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Neoglottis phonatoria

106 cases of a one-stage surgical procedure for vocal rehabilitation after laryngectomy

by

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Introduction

Speech is of paramount importance in human life, and the loss of voice is a serious disability. Hence speech rehabilitation is of vital importance in laryngectomized patients and a very simple surgical technique has been developed by Staffiere for speech rehabilitation after laryngectomy.

Historical Aspects

The various methods of vocal rehabilitation after laryngectomy are as old as the operation of laryngectomy itself.

Billroth, who performed the first laryngectomy about a hundred years ago, placed an artificial larynx in the patient on the 21st day after the operation. This was an external prosthesis prepared by Gussenbauer, assistant of Billroth. It consisted of a cannula for tracheal respiration and a valved fistula tube which could redirect the expired air through a reed into the hypopharynx where the vibrating column of air could be transformed into speech.

Unfortunately, this century-old prototype of a laryngeal prosthesis, brilliantly ahead of its time, was abandoned and forgotten, for all the efforts in the area of vocal rehabilitation for the next 90 years were directed towards two major approaches:
(1) oesophageal speech; (2) electronic noise-generating devices, both external and internal.

Several newer developments in the field of vocal rehabilitation have been reported in the past decade.

The Asai (1972) technique was a great *breakthrough, resulting in a loud, clear voice* in many cases, but it is a multi-stage procedure and failures are frequent in the irradiated patient; furthermore, there may be severe problems with aspiration and growth of hair.

The wind tunnels of Conley *et al.* (1958) and of Montgomery and Toohill (1968) may also be mentioned.

The tracheo-oesophageal shunt (Guttman, 1935) is another interesting procedure widely practised by Komorn (1974) and by Calcaterra and Jafeh (1971). However, stenosis may follow this procedure.

The disadvantages of these surgical techniques and their inherent limitations stimulated surgeons to search for new ways of reconnecting the pulmonary air supply with the hypo-pharynx in a manner which resembled laryngeal speech. All of them are modifications of either the external reed device described by Gussenbauer in 1874 or the tracheo-oesophageal fistula devised by Guttman in 1935.

In 1969 Staffieri tried a new approach, inspired by a famous case. Forty years earlier, a Chicago iceman, suicidally depressed by the loss of his voice after a laryngectomy, had plunged an ice pick into his throat. Instead of dying, he regained the ability to speak; he had accidentally pierced *the oesophageal wall in a way that gave him* voice again.

To duplicate that miracle, Staffieri made a

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small slit in the oesophageal wall of a laryngectomized patient. He then placed a part of the oesophageal wall over the top of the trachea, forming a valve which linked the trachea to the pharynx. To speak, the patient simply placed a finger over the external tracheostomy in the neck. Exhaled from the lungs, air was forced through the internal oesophageal slit, allowing the pharynx to vibrate and create sounds; but the valve could open only when air from the lungs forced it open. When food or liquid came down the oesophagous, the valve remained closed. This simple technique is known as 'neoglottis phonatoria' (Staffiere and Serafini, 1976).

Staffieri performed the operation on 137 patients, with a success rate of 90 per cent. With this procedure, since breathing is easy, the new voice can be sustained almost as long as normal speech and hence it is notably superior to other techniques of voice restoration.

Research in electronics and prosthetics has lead to the trial of many implantable devices, but these are all in the experimental stage and there are many problems inherent in implants.

Pre-requisites for Vocal Rehabilitation by Surgery

Regardless of the method used, certain technical and physiological criteria must be met if the procedure is to be successful.

The technical requirements are: that the connection should be easy to construct, preferably in one stage; that it should be applicable in a wide variety of clinical situations, and not contraindicated by previous irradiation or by the type of cancer surgery performed; and that it should be permanent, without problems of stenosis or plugging by keratinous debris.

It should also meet the physiological requirements of not interfering with swallowing and not producing clinically significant aspiration. The speech should be easily produced in the majority of cases, and it should equal or exceed the speech produced by non-surgical techniques. The procedure must be safe for the patient and have a low incidence of complications; there should not be any significant increase in mortality or morbidity.

The surgical technique of 'neoglottis phonatoria' satisfies most of the above criteria to a large extent and hence it has been followed and accepted by us.

Indications and Contra-Indications

Indications:

The surgical indications are the same as those for traditional total laryngectomy. Each and every laryngectomy that is done should be planned and followed by surgical speech rehabilitation.

Contra-indications:

The only contra-indication is laryngeal cancer which has spread towards the oesophagus; and since this method necessitates the retention of an adequate amount of pharyngeal mucosa, it is not helpful in advanced cancer in the laryngopharynx.

It is also contra-indicated in subglottic laryngeal cancer.

Pre-Operative Management

This is the same as for routine laryngectomy. All the patients are given a high protein diet prior to operation and blood transfusion is given whenever indicated. Tracheostomy is routinely done pre-operatively in all cases. Dental sepsis is ruled out and dental extractions are carried out as required. Thirty-six of our patients received a pre-operative dose of 3000 to 5000 rads about 3–4 weeks before the operations.

Operative Details

This operation of 'total laryngectomy' with reconstruction of a 'phonatory glottis' does not differ from classical total laryngectomy *except in the final stages. In other words, a classical total laryngectomy is done,* with removal of the cricoid ring in all cases and of the hyoid bone if needed. Neck dissection can be done at the same time, if indicated. The greatest care must be taken to preserve the anterior wall of the cervical oesophagus, as this will be used for the surgical pro-

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cedure required for the rehabilitation of speech.

To achieve this functional result, a small slit, 3–6 mm long, is made through the preserved anterior oesophageal wall, 1 cm above the tracheal ring. The inner epithelial layer of this slit is sutured to the external muscular layer of the oesophageal wall.

After the neoglottis has been made, the lower part of the oesophageal wall is sutured all round the treacheal ring in such a way that the neoglottis is placed in the middle of the tracheal lumen and thus puts the respiratory tract in communication with the hypopharynx and upper resonators. Finally, the remaining upper part of the anterior oesophageal wall is turned up to close the surgical pharyngostome.

Except in heavily irradiated and bad-risk cases we now make an intentional fistula at the level of the hyoid bone routinely.

How the 'Neoglottis' Works

The 'neoglottis phonatoria' can be compared to a true one-way valve. In fact the walls of the slit, lined by the inner epithelium of the oesophagus, are controlled by the tension of the external muscle layer of the oesophagus and by the consistency of the submucosal layer and the lamina propria; both are elastic connective tissues. A visual demonstration of this property of the 'neoglottis' can be made by xerographic and endoscopic methods.

In the Staffieri method, the tracheostoma is closed by the patient with a finger. Self-closing valves, such as those of Sisson *et al.* (1975) are sometimes useful, but they require adaptations. When the tracheal stoma is closed, the expiratory air-stream enters the neoglottis and produces voice. Saliva and food do not enter the neoglottis if the fistula has been well constructed. However, leakage of saliva and liquids may occur at times but these swallowing difficulties are easily removed by surgical control of the neoglottis.

Material—Clinical Data

The procedure of 'neoglottis phonatoria' has been attempted by us in 106 cases of carcinoma of the larynx (including early pyriform fossa cases) which attended our department during the last $5\frac{1}{2}$ years:

Thirty-one cases were subjected to total laryngectomy with 'neoglottis phonatoria'; 75 cases were subjected to total laryngectomy with 'neoglottis phonatoria' and ipsilateral block dissection of the neck.

Data

Age:

The minimum age in our series was 28 years, that maximum 70 years. Details of the age-groups are shown below:

Age	No. of cases	Percentage
20–29	5	4.7
30–39	10	9.5
40–49	27	25.5
50–59	44	41.5
60–70	20	18.8

Sex:

In our series, only 16 cases were females and the male-to-female ratio was 5.6:1.

Supraglottic lesions were present in 53 cases, glottic lesions in 16 cases and early pyriform fossa lesions in 37 cases.

Type of Lesion:

Histopathological examination of tissues taken from all the cases in our series showed squamous cell carcinoma.

Post-Operative Care

This was the same as that for routine total laryngectomy. No extra care is required for 'neoglottis phonatoria'. Suction drainage with a Redivac drain is maintained for 72 hours.

Antibiotics are administered and fluid and electrolyte balance is maintained.

Ryle's tube feeding and standard care of the tracheostomy are carried out.

Asepsis and sterility are maintained in the ward during suction and dressings.

All cases are routinely given speech therapy from 8 days after the operation.

Thirty-six cases were given a post-operative course of radiation, 3000 to 5000 rads.

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All cases are being followed up regularly at frequent intervals.

Advantages and Disadvantages

Advantages:

The simple technique of 'phonatory neoglottis' described seems to have several advantages over other methods of surgical restoration of the voice.

It is easily carried out as a single-stage procedure; it has a very high success rate; and the quality of voice improves with time and is optimal in about 3 months' time.

The procedure also has the advantage that it is still possible to adopt other means of rehabilitation, should it be necessary to do so.

With slight modifications, the procedure can be applied to a previously laryngectomized patient.

Rehabilitation is begun early and long periods of speech therapy are not necessary.

Should it be deemed necessary, a revision operation can be performed.

The procedure has hardly any extra or special complications other than those of routine total laryngectomy. The procedure does not add to or affect the morbidity or mortality of total laryngectomy.

Radiotherapy is not a contra-indication to this procedure. Synchronous neck dissection does not contra-indicate this method of vocal rehabilitation.

Disadvantage:

In this procedure, the pharyngeal musculature plays an important role as a vibrator. Hence, in patients in whom large amounts of pharyngeal mucosa and muscle have to be excised. As in advanced laryngopharyngeal cases, it is not helpful, nor should it be performed in cases of subglottic carcinoma.

Complications

The complications encountered in our series of 106 cases were as follows:

Spill-over into the tracheo-bronchial tree:

In 53 cases there was minor spill-over only. This amounted to a drop or two occasionally, often with a hurried meal, and usually occurring only with liquids. The patients soon became adjusted to this and no special care was necessary.

In 16 cases, there was more spill-over, particularly in the early post-operative period, but this was overcome by changing the diet and adjusting the patient's position. However, one patient preferred closure to recurrent spill-over.

Pneumonitis:

Pneumonitis occurred in 7 of our cases, and in 6 of them it resolved with routine antibiotic treatment. One patient had a massive resistant infection and succumbed to it. It is important to note that most of these patients are in the geriatric age-group, with emphysema and occasionally bronchiactesis, and so it is essential to keep a watch on the chest post-operatively. Every case of unusual pyrexia should have immediate chest X-rays, sputum culture and appopriate antibiotic therapy.

Granuloma Formation in the Neoglottis:

In one case the patient had a total loss of voice due to a foreign-body granuloma, which looked like a polyp, at the suture line; this was easily removed at endoscopy and resulted in the restoration of speech. However, the quality was not as good as in the other cases.

Other Complications:

Over and above these complications, we also encountered other complications.

These are given below in tabular form:

Complications	No. of patients	Percentage
1 Spill-over into the tracheo-bronchial tree		
(a) Minor	53	50
(b) Intermediate	16	15
(c) Major	—	—
2 Pneumonitis	7	6.5
3 Granula formation	1	.9
4 Stitch abscess	5	4.7
5 Thrombophlebitis	5	4.7
6 Wound infection	20	18.8
7 Flap necrosis	1	.9
8 Fistula formation	10	9.4
9 Parotitis	1	.9

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Results

Three different criteria were used to assess the speech intelligibility and acceptability:

(1) Number of syllables per breath.
(2) Volume of voice.
(3) Resonance.

Judgements were made as Excellent, Understandable and Failures.

Exellent speech was determined on the following basis:

(a) The patient was able to speak more than 16 syllables per breath.
(b) Speech was audible to a distance of 10 feet in a fairly quiet room.
(c) Balanced resonance.

Understandable speech was judged on the following criteria:

(a) The patient was able to speak 8–16 syllables per breath.
(b) Speech was audible to a distance of 5 feet in a fairly quiet room.
(c) Moderate to severe hoarseness of voice.

Poor speech (or failure) was judged on the following basis:

(a) The patient was able to speak less than 8 syllables per breath.
(b) He had only a very hoarse whisper.
(c) He was unable to take part in conversation.

All these patients (Failures) refused revision operation or had recurrence of disease.

TABLE OF RESULTS

Result	No. of patients	Percentage
Excellent	62	58.5
Understandable	22	20.75
Failure (Poor)	22	20.75

Discussion and Conclusion

Basically, for the production of speech it is necessary to have bellows, a vibrator and an atriculatory mechanism.

The laryngectomized patient can be helped in several ways.

The electronic larynx is expensive and difficult to repair, and the speech produced by it is mechanical and monotonous.

Successful oesophageal speech requires great motivation, expert guidance and great perseverance, and still it has a high failure rate.

Surgical speech rehabilitation has a high rate of success.

We strongly recommend this technique for all under-developed countries, where patients are poor, they often come from villages where there is no electricity, and there is normally no speech therapist.

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