

부비동수술 후 비음형대와 비개존도의 변화에 대한 분석

손정엽 · 권병우 · 박헌수

The Analysis of the Changes of Nasal Formant and
Nasal Patency after Sinus Surgery

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-ABSTRACT-

Background and Objectives : Nasal sounds are normally produced with an opened velopharyngeal part during pronouncing nasal consonants. Various disorders in nasal cavity and paranasal sinus can affect the resonance of nasal sounds, and result in change of nasality perceptually. Many instruments including rhinomanometry and acoustic rhinometry can assess the nasal passage dynamically and statically, but cannot assess the extent of nasality objectively. Recently analytic methods with computerized equipments such as PCquirer and sound spectrum are gaining wide attention to evaluate the nasality objectively. The aims of this study were to measure and follow the postoperative changes of the formant of nasal consonants, to evaluate the relationship between these acoustic and volumetric changes of rhinosinus, and to estimate the effect of rhinosinus as a nasal tract on nasal resonance after operation. **Materials and Method** : The changes of formant, spectral pattern and nasal symptom were evaluated in 25 patients before ESS (endoscopic sinus surgery) and 2 months after ESS. An acoustic rhinometry were used for measuring the resonant volume of rhinosinus. **Results** : The first formant was decreased when ESS was carried out two months after the surgery. Subjective symptom and acoustic rhinometric results were significantly improved. However, The increment of resonant volume in rhinosinus was not correlated with the degree of decrement of the first formant two months after the surgery. The change of voume and formant were not correlated with subjective symptomatic improvement. **Conclusion** : Acoustic and sound spectrographic analysis are considered to be useful tools for objectively assessing the nasality after surgery in patients with paranasal sinusitis. But there are some limitation for measure of relationship between formant and nasal patency via symptomatic change. (J Clinical Otolaryngol 2002;13:93-99)

KEY WORDS : Nasal formant · Endoscopic sinus surgery.

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2)3) 가 , 12 25 13~66 (34) 13

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가 25

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4) 가

(nasal consonant) /ㅁ[m]/, /

ㄴ[n]/, /ㅇ[ŋ]/

[Δmma] ; ' [nana] ; ' [iŋə] '

가

Merocel®

가 가 2 PCquirer(ver

4.9.5) (Linear Predictive

Coding : LPC) (Fast Fourier Tr-

ansform : FFT) (Sound

spectrum) (Fig. 1).

연구대상 ; ' ' 3 15cm

가 2 3 11kHz

가 , PCquirer(ver4.9.5)

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대상 및 방법

연구대상

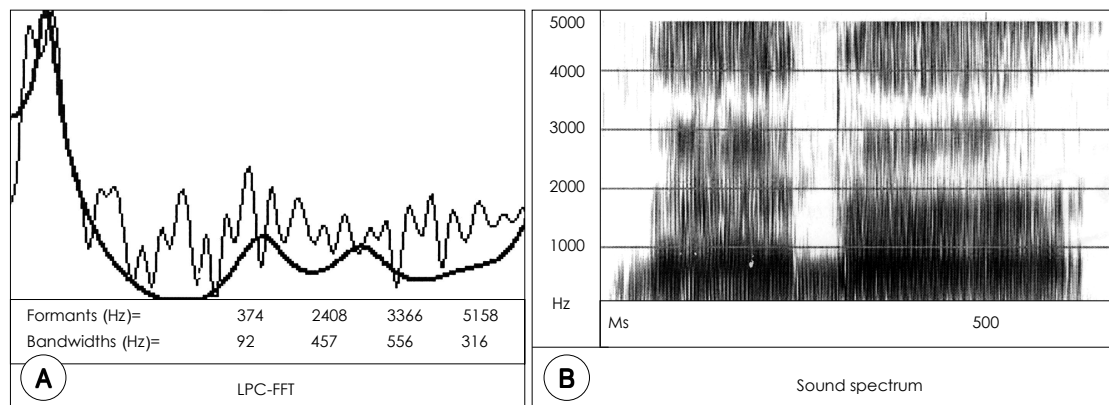


Fig. 1. The LPC-FFT ((A) : Linear Predictive Coding and Fast Fourier Transform) and Sound spectrum (B) of /LH-/ by PCQuirer.

(spectrum) Vowel Consonant Vowel(V₁CV₂)

Consonant(C)

independent sample t - test
(p<0.05).

paired t - test Pear-
son correlation test

nosepiece 15
Eccovision Acoustic Rhino-
meter(Model AR - 1003, Hood Laboratories, Pem-
broke, MA) Nosepiece
가

결 과

비음형태 측정과 스펙트럼(Spectrum)의 변화

가
1 5 (1 ; no symptom, 2 ; minimal, 3 ;
mild, 4 ; moderate, 5 ; severe)

' ' [n] ' ' [ŋ] 1
(Fig. 2)

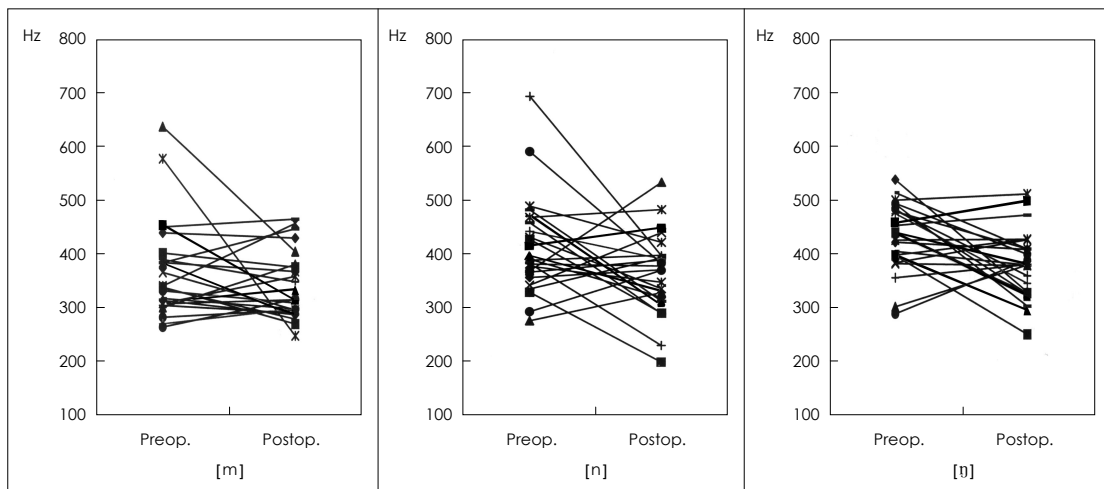


Fig. 2. The Distribution of first nasal formant of ESS (Endoscopic sinus surgery) group.

Table 1. The nasal formant of ESS group (p<0.05)

	[amma]			[nana]			[iŋə]		
	f1	f2	f3	f1	f2	f3	f1	f2	f3
Preop	361.04	1762.12	3226.00	364.68	2249.36	3721.44	380.04	2342.96	4301.36
Postop	338.52	1989.64	3552.14	414.64	1710.20	3070.08	431.76	2410.24	4381.24
p value	0.146	0.428	0.296	0.032	0.429	0.326	0.005	0.87	0.88

Preop : preoperative, Postop : postoperative

Table 2. The change of nasal formant ($p < 0.05$)

	[amma]			[nana]			[ina]		
	f1	f2	f3	f1	f2	f3	f1	f2	f3
Preop	367.04	1762.12	3226.0	414.68	2249.36	3721.44	431.76	2342.96	4301.36
Control	377.92	1343.84	2747.24	434.28	2260.40	3896.64	348.56	2205.40	3928.00
p-value	0.803	0.044	0.168	0.506	0.978	0.728	0.05	0.707	0.510
Preop	367.04	1762.12	3226.0	414.68	2249.36	3721.44	431.76	2342.96	4301.36
Postop	338.52	1989.64	3552.76	364.68	1710.68	3070.08	380.04	2410.24	4381.24
p-value	0.348	0.026	0.040	0.014	0.097	0.082	0.045	0.536	0.416

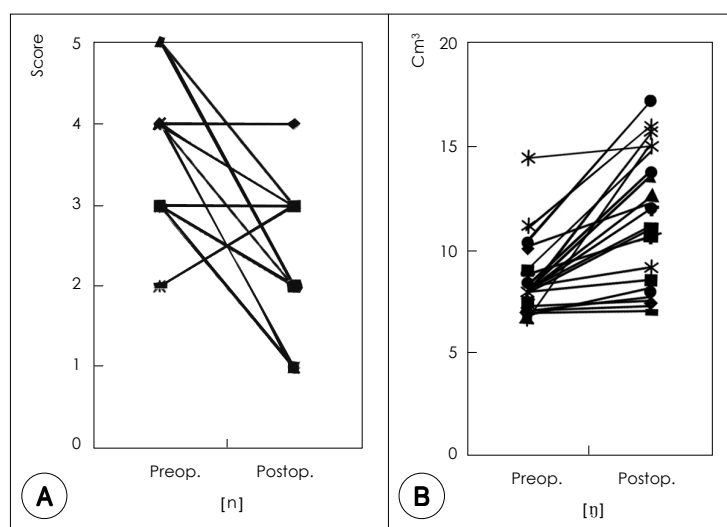


Fig. 3. The Change of symptom score (A) and volume (B) by rhinometry.

가
' [n] ' [m] 1
(Table 2).

부비동의 용적변화와 증상의 변화

(Fig. 3).

가

(Table 3).

가

(Fig. 4).

' /□/ 1

상관관계 분석

가

(Figs. 5 and 6).

5%

Table 3. The change of acoustic rhinometry compared to control group ($p < 0.05$)

	Rhinometry (cm ³)
Preop	8.41
Control	10.66
p-value	0.01
Preop	8.41
Postop	11.82
p-value	0.123

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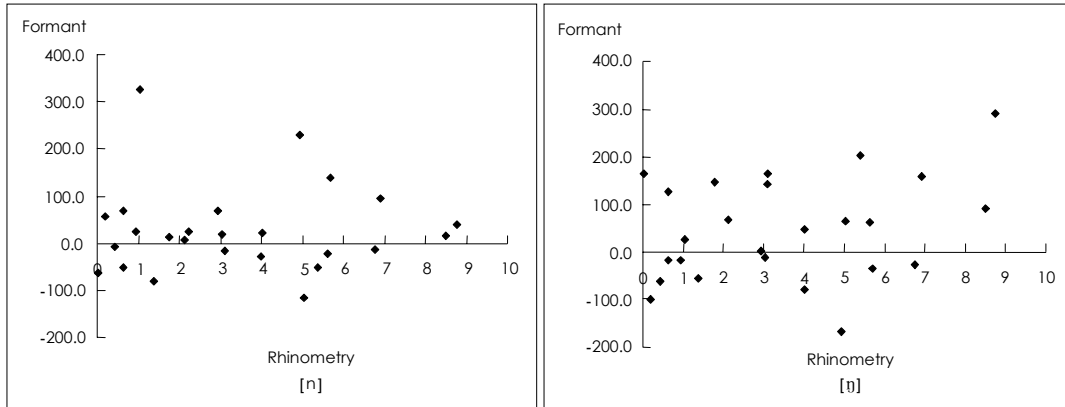


Fig. 4. The correlation between the change of nasal formant [n], [ŋ] and volume by acoustic rhinometry.

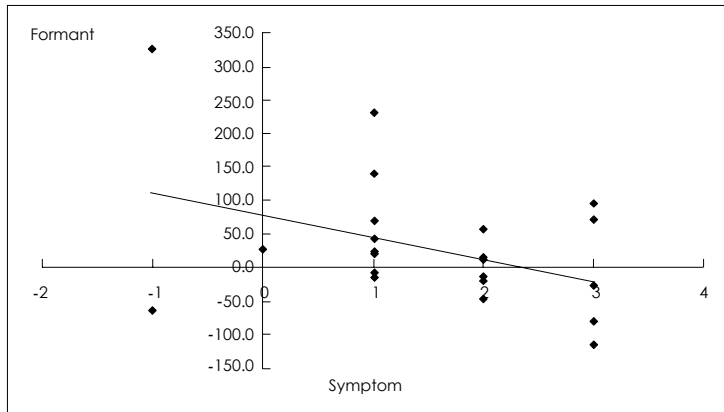


Fig. 5. The correlation between the change of nasal formant /L/ and symptom score.

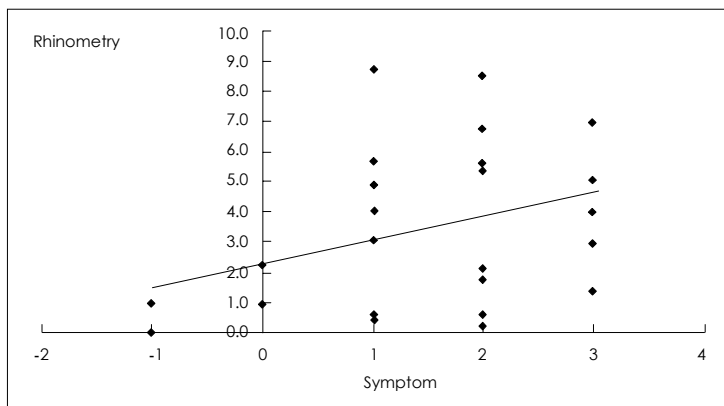


Fig. 6. The correlation between the change of rhinometry and symptom score.

고찰 . Fant⁵⁾ (sound filter theory)
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가 (formant)
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 1960
 (rhinomanometry)
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 Porter¹³⁾
 가 0.98
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 가¹⁴⁾¹⁵⁾
 Hong¹⁶⁾
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중심 단어 :

REFERENCES

1) Chen MY, Metson R. *Effect of sinus surgery on speech. Arch Otolaryngol Head Neck Surg 1997;123:845-52.*

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- 2) Hilberg O, Grtmer LF, Pedersen OF. *Turbinate hypertrophy: evaluation of the nasal cavity by acoustic rhinometry. Arch otolaryngol* 1990;116:283-9.
- 3) Lenders H, Pirsig W. *Diagnostic value of acoustic rhinometry: patients with allergic and vasomotor rhinitis compaired to normal controls. Rhinology* 1990;28:5-16.
- 4) Jin SM, Kang HG. *Significance of nasometer and first formant for nasa patency after septoplasry and turbinoplasty. J korean Logo Phon* 1997;8:161-5.
- 5) Fant G. *Acoustic theory of speech production. The Hague Mouton*;1970.
- 6) Curtis JF. *An acoustics of nasalized speech. Cleft palate J* 1970;7:380-96.
- 7) Fujimura O. *Analysis of nasal consonants. J Acoustic Soc Am* 1962;34:1865-75.
- 8) Fletcher SG. *Nasalance vs listener Judgements of nasality. Cleft palate J* 1976;13:31-44.
- 9) Fletcher SG. *Theory and instrumentation for quantitative measurement of nasality. Cleft palate J* 1970;7:601-9.
- 10) Masuda S. *Role of the maxillary sinus as a resonant cavity. J Otolaryngol Jpn* 1992;95:71-80.
- 11) Williams RG, Preece M. *The effect of adenoid and tonsil surgery on nasalance. Clin Otolaryngol* 1992;17:136-40.
- 12) Ahn CM, Kim YW. *Fat injection of Functional velopharyngeal Insufficiency as the supportive treatment. J of speech science* 1998;4:18-25.
- 13) Porter M, Willianson J. *Manometric rhinometry: a new method of measuring nasal volume. Rhinology* 1995;33:86-8.
- 14) Choi C, Kim HJ, Rho YS. *A study of the rhimomanometry in normal persons. Korean L Otolaryngol* 1989;32(5) :832-9.
- 15) Parker AJ, Maw A. *An objective method of patients for adenoidectomy. Clin Otolaygol* 1989;14:161-6.
- 16) Hong KH, Kim YJ. *An effect of tonsillectomy on formant and nasality. Korean J Otolaryngol* 1994;37(3) :543-52.