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Functional evaluation of velar insufficiency by means of the rhinomanometric method

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SUMMARY

25 subjects aged between 5 and 17 years, 15 females and 10 males, underwent anterior rhinomanometry. 10 of them were normal and 15 affected by velar insufficiency following adenotonsillectomy in 11 case and palatosynthesis in 4. The rhinomanometric tracing was obtained while the patient repeatedly pronounced oral vowels such as **a, e, i, ɔ, u** *and CVs such as* **ka, ga.** *In normal subjects intranasal pressure modifications were represented by a series of dyphasic waves with a positive-negative polarity. In the subjects with velar insufficiency the waves were almost monophasic with positive polarity. During and after the phoniatric rehabilitation, waves returned to be dyphasic together with a progressive reduction of hypernasality. While morphology of the rhinomanometric tracing can be considered a reliable index of velar function, wave's amplitude is influenced by the anatomical conditions of the nasal cavity and by the intensity with which the subject pronounces the vowels and the CVs. Rhinomanometry represents therefore an atraumatic, rapid and reliable technique, easy to perform, in order to evaluate velopharyngeal function and to monitor the increase of velar function during and after treatment.*

INTRODUCTION

Elevation of the soft palate during swallowing and articulation of oral phonemes excludes the rhinopharynx, while during suction and nasal breathing its narrowing excludes the oral cavity.

A velopharyngeal insufficiency causes hypernasality during speech due to an increased airflow through the rhinopharynx and is most often related to paralysis, hypotonia and/or congenital wideness of the rhinopharyngeal space, due to the sequelae of surgery, namely palatosynthesis and adenotonsillectomy.

As during speech the velar contraction modifies pressures within the nasal cavity, the purpose of the present study is to investigate velar function by recording such

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modifications in normal subjects and in patients affected by velopharyngeal insufficiency by means of the anterior rhinomanometric method.

MATERIALS AND METHODS

Pressure variations within each single nasal cavity during the repeated pronounciation of oral vowels such as **a, e, i, ɔ, u** or CVs such as **ka** and **ga,** were recorded by means of a 2-channel Cottle Rhinomanometer. Two nozzles connected with the pressure channel were applied to the nostrils paying attention not to modify significantly their shape. The patient was invited to inspire once through the nose and to pronounce the oral vowels and CVs during expiration.

25 subjects, aged between 5 and 17, 15 males and 10 females, were studied. 10 of them were normal, and 15 affected by velopharyngeal insufficiency following adenotonsillectomy operation in 12 cases and palatosynthesis in 3. In no cases signs or symptoms of upper airway pathology were present.

The test was repeated almost within the same humidity and temperature conditions, almost at the same clock time, in order to minimize variables, after phoniatric therapy consisting in 3–4 weekly sessions, during which breathing exercises stimulating speech muscles and rehabilitation concerning phonemes articulation was carried out.

RESULTS

In normal subjects pressure modifications during speech in each nasal cavity were represented by dyphasic positive negative waves with variable amplitude. Such a behaviour was evident during pronounciation of CVs, such as **ka** and **ga** and of the oral vowels in which the degree of velopharyngeal occlusion was higher (Figure 1).

In the twelve patients with velopharyngeal insufficiency following adenotonsillectomy, the waves were almost monophasic and with positive polarity before treatment, while following phoniatric rehabilitation, when hypernasality had

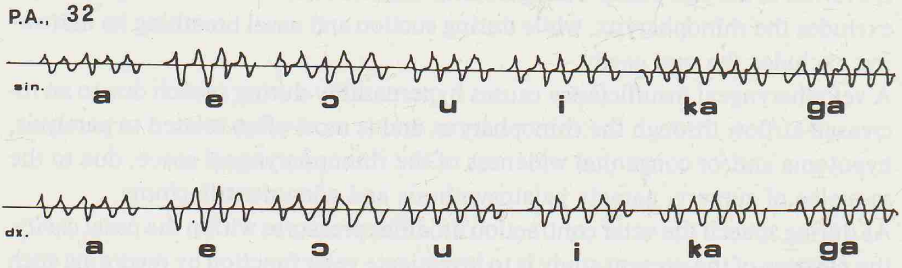

Figure 1. P.A., 32. In normal subjects during pronounciation of oral vowels such as **a, e, i, ɔ, u** and CVs such as **ka** and **ga** the pressure within the nasal cavities shows a clearly identifiable dyphasic behaviour, the wave showing a characteristic positive-negative polarity.

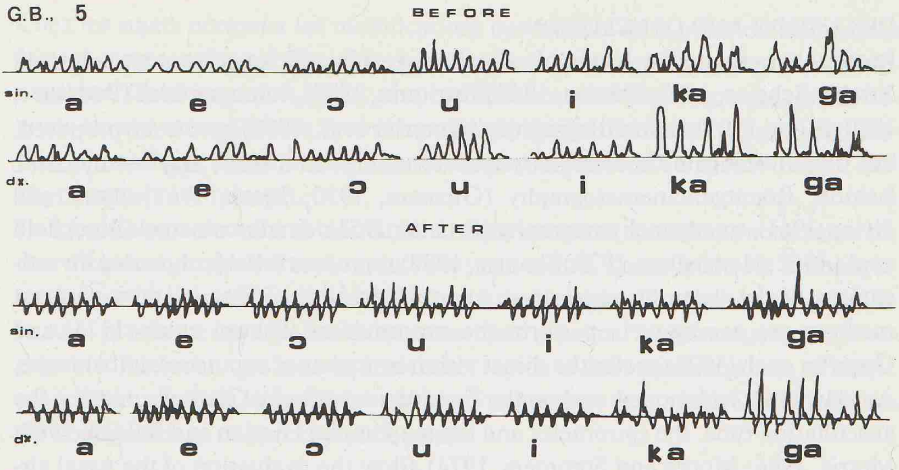

Figure 2. G.B., 5. In this subject, presenting hypernasality after adenotonsillectomy, the intranasal pressure shows a monophasic behaviour before treatment. After treatment, the normal dyphasicity becomes again evident, correlating well with the reduction of the hypernasality.

disappeared, the normal dyphasic behaviour became progressively evident (Figure 2). Also in three subjects who underwent palatosynthesis before the phoniatric treatment, we observed the presence of monophasic positive waves, while at the end of the rehabilitation dyphasic peaks became again evident, together with the reduction of the hypernasality (Figure 3).

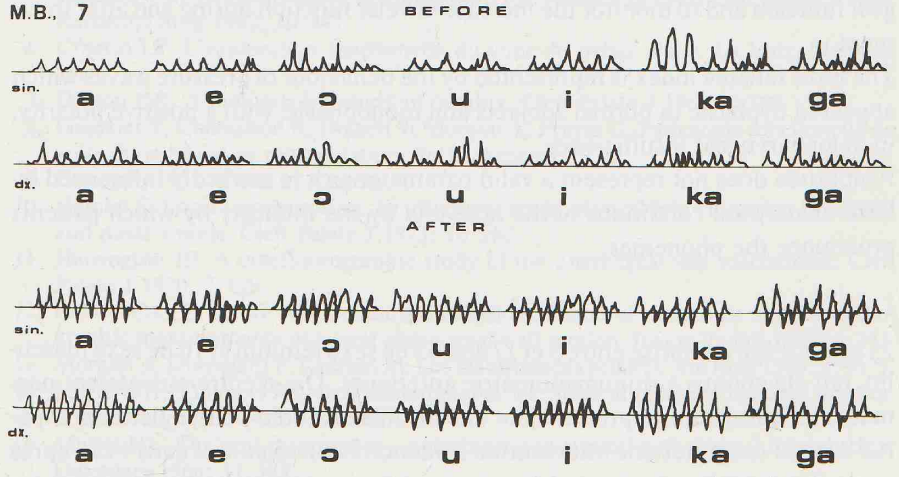

Figure 3. M.B., 7. The subject showed hypernasality following palatosynthesis. Again, before treatment, the intranasal pressure showed a monophasic behaviour. After treatment, the normal dyphasicity became again evident.

DISCUSSION AND CONCLUSION

In order to evaluate the degree of velopharyngeal insufficiency, standard regional X-rays (Scheier, 1897; Dikson, 1969; Patriquin, 1973), tomographies (Podvinec, 1950; Bjork, 1961), xeroradiographies (Guerrier et al., 1978) have been proposed, but they investigate the velopharyngeal structures in a static and not dynamic fashion. Roentgencinematography (Guzman, 1930; Bjork, 1961; Bjork and Nylen, 1961), roentgenchymography (Croatto, 1953), cinefluoroscopy (Blackfield et al., 1962; Harrington, 1970; Shapiro, 1982) represent reliable dynamic investigations of the velar structures but a certain amount of X-rays and a contrast medium are necessary to perform the examination. Tokuso et al. (1973) and Guerrier et al. (1978) prefer the direct vision by means of a transnasal fiberscope. Aerodynamic techniques, such as the Zwaardemaker's and Glathel's mirrors, the auscultation tube, the spirometer and the manometer (Arslan and Baldan, 1960; Morris, 1966; Moore and Sommers, 1974) allow the evaluation of the nasal airflow during speech, but the velar contraction in these cases is slower than during speech (Morgon et al., 1969; Spriestersbach et al., 1962). Also electro-aerometry (Smith, 1960), ultrasonography (Kelsey et al., 1969; Hamlet, Skolnick et al., 1975) and electromyography have been proposed (Basmajan and Dutta, 1961).

Our results show a marked difference of intranasal pressure behaviour as recorded by means of the anterior rhinomanometry technique during pronouncement of vowels and CVs between normal subjects and patients with velopharyngeal insufficiency.

As observed also by Poli et al. (1983), anterior rhinomanometry represents an atraumatic, rapid and reliable technique, easy to perform to evaluate velopharyngeal function and to monitor the increase of velar function during and after treatment.

The most reliable index is represented by the behaviour of pressure waves which appeared dyphasic in normal subjects and monophasic, with a positive polarity, in velopharyngeal insufficiency.

Amplitude does not represent a valid parameter as it is markedly influenced by local anatomical conditions of the nose and by the intensity by which patients pronounce the phonemes.

RÉSUMÉ

25 sujets d'âge comprise entre 5 et 17 ans, 15 de sexe féminin et 10 de sexe masculin, ont été soumis à rhinomanométrie antérieure. Dix d'entre-eux étaient normaux, les quinze autres présentaient une insuffisance vélo-pharyngienne comparue dans 11 cas, après une intervention d'adénotonsillectomie et dans 4 cas, après une palatosynthèse. Le tracé rhinomanometrique a été obtenu pendant que les patients prononçaient plusieurs fois les voyelles orales **a, e, i, ɔ, u** et les consonnes-voyelles **ka** et **ga.**

Chez les sujets normaux les modifications des valeurs de la pression intranasale étaient représentées par une série de déflexions diphasées avec polarité positive-négative. Chez les sujets ayant une insuffisance vélo-pharyngienne, les déflexions étaient monophasées avec une polarité positive. Pendant et après la réducation phonétique, les déflexions redevenaient diphasées en même temps que l'hypernasalité diminuait.

La morphologie du tracé rhinomanométrique peut être considérée comme un index d'évaluation de la fonction du voile; par contre, l'amplitude est influencée par les conditions anatomiques de la cavité nasale et par l'intensité avec laquelle le sujet prononce les voyelles et les consonnes voyelles. La rhinomanométrie représente une technique sans traumatisme, rapide et de réalisation aisée, affidable pour l'évaluation de la fonction velo-pharyngienne et de la réprise de la fonction du voile pendant et après le traitement.

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