AERODYNAMIC REGISTRATION OF SPEECH.

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ABSTRACT

Subtle deviations in articulatory behaviour can prohibit cleft palate patients from aquiring normal (non nasalized) speech after apparently successful surgery. This is not least a question of management of aerodynamics in speech. Registrations of nasal air flow and intraoral air pressure during therapy, with use of a dual oral-nasal Rothenberg mask, can be of great help for the patient as a pedagogical means in detecting and correcting faulty speech patterns.

INTRODUCTION

Patients who have established their speech production pattern under conditions incompatible with building up necessary intraoral air pressure have often adapted their articulatory strategies to these less favourable conditions. This is especially true of cleft palate patients who have needed secondary palatal surgery or who have had primary surgery late in life.

Not only deviant articulatory placement but also subtler deviations in the configuration of the vocal tract may prevent them from acquiring normal speech after apparently successful surgery. This is not the least a question of management of aerodynamics in speech. Warren (1986), [2] suggests that the regulation of aerodynamics is important in the development of speech production patterns. He further suggests that it governs the choice of compensatory behaviours and the programming of speech patterns in these patients. He proposes yet another approach for modifying these faulty speech patterns.

Subtle deviations in these patients have been described in detail and illustrated by spectrograms (Ericsson, 1987), [1]. Acoustic measurements have proved to be a valuable complement to usual clinical investigation of performance in these patients, and in evaluating the results of therapy. Understanding of all the information that is given in a spectrogram requires experience and possibility of consulting with experts in phonetics.

For the patient a spectrogram often might be difficult to interpret. Therefore it is of utmost importance to find a pedagogical means which the patient understands without difficulties. It is worth mentioning that these patients often don't actually hear their speech defects, even though they are aware that something must be wrong through comments from other people.

PRACTICAL PROCEDURES

We register with the aid of a dual oral-nasal Rothenberg mask, nasal air flow and intraoral air pressure during speech, before and after correction. The results are shown to the patient on the computer screen, which encourages and helps him to change his habit.

Thus, the patient can realise the results of articulatory changes with three senses: vision, hearing and feeling. To our knowledge, no one else is using simultaneous registrations of nasal air flow and intraoral air pressure as a pedagogical means during therapy.

EQUIPMENT

We use a dual oral-nasal Rothenberg mask. The openings in the mask is covered with fine wire mesh, to produce a pressure difference proportional to the air flow. However, the oral transducer is connected to a small tube which protrudes into the corner of the mouth.

Thus we measure intraoral pressure for labiodental sounds. The amplified output from the pressure transducers is connected to a 30 Hz lowpass filter to remove any speech frequencies from the registration. The filtered signal is digitised and recorded by SOUNDSWELL [3] , a speech recording and analysis software package. At the moment, we have no registration of speech, because it is most important to monitor the aerodynamics in the training situation for visual feedback. However, we are in the process of adding microphones to the Rothenberg masks for listening purposes and for extended evaluation of articulatory behaviour.

CASE DESCRIPTIONS.

Cleft palate patient

Registrations from a 16 year old boy are given in Figure 1a-c. He was born with bilateral cleft lip and alveolus and cleft palate. After lip operation the palate was operated before 2 years of age. Secondary operation with pharyngeal flap was performed when the boy was 10 years old, as the velopharyngeal function had proved to be insufficient.

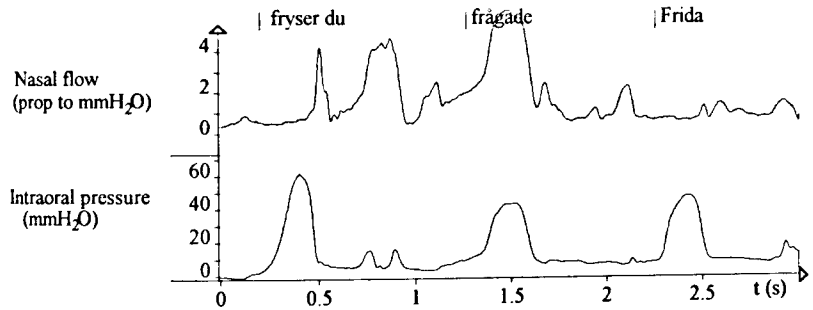

Figure 1 a shows nasal air flow and intraoral air pressure during pronunciation of the phrase: 'Fryser du frågade Frida?' (Are you cold? Frida asked.) before correction of speech.

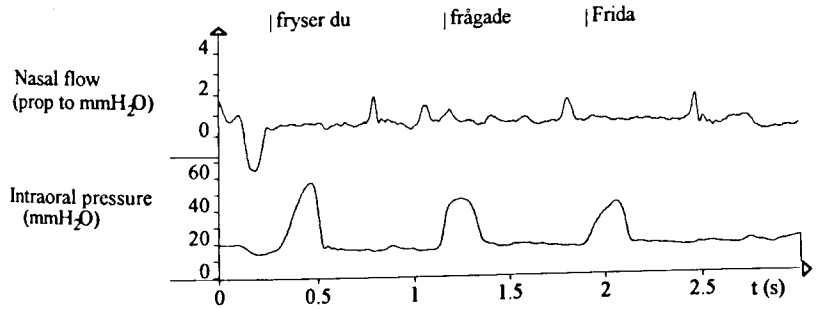

Figure 1 b shows the registrations of the same phrase immediately after correction.

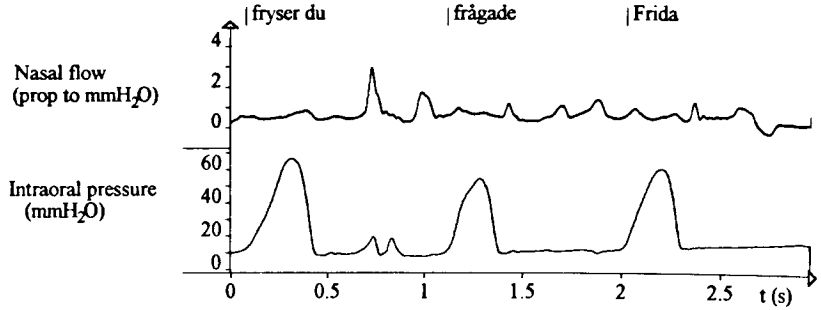

Figure 1 c shows the same phrase as spoken on first trial at a therapy session one month later.

Evident nasal escape can be noticed on Figure 1a. The relation in time of the nasal escape on /f/ to the intraoral air pressure built up on production of this sound can be studied. In the second and third registrations the nasal escape has diminished.With our equipment we can measure the air pressure in the oral cavity for sounds with articulatory seat in front of the little tube introduced in the corner of the mouth, thus bilabial and labiodental sounds. In training we have found it most convenient to start with these sounds, as the entire vocal tract is situated behind the place of articulation. Generalisation then often easily occurs to sounds of the same category on dental and velar places. Figure 2 shows the same phrase spoken by a normal speaking person.

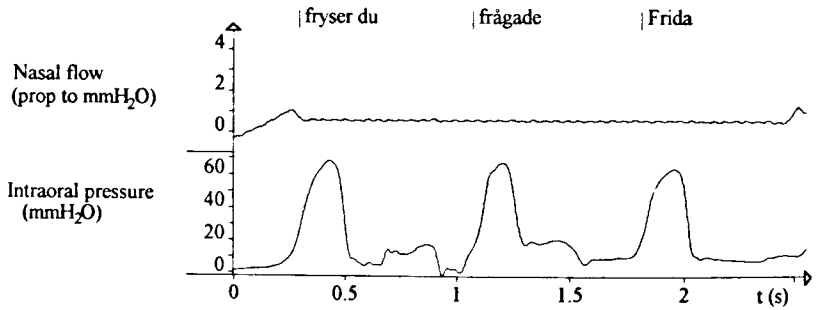

Figure 2 shows a registration from a normal speaker for comparison.

Patient with no history of cleft palate.

Figure 3 shows registrations from a 9 year old boy who was referred for nasal emission on /s/ in certain context. He had received speech therapy in school for some years. We could not find any nasal emission on /s/, but the patient seemed very aware of these sounds and prolonged them. On recording we noticed nasal emission sometimes but not always on /f/ and to lesser extent on /p/ and /b/. No history of cleft palate. The aerodynamic registrations show that the production of /f/ sometimes seemed to start with nasally directed airflow. On next visit, two weeks later, the nasal emission in the same utterance could not be noticed as shown in Figure 3b. The utterances shown here are bisyllables with final syllable stressed.

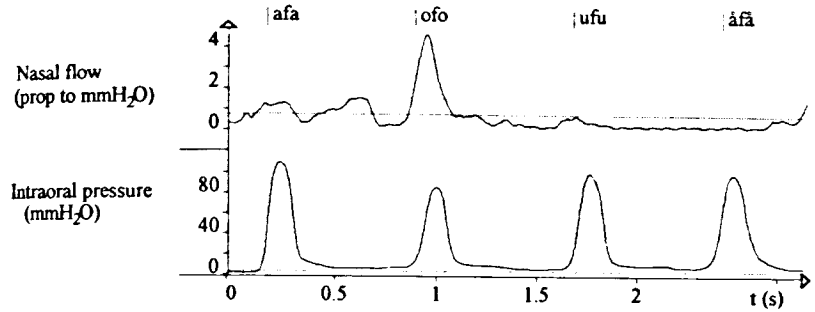

Figure 3a. Pretherapy registrations. Notice that nasal flow precedes the oral pressure build up for /f/ in "ofo".

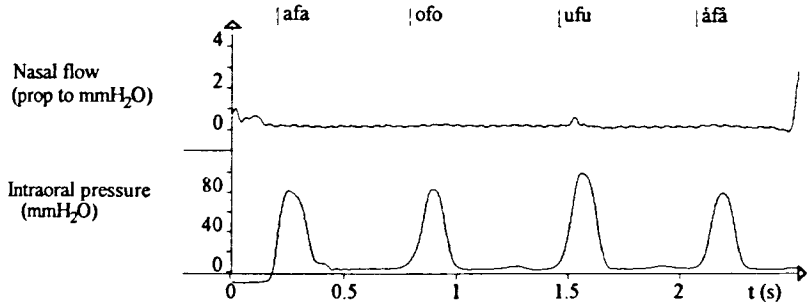

Figure 3 b. Posttherapy registration, two weeks later.

The boy and his mother found the aerodynamic registrations helpful in demonstrating the articulatory habit and the results of the changes during therapy. Later his tendency to prolong the /s/-sounds also disappeared, and his family members had spontaneously found his speech to be better.

REFERENCES

[1] Ericsson, G. (1987), *Analysis and Treatment of Cleft Palate Speech: Some Acoustic-Phonetic Observations*, Linköping University Medical Dissertations, No. 254.

[2] Warren, D. W. . (1986). Compensatory Speech Behaviour in Individuals with Cleft Palate: A Regulation/Control Phenomenon? *Cleft Palate J.*, vol. 23, pp. 251-260.

[3] *Soundswell user's manual*,1987-1994, Soundswell Music Acoustics HB