Tracheoesophageal speech with manual versus automatic stoma occlusion: a multidimensional comparison

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Abstract

Objectives: The objective of this study was to make a qualitative comparison between tracheoesophageal speech with manual stoma occlusion and handsfree tracheoesophageal speech with the Provox FreeHands device.

Patients/Materials and Methods: Both manual and handsfree tracheoesophageal speech were compared in 13 patients who were regular users of Provox FreeHands for at least four months. Evaluation of speech material consisted of objective analysis using the KayPentax CSL, perceptual ratings by a group of experienced listeners and patients own perceptual judgment. In addition, data concerning user-friendliness, additional values and inconveniences of the FreeHands device were gathered using questionnaires. The Voice Handicap Index (VHI) was used to evaluate the relation between voice related QOL and method of stoma occlusion. Therefore a control group of TE-speakers, who did not use handsfree speech, was selected.

Results: Objective analysis revealed significant differences (p< 0.05) for parameters fluency (i.e. the number of syllables produced on one intake of breath) and maximal phonation time, to the detriment of handsfree speech. There were no significant differences found for the dynamic characteristics. Perceptual judgments of running speech were rated higher in the manual occlusion condition for most patients, but there were interrater differences. Subjective impressions showed that the majority of patients preferred handsfree speech to manual stoma occlusion, noticeably for voice quality, fatigability, attractiveness and feelings of self-confidence. Major inconveniences of handsfree speech were a significantly decreased duration of sticker adhesion, the occurrence of disturbing noises and the need for continued effort. The VHI scores were significantly higher in the group of handsfree speakers compared to the control group.
Conclusions: This clinical study showed that in selected patients the Provox FreeHands shows important subjective benefits. Improvements however are necessary to make the device a useful rehabilitation device for a larger group of laryngectomized patients.

Keywords: tracheoesophageal speech, handsfree speech, automatic tracheostoma valve

1. Introduction

Loss of voice is considered as being the major handicap after a total laryngectomy. Since the first laryngectomies in 1866 and 1873 there has been an evolution in developing techniques for speech rehabilitation. Although in general survival chances have not changed a lot in the last 25 years, a growing attention for speech rehabilitation after surgery has lead to an important improvement of quality of life (Ackerstaff & Hilgers, 1996).

Tracheoesophageal speech is considered as being the most effective way of alaryngeal speech. Advantages are the shortened revalidation time, the use of the normal respiratory system and the better quality of speech (Robbins et al., 1984; Fujimoto et al., 1991.

A frequently reported disadvantage of this way of voice production is the necessity to use one hand to close the tracheostoma. This impedes doing bimanual tasks and attracts the attention to the impairment. (Blom et al., 1982; Singh, 1987; Verkerke et al., 2002).

To overcome this major disadvantage Blom et al. introduced handsfree tracheoesophageal speech using an automatic stoma valve(Blom et al., 1982). Since then different types of tracheostoma valves have come onto the market. In our study Provox FreeHands HME (ATOS Medical) was used (Hilgers et.al 2003). Provox FreeHands HME (fig 1) is an automatic tracheostoma valve with an integrated filter cassette. In contrast to most other types, the openings for breathing are on the side of the device. By increasing exhalation airflow, a membrane will unroll which closes the side openings and gives the patient the ability to speak. The valve in front makes coughing possible without loosing the device.

Fig. 1 Provox FreeHands with HME-cassette. The coughing valve is opened, the membrane is rolled.
2. Patients/Materials and Methods

To compare manual and automatic stoma occlusion 13 patients who use the automatic stoma valve on a regular base were selected. The test group existed of 12 men and 1 woman. Their age varied between 40 and 78 years (mean 57 years). To compare quality of life a control group was composed. Therefore we contacted the patients who had tried out the FreeHands system, but had not bought it for different reasons. 11 patients granted their cooperation. All patients of both study group and control group completed an identification form, the Voice Handicap Index and a questionnaire in which was asked for user-friendliness of the device and patient satisfaction.

The 13 patients of the test group had to read a standard text at a comfortable loudness and sustain the vowel /a/, first at a comfortable loudness and then as long, as loud and as soft as possible, both with manual and with automatic stoma occlusion. In this way 26 speech samples were collected and registered on DAT-recorder.

Following objective parameters were selected: speech rate (i.e. the number of syllables per minute), fluency (i.e. the number of syllables produced on one intake of breath), maximal phonation time (MPT), minimal and maximal intensity and dynamic range. Fundamental frequency measurements turned out to be impossible in 22 of the 26 samples since the vibration pattern was too deviant. For these dynamic measurements we used the Computerised Speech Lab (CSL Model 47300B, Kay Elemetrics).

The perceptual judgments were performed by 6 blinded experienced listeners who were asked to compare, for person 1 till 13, both speech samples. For the parameters naturalness, intelligibility, tension, disturbing noises, intonation/variation and general voice quality, they had to indicate which of both samples they found the best. The possibility ‘both samples are equal’ was also added.

To examine the influence of handsfree speech on the quality of life of our patients, the VHI’s of the test group and the control group were compared.

For statistical processing of the data we used SPSS 9.0

3. Results

3.1 Objective analysis

There was a significant difference (p< 0.05) between automatic and manual stoma occlusion for the parameters MPT and fluency. In the manual stoma occlusion condition patients could sustain the vowel /a/ on average 4 seconds longer than in the handsfree condition. With manual occlusion they could
produce 11 syllables on one intake of breath, in contrast to 8 with automatic occlusion. For the parameters tempo of speech and the dynamic characteristics no significant differences were found.

3.2 Perceptual evaluation

When we focus on the results per patient, we can see that the speech of 3 persons was judged better when they were using FreeHands. For 3 other patients, the listeners reported no difference between both conditions. The handsfree speech of 7 patients was found less good than their TE-speech with manual stoma occlusion, by the majority of the listeners. On average, TE-speech with manual stoma occlusion is judged better than handsfree speech for the parameters naturalness, intelligibility, tension and general quality of speech. Only for the parameter intonation/variation no difference was reported in most of the cases (table 1).

Table 1: Subjective comparison (6 listeners) of handsfree and manual stoma occlusion on 5 parameters (n= 13)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Handsfree speech is better</th>
<th>Manual stoma occlusion is better</th>
<th>No difference between both conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Naturalness</td>
<td>16</td>
<td>44</td>
<td>18</td>
</tr>
<tr>
<td>Intelligibility</td>
<td>12</td>
<td>37</td>
<td>29</td>
</tr>
<tr>
<td>Tension</td>
<td>17</td>
<td>39</td>
<td>22</td>
</tr>
<tr>
<td>Intonation/variation</td>
<td>11</td>
<td>27</td>
<td>40</td>
</tr>
<tr>
<td>General quality of speech</td>
<td>18</td>
<td>49</td>
<td>11</td>
</tr>
</tbody>
</table>

In handsfree condition, disturbing noise is reported in almost all cases, whereas in half of the speech samples with manual occlusion no noise is heard by the listeners (table 2).

Table 2. Subjective comparison (6 listeners) of handsfree and manual stoma occlusion on parameter ‘disturbing noises’ (n= 13).

<table>
<thead>
<tr>
<th></th>
<th>No disturbing noises</th>
<th>Slightly disturbing noises</th>
<th>Strongly disturbing noises</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free hands condition</td>
<td>4</td>
<td>39</td>
<td>35</td>
</tr>
<tr>
<td>Manual condition</td>
<td>39</td>
<td>31</td>
<td>8</td>
</tr>
</tbody>
</table>
3.3 Subjective patient judgment

The majority of the patients of our test group preferred handsfree speech, concerning quality of voice, fatigability, attractiveness, and feelings of self confidence (table 3).

Table 3. Comparison of both ways of stoma occlusion by means of 4 parameters. Judgements from 13 patients.

<table>
<thead>
<tr>
<th></th>
<th>Voice quality</th>
<th>Fatigability</th>
<th>Attractiveness</th>
<th>Self confidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handsfree better than or similar to</td>
<td>9</td>
<td>8</td>
<td>13</td>
<td>11</td>
</tr>
<tr>
<td>manual occlusion</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Handsfree worse than manual occlusion</td>
<td>4</td>
<td>5</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

Almost all patients reported that the possibility to use both hands was the main advantage of the system. In addition a minority mentioned that their handicap was less remarkable with the free hands device. As main disadvantage patients reported the decreased adhesion of the stoma stickers when using FreeHands. The difference in duration of adhesion was significant (p < 0.05). A second frequently reported disadvantage is the fact that handsfree speaking is far more fatiguing than normal TE speech. Furthermore the presence of disturbing noises during speech was experienced as very adverse. Noises were specified as audible hissing noise during inhalation, whistling during speech (caused by the adhesives coming loose) and an audible flop when the membrane closes. The majority of the control group mentioned the higher cost of the device and the fact that handsfree speech is more fatiguing as the main reasons to decide not to use FreeHands any more. Other motivations were the decreased adhesion, disturbing noises and decreased speaking volume.

3.3 Quality of life

There was a significant difference between the FreeHands users and the control group for the VHI total score and the F-score (i.e. the functional component). The FreeHands group has higher scores, what corresponds with a lower quality of life.

4. Discussion and conclusions

The objective measurements showed worse results for handsfree speech for the parameters MPT and fluency. These findings can be explained by the theory that the air consumption is larger when using the automatic valve. There are different causes for this increased air consumption. Firstly, handsfree speaking requires a higher expiration force than manual stoma occlusion, both to unroll the
membrane and to maintain this situation while speaking. Another reason is that there is a certain delay in complete closure of the valve: during the unrolling of the membrane, a small amount of the expiration air can escape by the side openings. Figures 2a and 2b show these findings on the spectrograms of a sustained /a/, the first with manual occlusion, and the second with automatic valve occlusion. On figure 2b we can see a burst of multifrequent energy (white arrow), followed by a smaller low frequency component (black arrow). Then a short break occurs, followed by the spectrum of the vowel /a/. These spectral characteristics correspond with the moment on which the membrane unrolls (white arrow) and the valve closes (black arrow), and do not occur when the stoma is closed manually. They are found to a smaller or larger degree in the handsfree speech of all patients.

This phenomenon does not only cause a larger air consumption during speech, but also leads to the presence of disturbing noise. In perceptual evaluation the occurrence of disturbing noises is reported in handsfree speech in almost all patients, whereas this is much less the case in manual TE-speech. Other authors confirm this finding (Williams et al., 1990; Fujimoto et al., 1991).

By both the Free Hands users and the control group, the occurrence of noise, hissing sounds, flops and whistling was mentioned as a disadvantage of the system.

An important issue is the adhesion of the FreeHands device. Looking at individual findings in the test group, we see a group of patients in which the duration of adhesion does not differ according to the way of stoma occlusion. Nevertheless, in the other group the difference in duration is very large, from several days when using manual closure to some hours when using FreeHands.

These patients can only use the automatic valve occasionally during a short period and therefore mention the limited duration of adhesion as an important disadvantage of the system.
Previous studies also reported the maintenance of an airtight seal between stoma valve and peristomal skin as the main problem of handsfree TE-speech (Zanoff et al., 1996; van den Hoogen et al., 1996; Lewin et al., 1999, Op de Coul et al., 2005).

Despite poorer results for handsfree speech, both in objective and perceptual evaluation, and the reported disadvantages by FreeHands users themselves, patients prefer the FreeHands condition. Similar results are found by Op de Coul et al. (2005).

We can conclude that in selected patients the Provox FreeHands shows important subjective benefits. Improvements however are desirable to make the device a useful rehabilitation device for a larger group of laryngectomized patients.

5. References


Williams SE, Scanio TS, Ritterman SI. Perceptual characteristics of tracheoesophageal voice produced using four prosthetic/occlusion combinations. Laryngoscope. 1990;100(3):290