PERCEIVED HYPERNASALITY IN THE PRESENCE OF ADEQUATE VELOPHARYNGEAL CLOSURE AS MEASURED BY AERODYNAMIC STUDIES

By

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ABSTRACT

It was found that there was a group of patients with repaired cleft palate who demonstrated a discrepancy between aerodynamic assessment of velopharyngeal (VP) adequacy and clinical judgement of nasal resonance. The aim of this work is to study such group of patients in order to understand and explain this discrepancy. This study comprised 37 subjects divided into two groups. The first group comprised 12 patients with the diagnosis of repaired overt or submucous cleft palate with an age range of 5 to 25 years (mean age = 13 years). This group showed an audible degree of hypernasality in their speech while they have adequate VP port area by aerodynamic measures. The second group (n = 25) comprised age and sex matched normal subjects who

demonstrated normal resonance of speech. All the subjects were assessed subjectively for the degree of open nasality on a 4-point scale and objectively by acoustic and aerodynamic studies.

Acoustic studies demonstrated a highly significant difference in the nasalance scores between both groups. Aerodynamic studies demonstrated a statistically non-significant difference concerning nasal flow and intra-oral and nasal pressure findings between both groups. While, on the other hand, the timing of both the nasal flow and the intra-oral pressure showed highly significant difference between both groups. Also, the nasal flow peak showed a highly significant shift to the right with delay in flow in relation to the intra-oral pressure.

tients with repaired cleft palate who demonstrated a discrepancy between aerodynamic assessment of velopharyngeal adequacy and clinical judgement of nasal resonance. The speech of those patients were judged as hypernasal although VPA was less than 5 mm^2 by aerodynamic measures. In 1993, Warren et al.⁴ tried to explain this phenomenon on the basis of a timing disorder of VP closure.

The aim of this work is to study such group of patients with repaired cleft palate who demonstrated an audible degree of hypernasality in their speech while they have adequate VPA by aerodynamic measures in order to understand and explain this discrepancy between the subjective perceptual ratings and the objective aerodynamic measures.

MATERIAL AND METHODS

This study comprised 37 subjects divided into two groups. The first group comprised 12 patients who attended the Phoniatrics Unit, Ain Shams University Hospitals with the diagnosis of repaired overt or submucous cleft palate. They were 6 males and 6 females with an age range of 5 to 25 years (mean age = 13 years). This group showed an audible

degree of hypernasality in their speech while they have adequate VPA by aerodynamic measures. The second group (n = 25) comprised age and sex matched normal subjects who demonstrated normal resonance of speech. None of the subjects of either group demonstrated hearing loss, mental subnormality or neuromuscular disorders.

All the subjects were assessed subjectively and objectively as follows :

(A) Subjective assessment:

Auditory perceptual assessment of the degree of open nasality of all subjects was judged by 3 clinicians on a 4-point scale:

0 = normal (no audible open nasality).

1 - mild degree of open nasality .

2 = moderate degree of open nasality .

3 = severe degree of open nasality

(B) Objective measures:

(1) *Acoustic measures* : The VPA of all subjects were assessed using Kay Elemetrics Nasometer (model 6200-2, version 1.5) for measurement of nasalance scores for an oral sentence (/ali rah jel'ab korah/) on the basis of calculating the ratio of nasal to

B) PERCI readings :

i) *Flow and pressure findings :* All items entering the equation were compared between both groups to determine any differences in their results. It was found that all parameters showed statistically non-significant difference ($P > 0.05$) although VP port areas showed a tendency for higher mean results in the patients group than the normal group (table 2).

ii) *Timing results :* The timing of both the nasal flow and the intra-oral pressure showed highly significant difference ($p < 0.01$) between both groups with group 1 producing more durations than group 2. The nasal flow peak also showed a highly significant shift to the right with delay in flow in relation to the intra-oral pressure ($p < 0.01$) (table 3).

Table (1): Results of nasalance scores of group 1 (patients, $n = 12$) and group 2 (normal subjects , $n = 25$) as compared by T-test:

Measures	Group 1	Group 2	T-value	P-value and significance
Nasalance (%)	41.3 $\pm$ 21	15.1 $\pm$ 5	12.5	$P < 0.01$ HS

HS = highly significant

Table (2): Results of flow and pressure findings of group 1 (patients, $n = 12$) and group 2 (normal subjects , $n = 25$) as compared by T-test:

Measures	Group 1	Group 2	T-value	P-value and significance
Nasal Flow (L/s)	20.7 $\pm$ 15	16.1 $\pm$ 13	1.07	$P > 0.05$ NS
Intra-oral pr. (cm H ₂ O)	3.9 $\pm$ 2	6.4 $\pm$ 4	1.9	$P > 0.05$ NS
Nasal pr. (cm H ₂ O)	0.86 $\pm$ 0.7	0.45 $\pm$ 0.3	1.3	$P > 0.05$ NS
Oral-nasal pr.	3.0 $\pm$ 2.4	6.0 $\pm$ 3.6	2.1	$P > 0.05$ NS
VPA (mm ²)	1.9 $\pm$ 0.5	1.1 $\pm$ 0.7	1.9	$P > 0.05$ NS

VPA = velopharyngeal orifice area

NS = non-significant

flow must occur during the oral pressure-rise phase. There should be no nasal flow at the oral pressure peak. In the patients' group the shift of the flow curve to the right is indicative of nasal flow associated with the pressure peak. This explains why these patients have perceived open nasality.

The prolonged open time for the VP orifice is confirmed by Dalston et al.⁷ and Warren et al.⁴ who described similar findings in a group of patients who demonstrated hypernasality with normal VP port areas. Dalston et al.⁷ explained the timing delay by adjustments that were presumed to be necessary in order to compensate for differences in VP movement capabilities. However, Warren et al.⁴ also found that patients had significantly lower nasal airflow rates than normal non-cleft subjects. Nevertheless, they suggested that the time where the nasal chamber is open to the vocal tract was more important to determine the degree of open nasality than the actual amount of airflow escaping through the nose.

The current study indicates that the acoustic measurements using

nasometer may be more sensitive in detection of open nasality than aerodynamic measurements using PERCI. Moreover, the results of the latter should be carefully interpreted when a discrepancy occurs between perceptual judgments and VP port areas. It is recommended that the velopharyngeal closure patterns for other conditions associated with VPI such as hearing impairment, mental retardation and neuromuscular disorders be studied in order to evaluate their closure patterns. The present study also indicates that in rehabilitation of such patients it may not be enough to have the patient try to minimize hypernasality by reducing expiratory effort. The duration of closure should also be shortened perhaps through visual feedback using PERCI for better outcome.

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الخنف المفتوح المسموع فى وجود قياسات طبيعية للصمام اللهاى البلعومى باستخدام دراسة ديناميكية الهواء

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وجد أنه فى مجموعة من مرضى شق سقف الحلق والذى أجريت لهم جراحة لاصلاح الشق، أنهم يعانون بعد العملية من نسبة من الخنف المفتوح المسموع وكذلك من اختلاف فى نتائج الفحص الديناميكي لالية الهواء. أثناء الكلام وهذا فى وجود قياسات طبيعية لمساحة الصمام اللهاى البلعومى لهذه المجموعة. تهدف هذه الدراسة الى معرفة سبب هذه الفروق فى النتائج. وتشمل عينة البحث ٣٧ شخص مقسمة إلى مجموعتين، المجموعة الأولى وتضم ١٢ مريض من مرضى شق سقف الحلق المخاطى بعد اجراء العملية تتراوح أعمارهم بين ٥ - ١٢ سنة (المتوسط ١٣ سنة). يبين فحص هذه المجموعة وجود خنف مفتوح مسموع مع وجود قياسات طبيعية لمساحة الصمام اللهاى البلعومى باستخدام وسيلة فحص ديناميكية الهواء (البيرسى). أما المجموعة الثانية وعددها ٢٥ فهى المجموعة الضابطة والكلام فيها طبيعى وكذلك قياسات الصمام اللهاى البلعومى. وقد تم رصد نتائج كل من المجموعتين بتقييم درجات الخنف المفتوح المسموع وأيضاً باستخدام القياسات الصوتية وقياسات ديناميكية الهواء للصمام اللهاى البلعومى، وتبين وجود نتائج إيجابية فى المجموعة الأولى فى تأخر العامل الزمنى بين سرعة مرور الهواء الأنفى وضغط الهواء الفمى وكذلك فى إنحراف منحنى سرعة مرور الهواء من الأنف الى اليمين. وهذا قد يفسر مانسمعه من خنف مفتوح فى وجود قياسات طبيعية لمساحة الصمام اللهاى البلعومى. وضحت هذه الدراسة أيضاً أهمية النازوميتر كوسيلة فعالة فى قياسات الخنف المفتوح وأنه أكثر فاعلية عن إستخدام جهاز البيرسى.