

ESOPHAGEAL SPEECH OR ARTIFICIAL LARYNX—A CRITICAL DISCUSSION

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'Communication has long been recognised as one of the most fundamental components of human behaviour' (Peterson, G. E., 1958). Man's primary method of communication is speech.

When one analyses good speech, the speech that most adequately contributes to social interaction, it is discovered that it possesses certain characteristics. Each of these characteristics makes its peculiar contribution to the total impression. These important characteristics of speech are pitch, loudness, voice quality, accent, style, articulation, stress, level and kind of language.

If it may be said that speech is our most important characteristic, then it follows that the surgical removal of the larynx affects the most human part of us. The patient who has lost his larynx, and who makes an otherwise satisfactory physical recovery presents a number of problems, that are always puzzling and sometimes discouraging. Baker (1954) puts the situation most succinctly: 'The loss of the larynx in humans produces an obliteration of the speech function that is unique because it is so complete. The absence of the phonating mechanism makes production of voice for speech impossible. More than this the surgical interaction of the upper air way also makes it difficult for the patient to produce those speech noises, which are important components of many speech sounds'.

There are two major methods of rehabilitation of these patients: that of teaching thermesophageal speech or recommending them artificial larynx. There are many other modes of rehabilitation of these patients. But it is the purpose of this paper only to review the controversy existing between the artificial larynx and esophageal speech. It has remained as a highly debatable point in the rehabilitation of these patients as to the better mode of rehabilitation among these two approaches. Arguments have waxed and waned, with each side having its own limitations and good points, but no agreeable point has been reached. It is not the scope of this paper either to find a definite solution for this, but only to review each sides claim with reference to the characteristics of the good speech cited above.

Snidecor (1968) says 'by having developed the technique of esophageal speech, the Speech Therapist has greatly lessened the degree of disability incidental to the total removal of the larynx'. In the 20th century and until few years ago, surgeons and Speech Therapists were somewhat over enthusiastic concerning

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the relative number of persons who could learn esophageal speech. However, more recent and realistic studies indicate that from 12 to 40 per cent of those surveyed *I* could not or did not develop esophageal speech (ACS, 1951; Putney, 1958; Gardner and Harris, 1961; Horn, 1962; Van Riper and Irwin, 1966; Greene, 1968; Snidecor, 1968). Some of the factors which render the acquisition of esophageal speech difficult or impossible are: Poor post operative results (Levin, 1952); Damage to the nerve supply of pharynx and tongue (Greene, 1964); Old age and frailty accompanied by lack of drive to learn (Greene, 1964); Deafness and inability to monitor speech (Levin, 1952 and Lauder, 1968); Low intelligence and real distaste for esophageal speech (Greene, 1964); Suspected recurrence of the cancer, metastasis and multiple lesions (Levin, 1952) and complications arising after the operation such as edema, infection, necrosis etc., (Parnell, 1968). Since reinstating communication is the most important thing, the argument for an artificial larynx is quite natural and logical.

I Other factors which make esophageal speech difficult like extensive surgery, for example, gross neck dissection—unilateral and bilateral; removal of the cricopharyngeus muscle; laryngectomy with glossectomy; pharyngectomy; mandibulectomy also make necessary the acquisition of artificial larynx. '

Though not all the patients are affected by the above factors, we still know that not all laryngectomees are able to develop esophageal speech, the reason for which is not known in spite of the vast amount of knowledge about these patients at our disposal. In the words of Finklebeiner (1968) 'despite the amount of knowledge regarding the esophageal speech which has accumulated in the past 50 years, one of the important questions which has remained to be answered is why some individuals are able to learn to use the new voice without undue difficulty, while others who appear equally motivated fail in their efforts to acquire it'. Under these circumstances the choice of an artificial larynx seems to be justified.

Many Speech Pathologists, Physicians, Laryngectomees and para-medical specialists claim that the early introduction and use of the artificial larynx following laryngectomy is a psychological as well as economic necessity; that esophageal speech can be developed later when the patient has recovered from traumatic experience.? -They assert that the artificial larynx is much more understandable than esophageal speech and it enables the user to communicate much sooner and more effectively, particularly in situations involving emotional stress or when more volume than is normally possible with the esophageal voice is required/ Heaver and Arnold (1962) are the ones to advocate the use of artificial vocal aids during the time the patient is learning esophageal speech. This seems to be logical particularly because reinstating communication as early as possible, as said earlier, is the most important thing that we can do to a laryngectomee.

However, the opponents of the artificial larynx are quick to point out that the use of this instrument is an unnecessary crutch and interferes with the development of esophageal speech (Hyman, 1955; 1968; Broadnitz, 1962; Furn, 1968; Edelman, 1968; Grant, 1968). Edelman (1968) says that the use of

artificial larynx is a crutch in developing good esophageal speech because of the following reasons: (1) The pattern of air intake in that is not the same needed for esophageal speech and "(2) if a greater part of the person's communication effort is dependent on a button instead of on the coordinated movements of the oral structures, that person will be establishing habit patterns for voice production which are opposed to those needed for esophageal voice. It is the general opinion that the too early introduction of them may discourage patients from learning esophageal speech/ Further Broadnitz (1962), Furr (1968) and Hyman (1955) contend that artificial larynx takes away the motivation of the patient to learn esophageal speech.

However, considering that 40 per cent of all laryngectomees do not acquire esophageal speech, it becomes necessary to provide artificial larynx as soon as possible.¹ It is interesting to observe Martin (1963), who after an evaluation of all the above surveys says 'despite the optimistic claims (sometimes as high as 80 per cent) I would estimate that half of all laryngectomees never acquire a reasonably adequate and socially acceptable esophageal voice, that is better than 'indifferent', 'poor', 'offensive', or 'absent'. Lueders (1956) is in conformity with Martin and maintains that approximately 1 /3 of all the patients do not learn to speak and that in his judgement of some patients, who consider themselves able esophageal speakers, the proficiency of the remaining 2/3 might be questioned'.

'Kallen (1934) reports of the acute depression which often interferes with speech progress/. A pathological reactive depression is the usual sequela to the doctors dictum that the larynx is cancerous and that it has to be removed at once, and that natural speech will no longer be possible (Heaver and Arnold, 1962). And even after the operation when the patient can't speak, this depression will persist, however effective our counselling may be. This is further supported by Lueders (1956) who says/'the psychological importance of an early return or communicative ability should be considered, speech being the most important social function, should be restored to the patient as soon as possible. The psychological effect of enforced silence during a protracted learning period for the esophageal speech is the building up of resentments and frustrations that tend to make the patient uncooperative. It is better perhaps, to offer him the help of electro-larynx, with which he can at least satisfy his all important sense of speech'.]

In this connection Martin's (1963) argument seems- to be logical. He says 'furthermore, contrary to the pronouncement of many esophageal voice teachers, resorting to such a device promptly after operation, in my experience, does not preclude or discourage the patients from later efforts to the attainment of esophageal speech, nor does it lessen the chance of ultimate success in that endeavour. It can serve, however, as a stopgap, in all the cases and give the laryngectomee an unprejudiced eventual choice between the two methods. Also it makes possible the use of either one as a supplement to the other, depending upon the requirement of the occasion. Elimination of any unnecessary delay in achieving practical means of communication transcends any and all other considerations'.

Claim made by the opponents of the artificial larynx, is that the use of an artificial larynx is an unnecessary crutch and interferes with the development of esophageal speech, seems to/lack experimental evidence for no research has yet shown that /artificial larynx precludes or slows down the learning of esophageal speech (Diedrich, 1968; Grant, 1966; Lauder, 1968). Further Diedrich (1966) says 'it might show that the artificial larynx as a means of communication, the clinician should feel rewarded that he has provided a means by which this was accomplished and not feel guilty that he was unable to teach the person esophageal speech. It was a decision for the client to make, not the clinician'. And the advocates of the artificial larynx claim that the use of the artificial larynx need not interfere with the development of the esophageal speech, so long the patient's teacher perseveres in teaching the proper technique for esophageal voice.

However, it may be true that in some cases the use of artificial larynx may become a crutch which may dissuade some laryngectomees from acquiring esophageal voice; but/if his communicative and psychological needs are satisfied thereby, why should we insist that the patient communicate by other means? As Kneflar (1962) points out that our goal for laryngectomee's should not be 'acquisition of esophageal speech', but rather 'the development of that level of speech proficiency that as nearly as possible meets the communicative needs of each laryngectomized individual'.

Till some experimental evidence is forthcoming to prove that artificial larynx is a deterrent to the learning of esophageal speech, we shall presume that this is not so. In fact it may be an aid, inasmuch as it permits the person to keep his communication alive and the hazardous task of writing to communicate with his teacher does not arise; to return sooner to his job; it helps keep his morale high and tension low and thus helps establish a favourable climate for learning esophageal speech.

Diedrich (1966) says that articulation is an additional speech benefit which might occur from the use of the artificial larynx during immediate post-operative period. The user,of the artificial larynx must precisely articulate or the speech will be unintelligible./ He must learn, for example, to make voiceless consonant sounds with intrapharyngeal air pressure and not with pulmonary air. The learner of esophageal speech must also learn to articulate voiceless sounds in alike manner. Another secondary benefit of good articulation is its influence on air intake precision in articulation. This movement aids in the injection process especially during the syllable pulse of plosives and sibilants.. Hence, in this way artificial larynx helps learning esophageal voice and it is not a crutch as contended by its opponents. Diedrich (1966) says because of these possible speech gains through the use of the artificial larynx, it is suggested that the esophageal speech learning period can be shortened not lengthened'.

Other criticisms of the artificial larynx put forth by the proponents of the esophageal speech are:

- (1) that it has got too many limitations, not the least of which is the unacceptable sound it makes.
- (2) that the user of such an instrument cannot produce speech as intelligible as esophageal speech.

Lauder (1970) contends that the principal reason for the continuing unpopularity of the electrolarynx is that it is not a satisfactory substitute for the human voice because it sounds too mechanical and it is therefore unnatural. Barney *et al*, (1959) are also of the opinion that the sound so produced with the artificial larynx sounds somewhat mechanical.

In comparing esophageal voice, with the electrolarynx speech, Martin (1963) asserts that the Electrolarynx voice tends to be of uniform quality, that it is far rasping in tone than many acceptable esophageal voices and furthermore, that it is always devoid of intake burps, facial grimaces and concomitant forced expulsions of air from the stoma. Martin claims that even the best esophageal voice is monotonous and hoarse. Now let us evaluate the characteristics of esophageal voice and its effectiveness.

Greene (1964) says 'the esophageal speaker can become so fluent that strangers do not realise the true nature of the disability and may ask whether the patient has cold or laryngitis. This is tribute indeed to the naturalness of the voice which upto this time no artificial larynx has been able to emulate'.

However, it seems as though Greene is exaggerating the issue, for a number of studies (Damste, 1958; Snidecor and Curry, 1965; Rollin, 1967; Shipp, 1967, Curry, 1968; Snidecor and Nichols, 1968; Snidecor, 1968) have shown that even the superior esophageal voices lie far below than normal speakers, with respect to frequency, rate of speech (in terms of number of words per minute), loudness, quality of the tone, etc. And according to the criteria of Berlin (1963), which are indeed very simple, no esophageal voice will be rated as good. And further we know that many laryngectomees suffer from presbycusis which prevents them from being able to adequately evaluate the intelligibility of the esophageal speech that they can produce. This together with the often unheard high frequency noise produced by pulmonary air from their stoma (stomablast) often mitigates against what speech intelligibility they can master.

' No esophageal speaker so far has been found to fulfil the following criteria (Leuder, 1970) in order to come nearer to the normal speech level at least.

- (1) Sufficient volume to be comfortably heard by a listener with normal hearing at a reasonable distance in fairly quiet surroundings.
- (2) Intelligibility supported by clarity of articulation, expressiveness, pitch variation, phrasing and adequate visual cues.
- (3) Phonation produced with breath control resulting in a smooth speech airflow, naturalness of expression and avoidance of stoma blast.
- (4) A reasonable speech rate of at least 80-100 words per minute.

- (5) Few distracting speech mannerisms, facial grimaces and inappropriate body movements during phonation.

One of the best measures of efficiency in speech, is rate in words per minute. (Snidecor, 1968). In Snidecor's (1955) study no speaker could achieve a rate that would be satisfactory according to Darley's (1959) and Franke's (1939) norms.

According to Black (1942), Hanley (1951) and Snidecor (1944) normal speakers phonate from 60 to 75 per cent of the time during continuous speech. In Snidecor's (1955) study, all the laryngectomees lie far below this level of phonation time, which is thought to give some measure of vocal efficiency.

The results of the studies (Hyman, 1955; Snidecor and Isshiki, 1965; Snidecor, 1968; Van Den Berg, Moolenaar-Bijl, Damste, 1958; Nichols, 1968). On the relative loudness of esophageal speech and electrolarynx speech indicate that the esophageal speakers lie far below than that of normal speakers. Evaluating all these studies with respect to loudness and effectiveness of esophageal speech, Nichols (1968) says 'only the rare esophageal speaker can "turn up the volume" of his voice so that he can project to everyone in the room or in some busy place'.

The pitch of the effective esophageal speaker is substantially lower than that of normal speakers. A spectrographic study of the esophageal voice by Arslam and Rossi (1972) showed the complete absence of the regular succession of fundamentals and harmonics with a typical aspect of 'noise', even if there is a fairly regular arrangement of vocal formants.

With reference to quality or waveform information spectrographs analysis of esophageal voice (Snidecor, 1968) revealed that although the voice contains a noise component upto a high frequency region (6000 Hz), the harmonic components are still clear and easily distinguished from each other. The voices of esophageal speakers are often hoarse and they are frequently thought to have cold.

Coming to the effectiveness of the artificial larynx, it is interesting to review the results of Hyman's study (1955). He found, in comparing the voice of the electrolarynx and esophageal speakers, that the artificial larynx speakers are always preferred. This study indicates that acoustically speech production by means of the artificial larynx was preferred over esophageal speech.

Further in the case of the artificial larynx, the adequacy and effectiveness of pitch, loudness and to some extent quality depends on what we provide in the artificial larynx. With all this progress in electronic research, we can now give speech through an artificial larynx which simulates the normal speech in all respects. Electronic larynges produced in 1960's have considerably better quality. With the electrolarynx loudness is a matter of adjusting power to an adequate level or trying a more powerful instrument. Barney, Haworth and Dunn (1959) studied this problem at length. The loudness of the artificial larynx they produced (75 dB fixed) was felt adequate for conversational purposes, although in situations

in which the normal speaker would increase his intensity, they advised that the speaker move closer to his listener. Recently the present author (1974) has developed an artificial larynx the output of which can be varied from 55 to 88.5 dB (when the transducer is held pressed against the throat) and can be fixed at any particular level of intensity also. This maximum intensity of 88.5 dB provided in this artificial larynx is more than the peak intensity values of normals, which Hyman (1950) puts at 79 dB. This is one advantage over the WE TYPE 5A artificial larynx.

The experiments of Barney *et al.*, (1959) show that the introduction of the vocal source into the articulatory system in the pharynx produces a better voice than the same source introduced into the oral cavity and it has been further supported by Jayaram's (1974) study. Barney *et al.*, (1959) also conclude that the spectrum of the vibrator was on the average, adequate as a source of harmonics of vowel production.

Jayaram (1974) has developed a variable frequency artificial larynx where the frequency can be continuously varied from 50 to 350 Hz and the intensity from 70 to 110 dB (in the free field condition). The frequency is continuously variable but can be fixed at any level also. Further it has the possibility of selecting a suitable fundamental frequency, with needed supply of overtones, for each individual to match his optimum frequency.

Other advantages of the above variable frequency artificial larynx are:

- (1) Frequency spectrum of the artificial larynx voice is almost similar to that of the normal (natural) voice.
- (2) By means of an oscillator interruptor, the patient can stop the oscillator working either between the words or phrases or sentences. By this the speech was found to be extremely intelligible as it minimised the constant background buzzing noise.

Jayaram (1974) in his study has also shown that using this artificial larynx, intonation pattern found in normal speech, can be approached by varying frequency, thus making the speech less monotonous and more natural.

The intelligibility of speech produced with this artificial larynx was studied with normal subjects and was found to be extremely intelligible (as reported by the judges). All of the subjects had good articulation. They all could effectively use the oscillator interruptor, which minimised the background noise and thereby increased the intelligibility of the speech. All the subjects could be trained to use this artificial larynx.

So with all these recent developments in electronics, the situation is now entirely different than that existed in 1950's and 1960's. With the artificial larynx one can give a speech which is as effective as normal speech. The situation being this, one cannot understand the insistence on esophageal speech, which is after all hard work. And also the problem of esophageal voice requiring a

substantial expenditure of energy on the part of the patient, which many older patients cannot sustain for their everyday communicative needs, speaks against the use of esophageal speech. Also when taking into consideration the time taken to learn esophageal speech, one can't be blind to the frequently tragic emotional and financial impacts of such unnecessary long periods of voicelessness. After taking all these factors into consideration one is inclined to consider the artificial larynx as a more effective mode of rehabilitation of laryngectomees than esophageal speech/

However, with the advent of the Asai Technique which of course results in better speech than the above two, the importance attached to either artificial larynx or esophageal speech has been lessened. The advantages and disadvantages of this technique are beyond the scope of this paper.

But one can't ignore Diedrich and Youngstorm (1966) who have summarised the entire subject. They say 'The philosophy which the speech clinician should maintain does not appear to be a simple decision between esophageal speech or artificial larynx. They are not mutually exclusive. The question is not which method is better, but which methods are best, not only for any given patient, but for all patients, at any time within the rehabilitation time. What might be appropriate right after surgery may or may not be appropriate after one year. What is adequate speech at home may not be adequate at work. Also the clinician's method of choice may not be in harmony with the wishes of the patient's. Herein lies a professional ethic which should not be ignored—the patient must have the freedom of choice after he has been provided with the best available information about his problem'.

REFERENCES

- Arnold, G. E., 'Alleviation of alaryngeal dysphonia with the modern artificial larynx; 1. Evolution of artificial aids and their values for speech rehabilitation' *Logos* 3 (2), 1960, pp. 55-67, DSH Abstracts; 1, 1961, p. 449.
- Arslam, M. and Rossi, M., 'Electro acoustic and spectrographic analysis of the voice of the larynx'—*Acta Otolaryngology*, 73, 1972, pp. 230-235.
- Barney, H. L., Haworth, B. B. and H. K. Dunn, 'An experimental transistorised artificial larynx'—*Bell System Technical Journal*, 38, 1959, p. 1337.
- Berlin, C. E., 'Clinical Measurement of esophageal speech. I: Methodology and curves of skill acquisition: *JSHD*, 28, 1963, pp. 42-51.
- Berlin, C. H., 'Clinical measurement of esophageal speech. III: Performance of non biased groups; *ySHD*, 30, 1965, pp. 174-183.
- Curry, E. T. and Snidecor, J. C., 'Physical measurement and perception in esophageal speech, *Laryngoscope*. 71, 1961, pp. 3-11 as in *Speech Rehabilitation of the Laryngectomised* by Snidecor 1968.
- Curry, E. T., 'Acoustical measurement and pitch perception in alaryngeal speech', pp. 98-107 as in Snidecor, 1968.
- Damste, Van Den Berg and Moolenaar Bijl: 'Why are some patients unable to learn esophageal speech', *Annls. of Oto. Rhino. Laryn.*, 65, 1956, p. 998.

- Diedrich, W. M., and Youngstorm, K., 'A laryngeal speech', Springfield, C. V. Thomas comp., 1966.
- Finklebeiner, E. R., 'Surgery and speech, the pseudoglottis in respiration in total standard laryngectomy', pp. 58-85 as in Snidecor, 1968.
- Gardner, W. H., Harris, H. E., 'Aids and devices for the laryngectomees'—*Archs. of Otolaryngology*, 73, 1961, pp. 145-152.
- Greene, M. C. L., 'Voice and its disorders'—*Pitman Med. Pub. Comp.*, London, 1968.
- Hayes and Martin: 'Rehabilitation of the laryngectomee' *Cancer*, 16, 1963, pp. 823-41.
- Hyman: 'An experimental study of artificial larynx and esophageal speech', *JSHD*, 201955, p. 291.
- Jayaram, M., 'Development of a variable frequency artificial larynx' Master's Dissertation, Mysore, 1974.
- Lauder, E., 'The role of the laryngectomee in the post laryngectomy voice instruction', *JSHD*, 30, 1965, pp. 145-159.
- 'The laryngectomee and the artificial larynx', *JSHD*, 33, 1968, p. 147.
- 'A laryngectomee's viewpoint on the intelligibility of the esophageal speech', *JSHD*, 34, 1969, p. 355.
- 'The laryngectomee and the artificial larynx', A second look; *JSHD*, 35, 1970, p. 62.
- Nichols, A. L., 'Loudness and quality in esophageal speech and artificial larynx'; pp. 107-127 as in Snidecor, 1968.
- Parnell, P. W., 'Complications of the radical neck dissection'—*Archs. of Otolaryngology*, 58, 1968, pp. 180-184.
- Peterson, G. E., 'Speech and Hearing Research', *JSHD*, 1, 1958.
- Putney, J., 'Rehabilitation of the post laryngectomised patient'—*Annls. of Otol. haryn. Rhino.*, 67, 1959, pp. 544-549.
- Shipp, T., 'Frequency, duration and perceptual measures in relation to judgements of alaryngeal speech'—*JSHD*, 10, 1967, pp. 417-427.
- Snidecor *et al.*, 'Speech rehabilitation of the laryngectomised', C. V. Thomas Publ. Comp. Springfield, Illinois, U.S.A., II edn. 1968.
- Van Riper and Irwin, 'Voice and Articulation', London, Pitman Med. Publ. Comp. 1968.