, the ability to perform the procedure under local anesthesia, and the placement of the voice prosthesis during the same clinical visit that the TEP procedure is performed, allowing the

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possibility that the patient may be able to use his or her voice immediately.[10,11] In addition, the SLP can provide input regarding the position of the TEP site, and both the surgeon and the SLP can troubleshoot any problems with the tracheoesophageal speech together immediately after prosthesis placement. For example, prosthesis placement can be directly visualized, or can be checked immediately afterward if there is any question regarding its position.

Although office-based TEP is being embraced for its obvious advantages, the results of this technique on patient outcome have not been evaluated, particularly in comparison to OR-based secondary TEP. The objective of this study was to review our experience with office-based TEP and compare the outcomes with those of OR-based TEP. Traditionally, several prosthesis-resizing procedures are required to achieve a stable voice prosthesis size after TEP.[2,12] On the basis of our initial experience, we hypothesized that improved TEP sizing would be achieved in the in-office TEP patients and that fewer resizing visits would be required to achieve a stable prosthesis size. A retrospective review of all patients who had office-based TEP was performed, and the findings were compared with those of a cohort of patients who had OR-based TEP.

METHODS

This study was approved by the Institutional Review Board of the University of California, Los Angeles. A retrospective chart review was performed of all patients who underwent secondary TEP at our institution between January 2001 and January 2009.

Patients who required free-flap pharyngeal or pharyngoesophageal reconstruction were excluded from this study. Because we have experienced difficulty visualizing the procedure site while using transnasal esophagoscopy in patients who have undergone such reconstruction, these individuals undergo TEP in the OR under general anesthesia.

The same SLP performed insertion of the voice prosthesis and provided all follow-up care in all patients in both cohorts. The same surgeon performed all office-based TEP procedures. The OR-based TEP procedures were performed by several different surgeons; however, the technique used was identical in all patients.

The primary dependent measure was the change in voice prosthesis length, which was defined as the difference between the voice prosthesis length at the initial placement after TEP and the patient's final, stable prosthesis length. In review of the data for each cohort, those patients whose prosthesis size remained stable over 2 resizing visits appeared to maintain a stable prosthesis length thereafter. The stable prosthesis length was therefore defined as the length in millimeters at the time the prosthesis size remained unchanged over 2 consecutive resizing visits to the SLP. We also evaluated the number of visits made to the SLP before achievement of a stable prosthesis length, and the number of days from the voice prosthesis placement date to the observed date of stable prosthesis length. The day of prosthesis placement was counted as day 0 and visit 0 for both groups; thus, visit 1 was the first visit after prosthesis placement for both groups.

Mann-Whitney U tests compared the OR-based and the office-based TEP groups for T-stage and each of the primary and secondary parameters. A 1-way analysis of variance tested the difference of age between the means for both groups. The presence or absence of postoperative radiotherapy and a history of irradiation failure (prelaryngectomy irradiation) were evaluated with χ^2 analysis.

Office-based TEP was performed as follows. The nasal cavity was topically decongested with 1% phenylephrine and anesthetized with 4% lidocaine hydrochloride. After achievement of adequate topical anesthesia, a transnasal esophagoscope was passed through the nasal cavity into the esophagus. The esophagus was insufflated, and the proposed puncture site was located. The puncture site was located by inserting a 25-gauge needle from the tracheostomal side (approximately 5 mm below the superior-midline mucocutaneous junction) into the esophageal lumen. The puncture was then serially enlarged with an 18-gauge needle, a cruciate stab incision made with a No. 11 knife blade, and a curved hemostat. The puncture was then dilated with an 18F TEP dilator. The party wall was sized with a voice prosthesis sizer, and the voice prosthesis was inserted with a gel-cap insertion system. The prosthesis was oversized by 2 mm to allow for anticipated postprocedure party wall swelling.

The first few patients underwent voice prosthesis placement under direct visualization. In our current practice, we do not routinely place the prosthesis under direct visualization. Instead, after the puncture is made and the placement of the TEP dilator is confirmed, the endoscope is removed. The voice prosthesis is then placed according to the standard technique by the SLP. Thus, voice prosthesis placements for the office-based and OR-based procedures are similar. Rarely, the SLP requests repeat endoscopy if there is a question regarding placement, such as suboptimal speech. In no instance did repeat endoscopy lead to a change in voice prosthesis length.

TABLE 1. PATIENTS WITH OFFICE-BASED TRACHEOESOPHAGEAL PUNCTURE

Age (y)	*Sex*	*History of Irradiation*	*T Stage*	*Prosthesis Length Change (mm)*	*Visits to Achieve Stable Size*	*Days to Achieve Stable Size*
51	M	Post	4	0	2	31
51	M	Post	4	–4	1	17
55	F	Both	2	0	0	0
62	F	Pre	4	–2	1	4
64	M	Pre	4	0	0	0
68	M	Pre	2	0	2	57
71	M	Pre	2	–2	1	18
75	M	Pre	2	0	0	0
78	F	Post	4	0	0	0
81	M	Pre	1	0	0	0
81	M	Pre	3	–2	1	21
82	M	Pre	2	–2	2	20
83	F	Post	3	0	0	0

Pre — prelaryngectomy; post — postlaryngectomy; both — both prelaryngectomy and postlaryngectomy.

Operating room–based TEP was performed as follows. With the patient under general anesthesia, a rigid esophagoscope was inserted through the oral cavity and advanced to the puncture site at the esophagus. The puncture site was first located in a manner similar to that of office-based TEP with a 25-gauge needle. A 16F Peel Away introducer set (model G04500 C-PLI-16.0-38, Cook Medical, Bloomington, Indiana) was then used to make the puncture and insert a 14F red rubber catheter through the puncture. The Peel Away introducer set is a wire-guided dilator and sheath placement system that allows placement of a variety of catheters through the sheath. In brief, once the TEP site was chosen, the guidewire needle was inserted through the party wall and visualized in the esophagus. The guidewire was inserted through the needle, passed rostrally, and grasped at the mouth. The guidewire needle was removed, and the 16F dilator was passed over the guidewire to make the TEP. The dilator was removed and attached to the Peel Away sheath, and both were reinserted via the guidewire into the esophagus and passed rostrally. The dilator and guidewire were removed, leaving only the Peel Away sheath in place. A 14F red rubber catheter was then inserted through the sheath and grasped at the mouth while the sheath was peeled away and removed. A second red rubber catheter was inserted through 1 nostril, advanced to the oropharynx, and then brought out to the mouth. This was then tied to the TEP catheter at the level of the oropharynx. The other 2 ends of the catheters outside the body were also tied, thus creating a continuous ring of catheter through the TEP, up the pharynx, and out the nose.

TABLE 2. PATIENTS WITH OPERATING ROOM–BASED TRACHEOESOPHAGEAL PUNCTURE

Age (y)	*Sex*	*History of Irradiation*	*T Stage*	*Prosthesis Length Change (mm)*	*Visits to Achieve Stable Size*	*Days to Achieve Stable Size*
44	M	Post	3	–2	2	76
44	M	Pre	3	–6	3	42
47	F	Pre	2	–6	2	20
51	M	Pre	3	–6	3	83
51	M	Post	3	–8	2	8
56	M	Pre	2	–8	2	27
58	M	No	4	–2	2	31
59	M	No	3	–6	3	45
60	F	Pre	2	–6	3	34
63	M	Post	1	0	0	0
63	M	No	2	–4	3	33
65	M	Pre	2	–4	2	42
67	M	Pre	2	–7	2	28
68	F	Unknown	2	–2	2	10
74	M	Post	3	–6	3	37
75	M	Pre	3	–6	3	36
75	M	Pre	4	–6	3	48
79	M	Pre	3	0	0	0

In follow-up with the SLP 3 to 5 days later, the voice prosthesis was sized and placed in a manner identical to that of the in-office TEPs. However, the prosthesis for this group was placed without oversizing, because any anticipated postoperative swelling would have already occurred.

RESULTS

Thirty-one patients were included in this study. Eighteen patients (58%) underwent secondary OR-based TEP, and 13 patients (42%) underwent office-based TEP. The median age was 61 years (range, 44 to 79 years) for the OR-based cohort and 69 years (range, 51 to 83 years) for the office-based cohort. Fourteen patients (78%) in the OR-based cohort and 10 patients (77%) in the office-based cohort had a history of previous radiotherapy. Successful tracheoesophageal speech was achieved in all patients. In addition, the procedure was tolerated well by all patients in each group, and there were no complications.

There was a significant difference in the distributions of the primary outcome measure of voice prosthesis length change between the 2 groups (Mann-Whitney U, 206.0; degrees of freedom [*df*], 1; $p < 0.001$; Tables 1 and 2). Secondary outcome measures were also significantly different between the 2 groups. The distribution of the number of visits for the office-based cohort prior to achieving a stable prosthesis length was significantly smaller than that of the OR-based cohort (Mann-Whitney U, 32.0; *df*,

1; $p < 0.001$). The distribution of the number of days needed to achieve a stable prosthesis length was also significantly shorter for the office-based cohort than for the OR-based cohort (Mann-Whitney U, 49.0; *df*, 1; $p < 0.01$). The duration between appointments was not controlled, but on average patients returned for resizing every 2 to 3 weeks. The 2 groups did not differ significantly in the distributions of T-stages (Mann-Whitney U, 132.0; *df*, 1; $p > 0.5$), nor was the difference in age significant ($F[1,29] = 4.11$; $p > 0.05$). The incidences of prelaryngectomy radiotherapy and postlaryngectomy radiotherapy were also not significantly different ($\chi^2[1] = 0.343$; $p > 0.05$ and $\chi^2[1] = 0.782$; $p > 0.05$, respectively).

DISCUSSION

In comparing patients who underwent secondary OR-based TEP and those who underwent office-based TEP, significant differences exist in our patient sample. The finding of clinical importance is the difference in the overall change in the size of the TEP prosthesis between the 2 groups (Table 1). We demonstrated a greater change in prosthesis size in the OR-based cohort. This suggests increased postoperative party wall swelling with secondary OR-based TEP. The main difference in surgical technique between the 2 groups is the use of a red rubber catheter to stent the tracheoesophageal fistula for several days after OR-based TEP. Movement of the red rubber catheter with deglutition and head and neck movement may contribute to frictional irritation and a subsequent increase in inflammatory tissue expansion of the party wall in this patient subset. A commonly reported interval between secondary OR-based TEP and prosthesis placement is 3 to 5 days; however, longer intervals have been discussed in the literature.[13] Although our prosthesis placement is earlier than that reported in some studies, we would expect an increase in irritation and party wall expansion with a longer post-TEP interval. Overall, our OR-based group had the typical course of prosthesis resizing and prosthesis length change that has been reported by others.[2,14] However, we find that the initial fit of the prosthesis is quite accurate in the office-based TEP procedure. In the office-based procedure, we oversized the prosthesis length by 2 mm because we anticipated some postoperative swelling. Interestingly, we find that this initial fit was the final prosthesis length for 8 of the 13 patients, and the final size was 2 mm less than the initial fit in 4 others (Table 1).

It is reasonable to suspect that fewer visits may be required to downsize the prosthesis to its final size if the tracheoesophageal party wall at the TEP site develops less postoperative edema. Indeed, our data demonstrate significantly fewer visits and less time to stable prosthesis size for the office-based TEP group than for the secondary OR-based group (Tables 1 and 2). Although we found a statistical difference between the 2 groups in these secondary outcomes parameters, we note that we did not control the timing of postoperative visits, which may have been affected by a variety of uncontrolled factors. Nevertheless, a follow-up interval of typically 2 to 3 weeks was required until a stable prosthesis size was achieved. We followed this practice in our patients who had office-based TEP, as well. We have now changed the follow-up interval for patients who have office-based TEP to 3 to 4 weeks after initial prosthesis placement, as we find that these patients require less-frequent visits for prosthesis resizing.

CONCLUSIONS

Previously highlighted advantages of office-based TEP include shorter operative time, the ability to perform TEP under local anesthesia, and the possibility of tracheoesophageal speech immediately following the procedure. Thus, many otolaryngologists are adopting this surgical technique. We find that the patient outcomes are improved, as well. Specifically, this study finds that patients who undergo office-based TEP have less change in voice prosthesis length than do patients who undergo OR-based TEP. This is likely due to less party wall swelling with the office-based TEP technique. This study suggests that patients who undergo office-based TEP will therefore require fewer clinic visits for voice prosthesis resizing. However, a prospective study controlling the timing of postoperative visits would be necessary to fully support this hypothesis.

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