

VIDEORADIOGRAPHY OF FREE JEJUNAL GRAFTS FOR REHABILITATION OF SPEECH IN LARYNGECTOMIZED PATIENTS

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Abstract

In laryngectomized patients a tracheo-esophageal artificial fistula can be used to achieve air flow from the trachea to the esophagus during speech. A one-way plastic valve is often used for the fistula. A free jejunal graft between the trachea and the esophagus can also be used. To avoid aspiration the transplant is attached to the submental area giving the graft a siphon-like shape. We performed 23 videoradiographic examinations using high-density barium in 14 such patients. The aim was to evaluate the protective function of these grafts against aspiration.

Penetration of the bolus and a small amount of residual contrast material in the ascending limb of the graft was a normal finding. If the standard barium bolus reached the descending limb at any time during the examination, this was a sign of aspiration hazard. To avoid aspiration, the vertex of the speech siphon should be higher than the level of the hypopharyngeal anastomosis.

Key words: Larynx, surgery; videoradiography; speech; pharynx.

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Esophageal speech or electric speech aids are commonly used for vocal rehabilitation after total laryngectomy. A number of surgical techniques have also been developed for rehabilitation of the voice since BILLROTH performed the first laryngectomy in 1874. The fundamental concept behind all these surgical procedures is to create a tracheohypopharyngeal or a tracheoesophageal shunt. This has been done without (4-8) as well as with a voice prosthesis (1-3, 9). The ideal prosthesis is one that permits valve-like injection of air into the pharynx in order to produce phonation, and yet prevents aspiration. Well-known contemporary methods

such as the STAFFIERI fistula (9) and prosthetic shunts (5-8) have shown good results with respect to phonation. However, a major disadvantage of these methods is the high rate of aspiration, because a liquid bolus or pieces of solid food manage to cross the shunt (4).

In the surgical technique devised by EHRENBERGER et al. (4) a free autologous graft was anastomosed like a siphon between the trachea and the hypopharynx, the peristalsis directed to the hypopharynx (Fig. 1). Fixing the graft to the floor of the mouth made it look like a siphon. A relatively narrow hypopharyngeal anastomosis, the

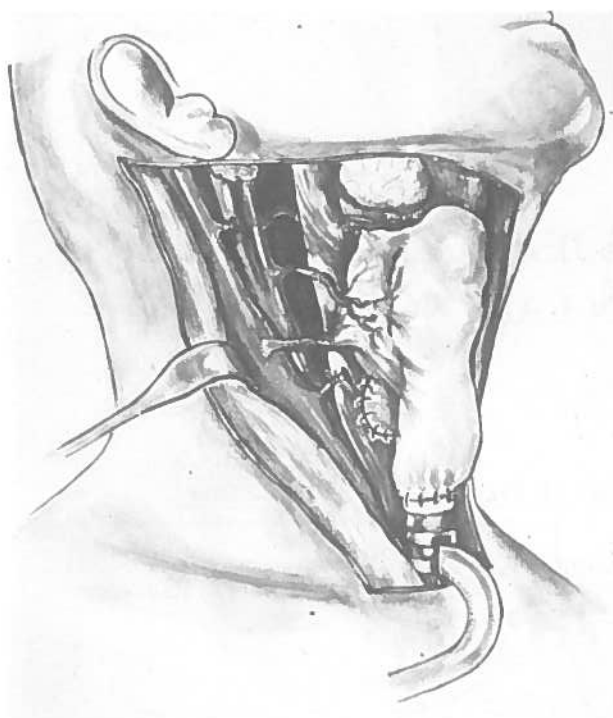


Fig. 1. Schematic drawing of the transplanted jejunum as a speech siphon between the trachea and the hypopharynx (Published with permission, ref. 4.).

siphon-like course and the direction of the peristalsis of the graft are considered to protect against aspiration. By blocking the tracheostoma with a finger or a valve all the expired air can be used for speaking (Fig. 2).

The aim of this study was to examine by videoradiography the protective function of these speech siphons against aspiration.

Material and Methods

Twenty-three videoradiographic examinations were performed with high-density barium in 14 patients (13 male, 1 female, mean age 52 years). The interval between the examination and surgery varied between 4 months and 6 years. Clinically 2 of the 14 patients presented with symptoms of recurrent aspiration but without any evidence of pneumonia. The examinations were performed with a Siemens Sirecord X video recorder on a Siemens Pantoscope fluoroscopic unit. For contrast high-density barium (Prontobarium HD, Gerot Pharmaceuticals, Vienna, Austria) was used. The size of the bolus (15 ml) was identical in all patients. The act of swallowing was documented by video in lateral and frontal projections. Conventional pharyngograms were also obtained. The following parameters were evaluated (Fig. 3):

A) The extent of bolus penetration from the hy-

popharynx into the graft: 0=No bolus penetration; 1=Bolus penetration only into the ascending limb of the speech siphon; 2=Bolus penetration into the descending limb; 3=Bolus penetration into the trachea (aspiration).

B) Residual contrast medium after bolus penetration: 0=No residual contrast medium; 1=Residual contrast medium in the ascending limb of the speech siphon; 2=Residual contrast medium in the descending limb of the siphon; 3=Residual contrast medium in the trachea.

C) The minimal distance between the vertex of the speech siphon and the level of the hypopharyngeal anastomosis (Fig. 4): this distance defines the level in millimeters at which the speech siphon acts as a barrier against penetration of contrast medium into the descending limb and simultaneously into the trachea. The minimal distance varies during deglutition, because of soft tissue movements. In our measurements the term 'minimum' means the smallest distance, occurring during the act of

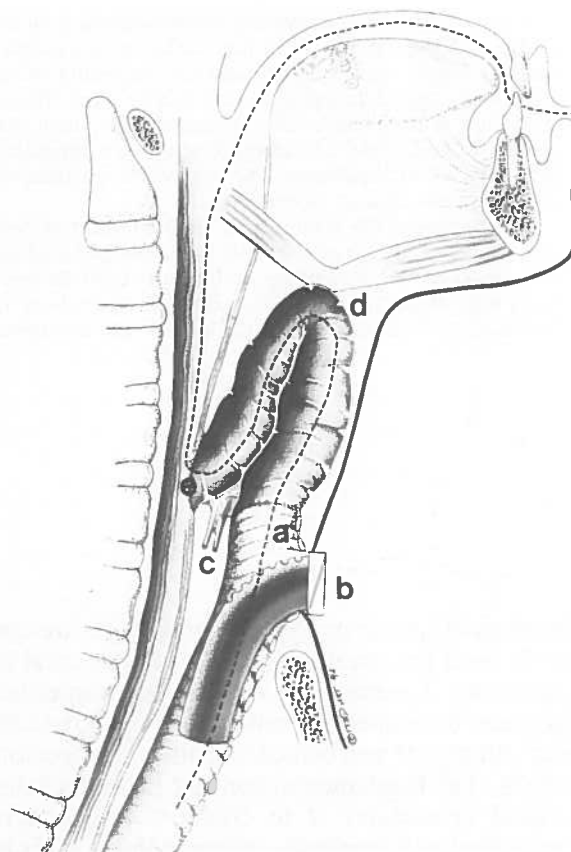


Fig. 2. Function of the speech siphon. --- Path traversed by the exhaled air during phonation. a=tracheal anastomosis; b=tracheostoma (blocked by finger or valve during phonation); c=vascular anastomosis; d=fixing of the graft to the floor of the mouth=vertex of the siphon; e=hypopharyngeal anastomosis.

swallowing. In other words, it expresses the weakest moment of the protective function of the speech siphon against aspiration. This distance was measured on the screen in lateral projection and the values derived were compared to the posterior-anterior diameter of the third cervical vertebra. Further calculations were performed in relation to the posterior-anterior diameter of the third cervical vertebra on conventional roentgen films. These measurements were converted into millimeters by assuming a mean enlargement factor of 1.3.

Results

A. Bolus penetration. Two of 14 patients showed clinical signs of aspiration. The remaining 12 were asymptomatic as regards aspiration. In 10 (83%) of 12 asymptomatic patients the bolus penetrated only into the ascending limb of the speech siphon. One patient showed no penetration of contrast medium into the siphon. In 1 asymptomatic patient

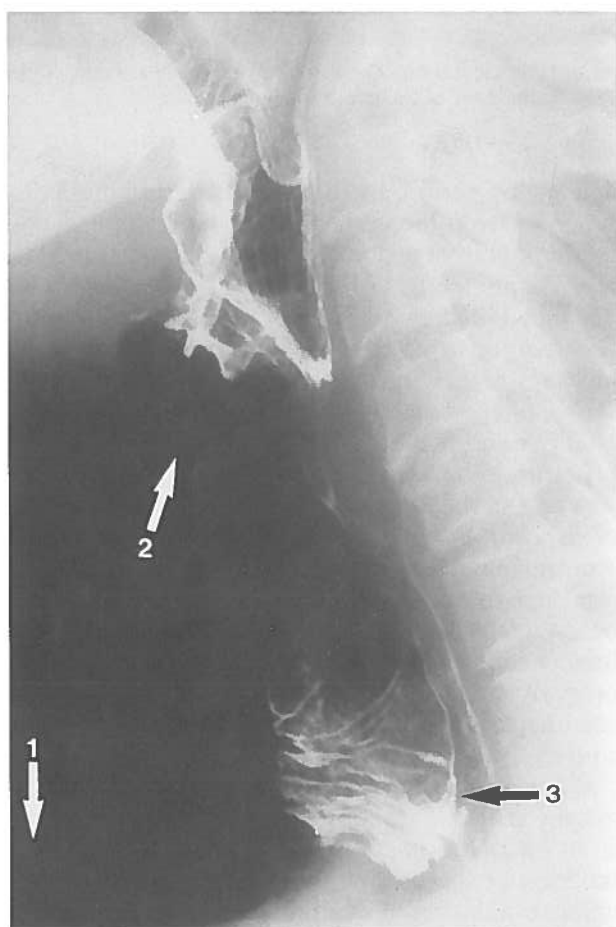


Fig. 3. Lateral radiogram of a normal speech siphon with air insufflation during phonation. 1. Level of the tracheostoma; 2. vertex of the siphon; 3. hypopharyngeal anastomosis.



Fig. 4. Black line marks the minimal distance between the hypopharyngeal anastomosis and the vertex of the speech siphon.

and in both patients with clinically established aspiration, the bolus penetrated up to the descending limb of the speech siphon. The standard bolus of 15 ml high-density barium did not cause aspiration in the bronchial system in any patient, including the 2 patients with known postoperative chronic aspiration.

B. Residual contrast medium: After deglutition 3 of the patients showed no residual contrast medium in the speech siphon, whereas 10 patients did. In these patients the penetration of contrast medium was limited to the ascending limb of the siphon (Fig. 3). One patient had residual contrast medium in the descending limb after deglutition and showed clinical signs of aspiration.

C. Minimal distance between the vertex of the speech siphon and the hypopharyngeal anastomosis: The minimal distance was zero in the 2 patients who showed clinical signs of aspiration. Hence there was no siphon-like barrier in these 2 patients (Figs 5, 6).

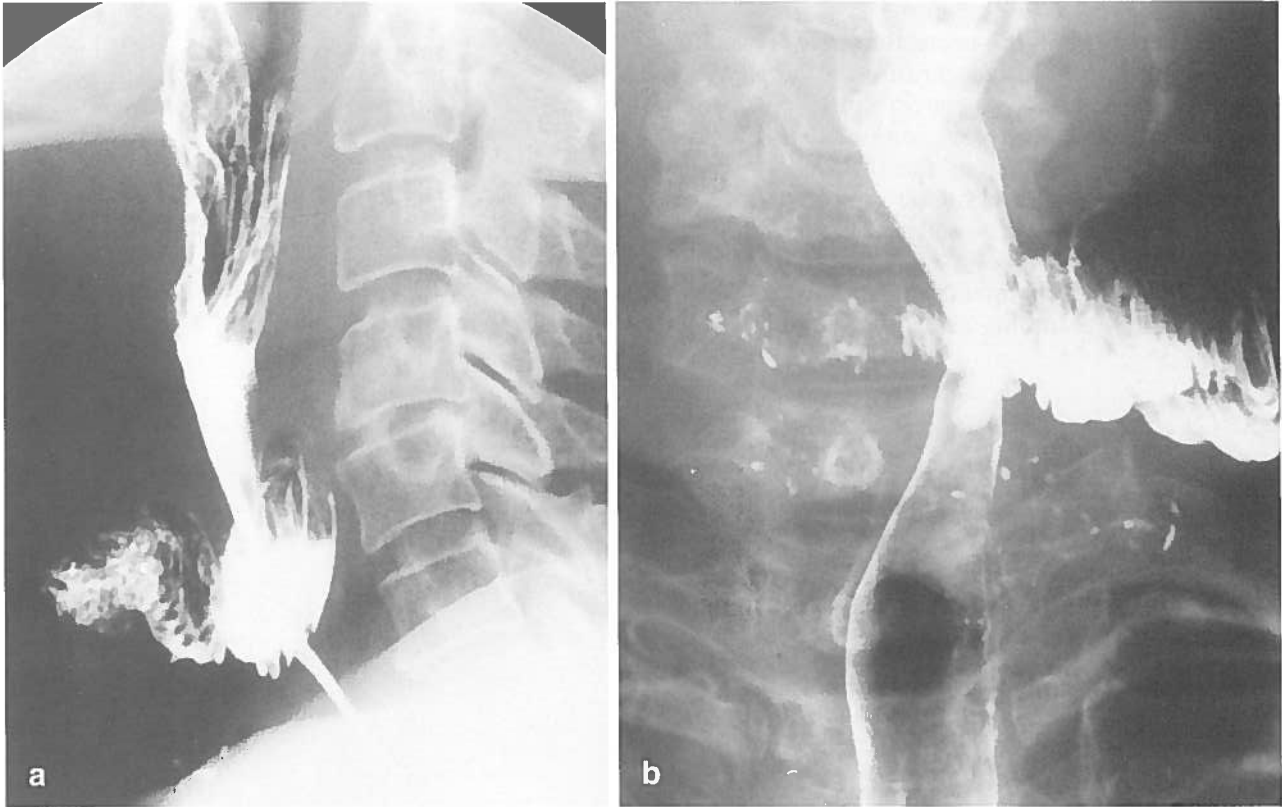


Fig. 5. a) Lateral and b) frontal images of a patient who had clinical signs of aspiration. The distance between the vertex of the siphon and the hypopharyngeal anastomosis is not measurable. Fixation to the floor of the mouth was inadequate.

The remaining 12 patients showed minimal distances from 17 mm up to 46 mm, mean 2.5 ± 0.8 mm).

Discussion

Videoradiographic examination of the protective function of speech siphons shows that a small contrast medium bolus penetrates the ascending limb of the siphon in almost all clinically normal patients. It is important to note that our results are based on a standard bolus of 15 ml high-density barium. If a standard bolus of this size reaches the descending limb at any time during swallowing, this is a sign of aspiration hazard for bigger boluses as well as for lower viscosity fluids, e.g., beverages.

Most of the clinically normal patients were shown to have a small amount of residual contrast medium in the ascending limb of the siphon. This means that in most cases a small amount of the contrast medium that has penetrated the graft remains there during the examination, which apparently is a harmless condition.

In addition to the documentation of swallowing a standard barium bolus, the investigation of the topography of speech siphons also provides valuable information about the ability to protect

against aspiration. Evaluation of the minimum distance between the vertex of the speech siphon and the hypopharyngeal anastomosis demonstrates the actual siphon effect of this surgical technique. This distance indicates the height a bolus has to overflow before aspiration may occur. If there is no measurable distance it means that only the peristalsis of the siphon in the direction of the hypopharynx and the air flow during phonation prevent penetration into the trachea. The minimal distance was zero in the 2 patients who showed clinical signs of aspiration. This means that the vertex of the speech siphon was at the level of the hypopharyngeal anastomosis. In 1 of these patients it could be established clinically and by comparison with former films that the transplant was not fixed properly to the floor of the mouth. So the graft was displaced caudally, disturbing its siphon-like course.

Our results lead to the *conclusion* that videoradiography using a standard barium bolus of 15 ml is an adequate method to examine the protective function of speech siphons against aspiration. Dynamic evaluation of deglutition can demonstrate a functional insufficiency of these transplants as well as topographic details which may impair their protective function.

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