

## ORIGINAL PAPER

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## The Blom-Singer tracheostoma valve as a valuable addition in the rehabilitation of the laryngectomized patient

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**Abstract** Prosthesis-assisted tracheo-esophageal speech has proven its value in post-laryngectomy voice rehabilitation, although manual occlusion of the tracheostoma during speech is necessary. In contrast a tracheostoma valve enables hands-free speech. We have now had experience with 30 patients using the Blom-Singer tracheostoma valve for more than 6 months and have found that most patients prefer prosthesis-assisted speech with the tracheostoma valve. Measurement of several speech parameters with digital and valve occlusion of the tracheostoma did not show any significant differences between the two speaking conditions. Problems included maintenance of an airtight seal, outward forcing of the valve diaphragm during forced expiration and subjective increased airflow resistance.

**Key words** Laryngectomy · Voice rehabilitation · Tracheostoma valve · Voice prosthesis

### Introduction

Since Blom and Singer [3] introduced voice prosthesis-assisted tracheo-esophageal speech in 1979, this method for post-laryngectomy voice rehabilitation has proven to be

superior to esophageal speech. At University Hospital Nijmegen speech rehabilitation was successful in 80% of our laryngectomized patients [9]. With the introduction of low-pressure voice prostheses [6, 10, 13, 14] and myotomy of the cricopharyngeal and lower pharyngeal constrictor muscle these results have even further improved [8, 12]. However, intermittent manual occlusion of the tracheostoma is necessary to create a tracheo-esophageal airflow during speech. This is a non-hygienic, inconvenient procedure for which some dexterity is needed. Of course, it ties hands and draws attention to the laryngectomized status. The stoma size in relation to the size of the fingertip is also of importance.

In 1982 the tracheostoma valve for hands-free alaryngeal prosthetic speech was introduced by Blom et al. [4]. The device consists of a circular housing which is attached to the skin with non-irritating adhesive discs. The valve assembly, supporting the valve diaphragm, can be inserted and removed leaving the housing attached to the skin. In the first-generation device the valve diaphragm was available in four thicknesses that defined the pressure needed to close the valve. The newly developed device has an adjustable valve. The valve sensitivity can be adjusted by rotating the face plate (Fig. 1). It can also be provided with a heat and moisture exchanger (Figs. 2, 3). Since the Blom-Singer valve has become more popular in The Netherlands, we assessed its value in the present study by evaluating the combined experience of University Hospital Nijmegen and the Daniel den Hoed Clinic, Rotterdam, The Netherlands.

### Materials and methods

Thirty laryngectomized patients were selected between June 1992 and May 1993 and provided with a Blom-Singer tracheostoma valve. Selection criteria consisted of existing stoma-occlusion problems because of decreased manual dexterity (e.g. arthritis) or stoma size and/or frequent bimanual activities in combination with speech.

The patients included 24 men and 6 women, with an average age of 59 years (ranging 40–73 years). Twenty-nine patients were using indwelling voice prostheses (low-pressure Groningen voice

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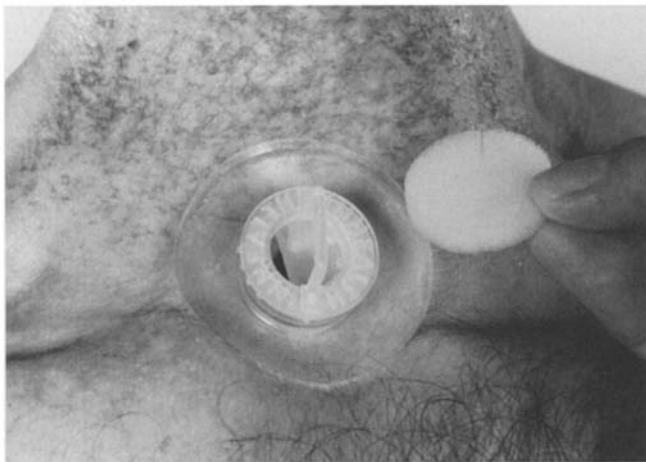
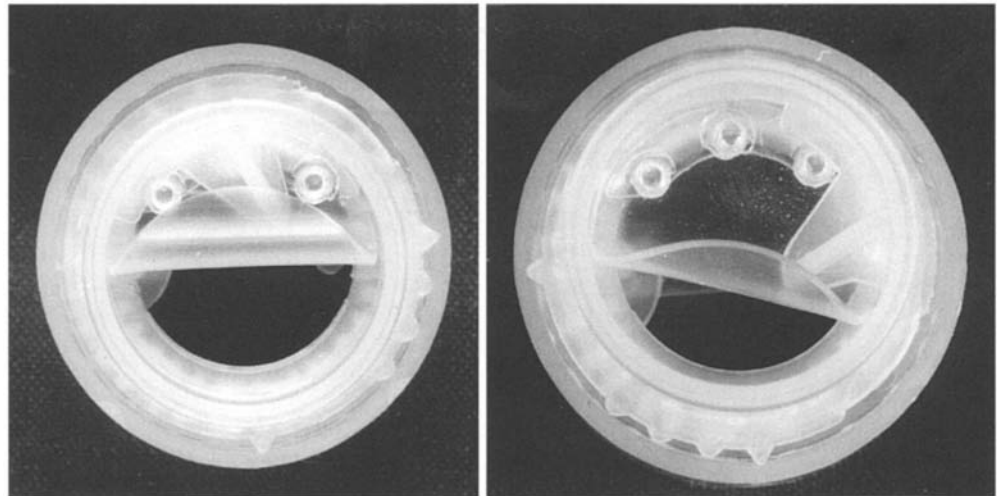
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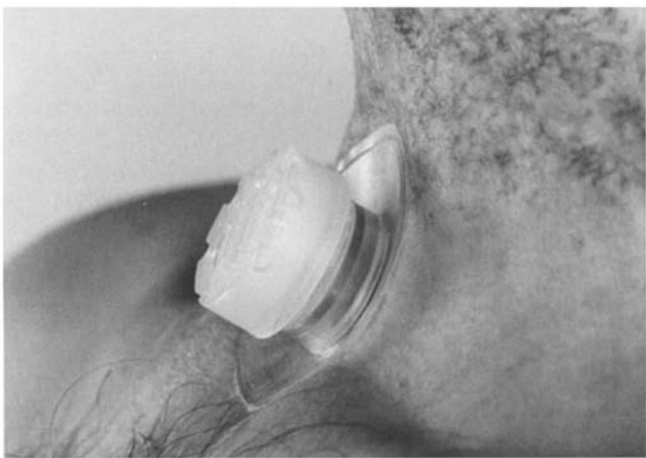
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**Fig. 1** By rotating the face plate of the tracheostoma valve the diaphragm can be partially closed to adjust the valve's sensitivity



**Fig. 2** The Blom-Singer adjustable tracheostoma valve with a foam filter



**Fig. 3** Lateral view of the adjustable tracheostoma valve in combination with the heat and moisture exchanger, which consists of a removable retaining cap and a replaceable foam filter

prosthesis [14], Provox voice prosthesis [6], Nijdam voice prosthesis [10]). One of them had a well-functioning Staffieri shunt. All were tracheo-esophageal speakers for 3 years on average (range 6 months to 11 years).

The tracheostoma valve was used by the study group for an average period of 6 months, ranging from 3 to 14 months. One patient was excluded because excessive leakage of air underneath the valve housing and skin problems due to erythema, pruritis and a vesicular rash limited his ability to participate.

All Nijmegen patients were asked to return for evaluation of the tracheo-esophageal voice with and without the tracheostoma valve. Recordings were made of 13 patients. All patients in Nijmegen and Rotterdam were also evaluated by questionnaire.

## Results

Manual tracheostoma occlusion was reported to be troublesome by half of the patients. If questioned about their speech rehabilitation approximately 60% said that esophageal voice alone was unacceptable while 90% were satisfied with the results attained with the prosthesis-assisted tracheo-esophageal speech. Combination of a valve with the prosthesis improved speech even further. Most patients (79%) preferred to speak with the prosthesis, with or without using the valve.

Some patients (31%) wore the tracheostoma valve all day but the majority chose specific activities such as visits (34%), work (17%) or leisure time activities (14%).

Tracheostoma valve application was found to be easy and required approximately 10 min. Most patients did not need any assistance with placement. The valve stayed in place for an average period of 7 h, although there was a large interindividual variation (from 1 to 48 h). Removal with white spirit or alcohol was no problem. Skin problems were usually mild and mainly consisted of local erythema or pruritis and occurred in 24% of the patients.

Maintenance of an airtight seal was one of the major problems found in patients and was associated with the anatomy of the jugular fossa, the sternoclavicular joints and/or the sternocleidomastoid muscles. Excessive intratracheal pressure during speech and copious mucus discharge were other significant factors. Outward forcing of the diaphragm, mainly while coughing (93%) or with loud speech (38%), was a frequently mentioned problem. For 38% of the patients physical activity was impossible while wearing the tracheostoma valve because of in-

**Table 1** Criteria used for evaluation of tracheo-esophageal speech (adapted from Mahieu [7])

Parameter	Speech quality		
	Good	Moderate	Poor
Availability	Always immediately on request; voice onset delay < 5 s	Occasionally voice onset delay > 5 s following request	Not available
Fluency	≥ 19 syllables per air intake	10–18 syllables per air intake	≤ 9 syllables per air intake
Voice modulation	Adequate pitch variation	Little pitch variation	Monotonous
Speech rate	≥ 200 syllables/min	150–200 syllables/min	≤ 150 syllables/min
Maximum phonation time	≥ 10 s	4–9 s	≤ 3 s
Dynamic range	≥ 25 dB	16–24 dB	≤ 15 dB

**Table 2** Percentages of patients ( $n = 13$ ) judged to be good, moderate or poor tracheo-esophageal speakers for speech parameters under two different occlusion speaking conditions

Parameter	Speech quality					
	Good occlusion		Moderate occlusion		Poor occlusion	
	Valve	Digital	Valve	Digital	Valve	Digital
Availability	92%	92%	8%	8%	–	–
Fluency	92%	85%	–	–	8%	15%
Voice modulation	77%	77%	8%	15%	15%	8%
Speech rate	85%	85%	8%	8%	8%	8%
Maximum phonation time	54%	46%	31%	38%	15%	15%
Dynamic range	31%	46%	46%	38%	23%	15%

creased airway resistance. Fifty percent experienced feelings of an obstructed airway. One third of the patients stated that usage of the valve during upper respiratory infections could be problematic. Some resolution was had with the recently introduced second-generation tracheostoma valve containing an adjustable closing-pressure mechanism. This new device could also be combined with a heat and moisture exchanger to reduce mucus production [2].

Breathing noises and the click when the valve closes were usually not a problem for most of the patients although some found it annoying (17%). Seventy-eight percent said the effort required to speak was increased with the valve. The quality of speech was believed to be different by 66%. Although there was no significant difference, 28% noticed a more relaxed voice and 21% a clearer voice. There was no apparent effect on the length of sentences or loudness of speech.

Criteria used for evaluation of tracheo-esophageal speech are shown in Table 1 [7]. Of the 13 patients from the Nijmegen ENT Department who had recordings made of speech with and without a tracheostoma valve, measurement of speech parameters with or without the valve did not show any significant differences (Table 2).

The tracheostoma valve was appreciated by most of the patients as a hands-free, less conspicuous, more hygienic and more comfortable way to speak in combination with various bimanual activities. One patient suffered

from arthritis of his fingers and prosthetic speech became possible only with the use of the valve. Overall, 83% of the patients stated that they felt less handicapped with use of the tracheostoma valve.

## Discussion

Even though loss of voice can be a devastating side effect of total laryngectomy, a majority of patients are able to produce some degree of esophageal voice. Since the introduction of the voice prosthesis, post-laryngectomy voice production has further improved rehabilitation options. However, manual occlusion of the tracheostoma can be uncomfortable and unhygienic and attracts the eye to the laryngectomized status. Digital pressure on the tracheostoma soft tissue can also possibly increase resistance to airflow through the pharyngo-esophageal (PE) segment. As hypertonicity at the PE segment is a frequent cause of failure in acquiring esophageal voice [12] this can be considered as an undesirable side effect. Use of the tracheostoma valve seems to solve some of the aforementioned problems.

Evaluation of tracheo-esophageal speech in our patients with and without the tracheostoma valve, according to the criteria shown in Table 1, did not show any significant differences for the speech parameters studied. This confirms the results found by Pauloski et al. [11].

Unfavorable peristomal anatomy due to prominent sternocleidomastoid muscles or a deep tracheostoma can cause problems with placement of the tracheostoma valve. To overcome this problem, Barton et al. [1] modified the Helsper button to provide for attachment of a tracheostoma valve. Since the majority of patients do not need a stomal button, we currently do not think that the risk of stoma dilatation, granulation tissue formation or bleeding is worth the potential benefit. The customized valve housing described by Cantu et al. [5] has yet to prove its usefulness.

We would stress from our experience that overproduction of mucus, excessive coughing or a high speaking pressure can be additional unfavorable conditions for use of a tracheostoma valve. These problems remain to be resolved in certain patients. Further development is required in the method of application of the valve, airway resistance and maintenance of an airtight seal. Outward forcing of the valve with loud speech is possibly resolved with introduction of the second-generation Blom-Singer adjustable tracheostoma valve, although coughing can still be a problem. By using a heat and moisture exchanger with the adjustable valve, airway irritation and mucus production can also be reduced significantly. Despite the limitations cited in our study, our findings show that the tracheostoma valve is indeed a valuable addition in voice rehabilitation of the laryngectomized patient.

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