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Treatment and Result of Slight Velopharyngeal Incompetence

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As the adequate velopharyngeal function is a prerequisite to correcting faulty articulations which may be found in patients with repaired cleft palate, submucous cleft palate, or congenital velopharyngeal incompetence. Our diagnostic and therapeutic measures start therefore with the diagnosis of velopharyngeal function, competent or incompetent. In principle, speech therapy to correct faulty articulation will be given only to those patients who are diagnosed as having adequate velopharyngeal function. Those with velopharyngeal incompetence will be surgically treated first, prior to any speech therapy.

Based on analysis of the inquiries sent to one thousand speech pathologists in the United States and Canada, Schneider and Shprintzen[1] showed that the two main modes of treatment employed for velopharyngeal incompetence were speech therapy (80%) and pharyngeal flap (70%). The former consisted in articulatory training in most cases. The total number exceeded 100%, because the respondents could provide multiple responses to a single question.

Van Demark and Morris[2] reported in their longitudinal study on the stability of velopharyngeal competency that subjects with marginal closure have a greater risk of needing further management (approximately one-third) than those with consistent velopharyngeal closure, but most achieve articulation scores highly comparable to the closure group and approximately two-thirds achieve ratings of velopharyngeal competency. But they did not mention whether they applied speech therapy for those patients with marginal closure or not.

Our clinical experiences indicate, however, that although speech therapy had no effect on velopharyngeal incompetence in most cases, it had worked well in several cases of slight incompetence.

It appears that speech therapy has frequently been utilized for correcting the

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slight velopharyngeal incompetence. However, selection of either further surgery (mainly pharyngeal flap operation) or speech therapy is often difficult in our daily clinic. In order to make the speech therapy more effective, more information is needed on the degree of incompetence, cleft type, and methods of speech therapy to be utilized.

The nasopharyngoscopic and fluorovideoscopic examinations, which we have recently adopted for testing velopharyngeal function, have revealed variable patterns of velopharyngeal closure as influenced by articulatory movement. More specifically, it was found that instruction and training for normal articulation could elicit velopharyngeal closure in those with slight velopharyngeal incompetence. Based on the finding, we have attempted speech therapy, for slight velopharyngeal incompetence for about 6 months before surgery. Some of the patients (about 35%) corrected their faulty articulations and slight velopharyngeal incompetence by speech therapy alone but some others (about 50%) needed further surgery.

In this paper, we describe indication and actual contents of our speech therapy, and the clinical features of two groups of slight velopharyngeal incompetence: speech therapy success and failure.

THERAPEUTIC GUIDELINE

In our clinical practice, speech pathologists and plastic surgeons make joint

Table 1. Diagnostic Means and Criteria for Velopharyngeal Function.

Diagnostic Means	Criteria		
	incompetence	slight incompetence	competence
1. listener's judgement	apparent	slight	none
2. aerodynamic measurement • pneumotachograph (velopharyngeal resistance: dyne sec/cm^5)	below 50	51–100	above 101
• rhinometric mirror (observation of stainless plate for nasal emission expressed in scale unit)	over scale 3	1–3	below 1
3. observation of velopharyngeal aperture • nasopharyngofiberscopy	no closure	imperfect closure	closure
• fluorovideoscopy	no closure	imperfect closure	closure
• inspection (per oral) distance between velum and posterior pharyngeal wall	long	fairly long	normal
velum movement	poor	slightly poor	normal
lateral wall movement	poor	slightly poor	normal

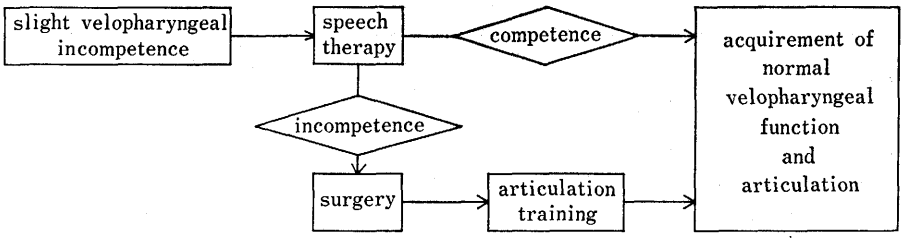

Fig. 1. Therapeutic guideline of slight velopharyngeal incompetence.

judgement about the velopharyngeal function on the basis of the findings of listener's judgement, pneumotachography, observation of rhinometric mirror for nasal emission, nasopharyngofiberscopy, and fluorovideoscopy. We have divided the extent of velopharyngeal function into three groups; incompetence, slight incompetence and competence.

The diagnostic criteria for slight velopharyngeal incompetence is as follows; slight hypernasality on listener's judgement, velopharyngeal resistance 51–100 dyne sec/cm^5 by pneumotachography, 1 to 3 graduations in rhinometric mirror, and a small gap in the velopharyngeal port as observed by nasopharyngofiberscopy and fluorovideoscopy (Table. 1).

Those who are judged as having slight velopharyngeal incompetence are first placed under speech therapy for about six months and may be later discussed for further surgical treatment (Fig. 1).

Our speech therapy procedure for slight velopharyngeal incompetence includes ① encouragement of the physical and mental development, ② articulation training. The infants are occasionally expected to improve their velopharyngeal incompetence along with the physical and mental development. Particularly, the patients below 4 years old are encouraged in their physical and mental development. We emphasize the promotion of their motor and social abilities through out-door play and exercise.

In addition to these trainings, those of over 4 years of age are advised to learn the knack of how to hold and use the air in the oral cavity for articulation (intra-oral pressure management). Those with articulatory disorders are given a course of articulation training for [p] consonant, followed by [k], [t], [ɕ]. It is our current therapeutic policy that training of only 4 consonants [p], [k], [t], and [ɕ] is sufficient for the patients below 6 years, as the other consonants tend to improve spontaneously in Japanese. For the older patients, [s], [tɕ], and [ts] may also be added to the therapeutic program.

Folded pharyngeal flap operation has usually been performed on those patients who required further surgery to correct velopharyngeal incompetence.

Subjects

The subjects for this study are 55 patients who were diagnosed as slight velo-

Table 2. Subjects and findings before therapy.

	CP	SMCP	CVPI
Number of cases	19	21	15
previous palatoplasty	19	4	1
speech			
faulty articulation with hypernasality	15	12	11
almost normal articulation with hypernasality	4	9	4

pharyngeal incompetence at our clinic from 1976 May to 1982 April and were followed up for more than a year. They ranged in age from 2 to 30 years at first visit, and included cleft palate (CP) 19, submucous cleft palate (SMCP) 21, and congenital velopharyngeal incompetence (CVPI) 15. All CP patients had undergone primary palatal repair, while the patients with SMCP or CVPI had not been operated upon except for 5 subjects (4 SMCP and 1 CVPI) who had undergone the primary palatal repair.

On the first examination, 38 subjects exhibited faulty articulations, while 17 showed slight hypernasality and almost normal articulation. SMCP subjects exhibited hypernasality without articulatory disorders more frequently than the other two groups (Table. 2).

RESULTS

1. RESULTS OF SPEECH THERAPY

As shown in Table 3, 27 out of the 55 subjects underwent surgery (mostly pharyngeal flap operation), after the speech therapy for over 6 months at our clinic had been found unsuccessful. These 27 patients consist of 10 out of 19 CP patients (53%), 9 out of 21 SMCP (43%) and 8 out of 15 CVPI (53%). Five patients, 4 SMCP and 1 CVPI, who had undergone the primary palatal repair had to undergo secondary surgery (4 pharyngeal flap, 1 re-push back).

On the other hand, 14 out of the 55 subjects improved velopharyngeal closure

Table 3. Results of speech therapy.

	CP	SMCP	CVPI	Total
further surgery required	10(53%)	9(43%)	8(53%)	27(49%)
success by speech therapy alone	3(16%)	6(28%)	5(33%)	14(25%)
under speech therapy or observation	6(31%)	6(29%)	2(14%)	14(25%)
faulty articulation only	1	3	1	5
others	5	3	1	9
Total	19(100%)	21(100%)	15(100%)	55(100%)

from slight incompetence to competence and corrected their faulty articulations through speech therapy alone which consisted of the encouragement of mental and physical development and articulation training. These 14 patients who showed improvement or correction include 3 out of 19 CP patients (16%), 6 out of 21 SMCP (28%) and 5 out of 15 CVPI (33%). In these 14 patients, all of the CP had undergone the primary palatal repair while the patients with other diseases had no previous surgery (Table. 3).

In addition to these 14 patients who finished speech therapy attaining a normal speech, 5 patients including 1 CP, 3 SMCP, and 1 CVPI, have already acquired a normal velopharyngeal function but are still under speech therapy for a couple of slight faulty or immature articulations. They are expected to finish the therapy in a short term.

Taken these 5 together, it can be said that speech therapy without surgery has been successful for slight velopharyngeal incompetence with faulty articulation in 19 out of 55 cases. They were 4 of 19 (21%) repaired cleft palate, 9 of 21 SMCP (43%) and 6 of 15 CVPI (40%). It is clinically interesting to note that the success rate of speech therapy for this type of speech problem was higher in SMCP and CVPI than in repaired cleft palate.

2. Pneumotachographic Study of Velopharyngeal Resistance

According to our longitudinal pneumotachographic study of velopharyngeal resistance in 26 subjects, those who were regarded as velopharyngeal competent after speech therapy alone demonstrated also increased velopharyngeal resistance over 400 dyne sec/ cm^5 within 1 year (Fig. 2–1).

Most subjects who later required surgery could not attain such high resistance but usually below 200 dyne sec/cm^5 (Fig. 2–2). Among the 26 subjects, 2 had been followed up over 3 years. One of CVPI improved faulty articulation through articulation training and was followed up for 3 years and 7 months. The velopharyngeal resistance increased up to 330 dyne sec/cm^5, although slight hypernasality and nasal snort, and low intelligibility of speech still remained. Finally the patient had pharyngeal flap operation, with an improved intelligibility in conversational speech. The other patients (CP) with slight velopharyngeal incompetence illustrates instability of articulation and velopharyngeal function in the course of speech therapy or followed–up period. He had once aquired almost normal speech through articulation training, but after 4 years of absence from our clinic, he again exhibited pharyngeal stop in place of [k] and [kj] consonants and velopharygeal incompetence. Articulation training was resumed for him. A few months later, he attained a normal articulation, but his speech remained still hypernasal and low intelligibility as observed on conversational level. Finally we decided to apply the secondary surgery to him.

Generally, the patients under speech therapy or followed–up tend to show great variation in velopharyngeal resistance at each time of examination. It is our current

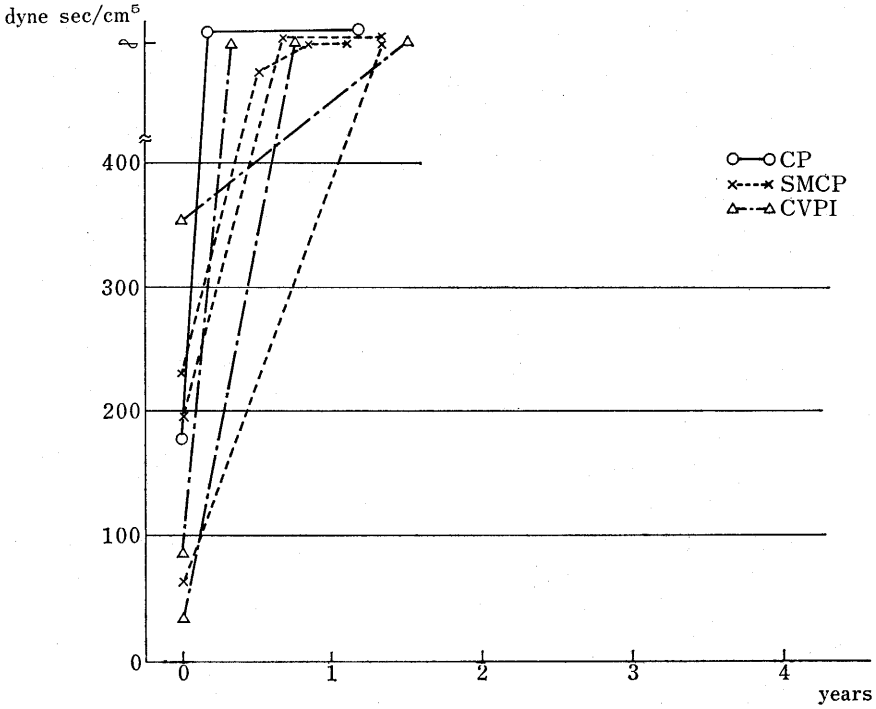

Fig. 2-1. Longitudinal changes of velopharyngeal resistance by pneumotachography "speech therapy success" group (N=7).

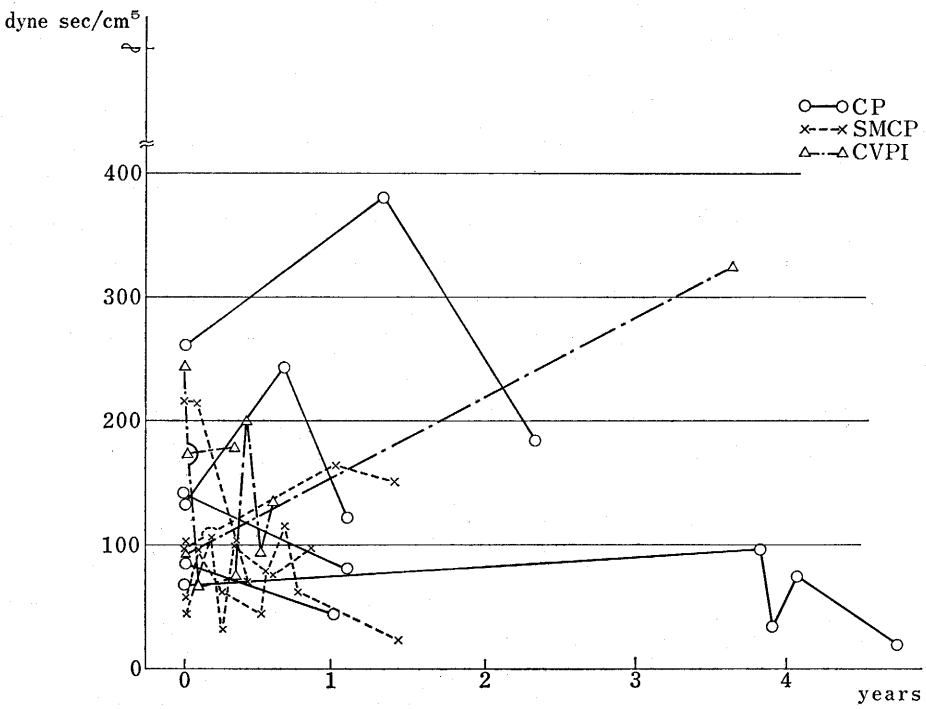

Fig. 2-2. Longitudinal changes of velopharyngeal resistance by pneumotachography "further surgery required" group (N=13).

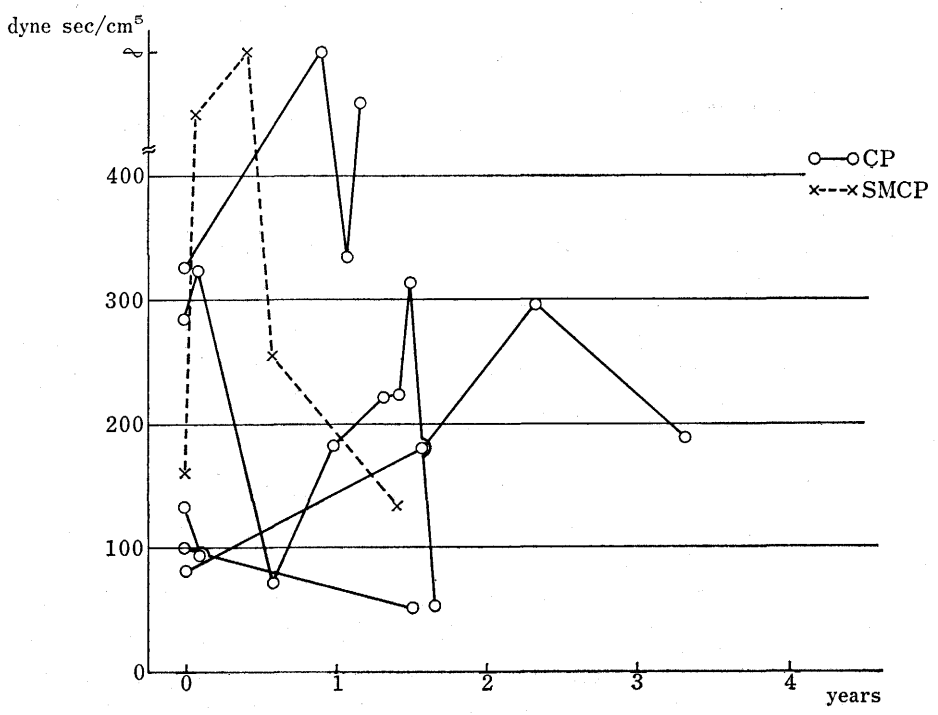

Fig. 2-3. Longitudinal changes of velopharyngeal resistance by pneumotachography "under speech therapy or observation" group (N=6).

presumption that most of the subjects whose resistances are below 200 dyne sec/cm^5 will require surgery, because despite of the speech therapy over 1 year, they still have hypernasality, nasal snort, and a small gap of pharyngeal port as observed by a fiberscope (Fig. 2-3).

3. The Age of the First Visit and the Results

According to the age of the first visit, the patients were divided into 2 groups; child group of 50 patients, ranged in the age from 2 to 11 years, and adult group of 5 patients over 20 years of age.

The child group was divided further into 2 subgroups; group A (under 5 years) and group B (over 5 years). Those who underwent the operation after the first visit were 13 out of 36 (36%) in group A, and 11 out of 14 (79%) in group B. Ten out of 36 children in group A improved their slight velopharyngeal incompetence or faulty articulation through speech therapy alone, that is 28%, while only 2 out of 14 (14%) in group B. This implies that the younger children have better chance for speech therapy alone to improve their velopharyngeal function or faulty articulations than the older children. In other words, the older children are more likely to require operation than younger children (Fig. 3).

As for the 5 adult patients, 3 required surgery while 2 improved the speech,

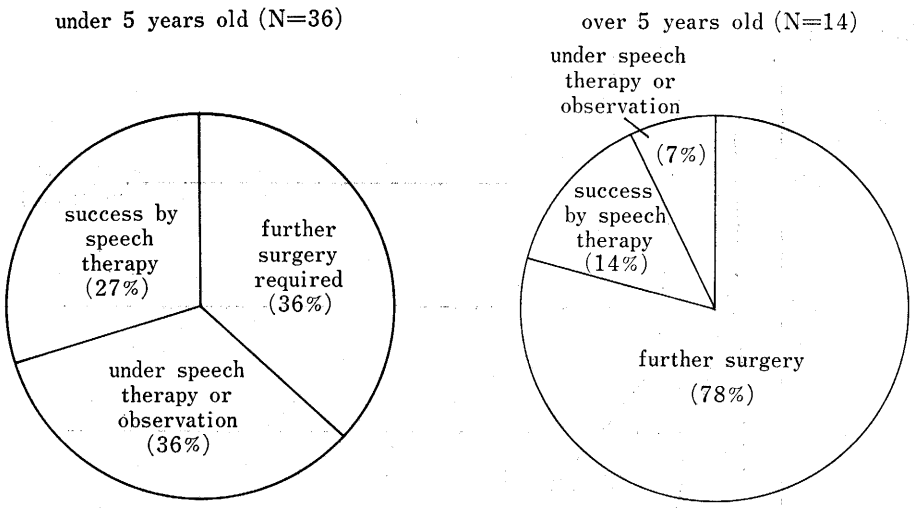

Fig. 3. The age of first medical examination and the results in the child group.

both in velopharyngeal function and articulation, by articulation training alone. The latter 2 successful cases were of very slight velopharyngeal incompetence but possessed typical cleft palate speech such as glottal stop or pharyngeal stop. One showed apparent incompetence for the fricative but only slight one for the plosive. The other had a faulty manner of accumulating the air in the oral cavity, which however has shortly been corrected by instructing the articulation of [p]. Improvement of articulation occurred rather shortly within 6 months of training in both the cases.

Two cases of special clinical interest further follow.

Case 1: male, congenital velopharyngeal incompetence, 3 : 11 years at the first visit. He illustrates the improvement in velopharyngeal function and faulty articulation through the assistance of the mental and physical development.

He exhibited remarkable hypernasality on his speech. Nasal emission was noted on blowing, over 3 points on rhinometric mirror. The vowels [i], [ɯ] were nasal. All consonants except for [m], [n] were omitted. Mild mental retardation was evident. He was encouraged to promote his motor and social abilities at day care center where one of the authors was working as previously described.

At the age of 4 : 7 years, that is 8 months after the first visit, hypernasality decreased a little. The velopharyngeal port was almost closed on fiberscopy for [p], [k], [t], but not for [ɾ].

At the age of 4 : 11 years, slight hypernasality remained on his speech. The nasal flow was scarce on pneumotachography for the production of [p]. The velopharyngeal closure was almost complete even for [ɾ] on fiberscopy. Therefore, he required no more special guidance and is now under periodical observation (Fig. 4).

Case 2: male, cleft lip and palate, 21 years old at the first visit. He illu-

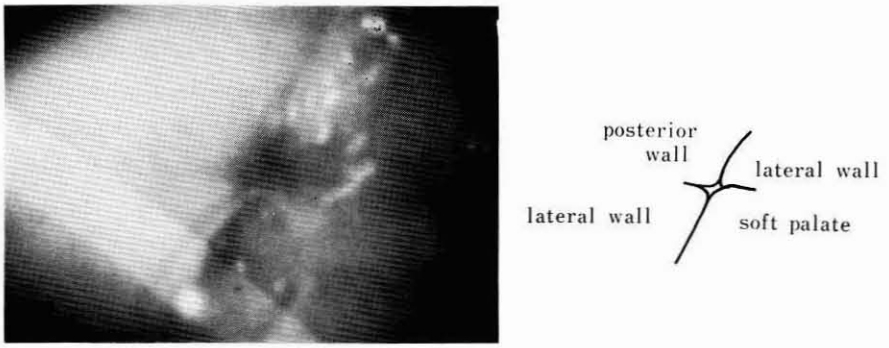

Fig. 4. Fiberscopic view for the production of [ɛ] at the age of 4 years and 11 months (Case 1).

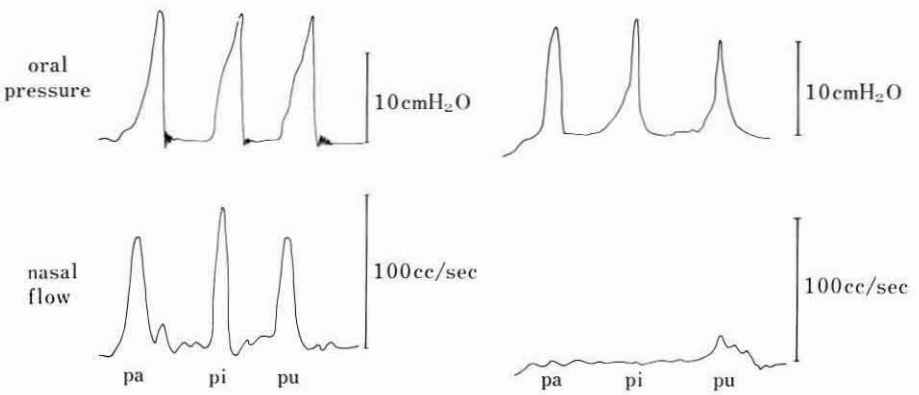

Fig. 5. Pneumotachogram in case No. 2.

strates improvement in velopharyngeal function and articulation through articulation training. He had had primary palate repair at the age of 7, but received no speech therapy. Since then slight hypernasality had been noted and consonants [k], [kj] were substituted by pharyngeal stop, and consonants [s], [ɛ], [ts], [tɛ] by pharyngeal fricative. The velopharyngeal resistance on pneumotachography was 188 dyne sec/cm⁵ (Fig. 5). Slight velopharyngeal incompetence was confirmed on fiberscopy and fluorovideoscopy for plosive consonants [p], [k], [t] but the incompetence was distinct for fricative consonants [s], [ɛ].

Articulation therapy was given for [p], [k], [ɛ], [s]. After 5 months, we observed that velopharyngeal closure was noted on fiberscopy for [p], [k], [t], [ɛ], [s] and no nasal emission was demonstrated on pneumotachography (Fig. 5). Finally he aquired normal speech.

Discussion

Ruscelle[3] divided palatal training procedure into 3 categories: indirect, semi-

direct, and direct. The indirect procedures are exemplified by articulation training or the use of Tonar that can help detect nasality, while the semi-direct one implies blowing, sucking and swallowing exercises. The direct one are such methods as electrical stimulation. He mentioned "present clinical treatments directed to the palatal mechanism don't have empirical support and consequently can not be successful on a routine basis."

Shelton et al[4] investigated the influence of articulation therapy on the patterns of palato-pharyngeal closure, comparing 6 experimental subjects with control subjects. His study showed that the treatment did not result in reduction of palatopharyngeal gap.

It was found in our study that some patients were improved in both articulation and velopharyngeal function through speech therapy alone. Our speech therapy included, however, the encouragement of the physical and mental development and articulation training.

The success rates of speech therapy for slight velopharyngeal incompetence were 28% for SMCP, 33% for CVPI and 16% for repaired CP group. The ratio of the patients judged as slight velopharyngeal incompetence to all of the cleft palate patients, including SMCP and CVPI, who visited our speech clinic in 1982, is approximately 50% for SMCP and CVPI group, and 35% for repaired CP group. With these data taken into account together, it can be said that slight velopharyngeal incompetence in cleft palate are less likely to be improved by speech therapy alone than that in the other diseases.

Those patients who were below 4 years old or accompanied by physical and mental retardation even over 4 years old, were stimulated for physical and mental development prior to articulation training.

We have noticed that the children with SMCP and CVPI are frequently accompanied by motor and mild mental retardation, poor chewing function, and immature articulation. By the above mentioned stimulation these patients obtained unexpectedly excellent results, bringing about substantial improvement both in velopharyngeal function and articulation without articulation therapy.

The interaction between physical and mental development and the velopharyngeal function as we noted in these children would be a subject of great clinical interest, which awaits further research.

Some other findings which would predict good results after articulation therapy are ① velopharyngeal resistance exceeding 400 dyne sec/cm^5, ② the plosive [p] consonant correctable within 2 months, ③ velopharyngeal closure possible on producing the plosive or fricative consonants in whisper as observed on fiberscopy and ④ velopharyngeal incompetence occuring only on the faulty articulation of fricative consonants while velopharyngeal slight incompetence on the plosive consonants.

The subjects who underwent additional surgery were more frequent in CP group than in SMCP or CVPI group. We have noted that indication for the additional

surgery are ① over age 5 years, and ② no improvement of slight velopharyngeal incompetence and faulty articulation after articulation therapy for over one year.

Three patients increased their velopharyngeal resistance up to about 200 dyne sec/cm^5 after speech therapy, but underwent additional surgery, because they exhibited weak consonant, nasal snort and low intelligibility of their speech. These findings imply that the patient who could not exceed 200 dyne sec/cm^5 inspite of articulation training over one year, would require additional surgery later, even though the resistance was as high as 300 dyne sec/cm^5 on pneumotachography.

The fact that all the 5 patients with repaired SMCP or CVPI required secondary surgery, together with high incidence of secondary surgery in repaired CP, may indicate the importance of primary surgery in terms of scar formation and possible damage to the levator muscle. Anyway, the velopharyngeal incompetence after the primary repair is obviously resistant to speech therapy to correct the velopharyngeal incompetence. After all, more objective, accurate and detailed evaluation of velopharyngeal function, using nasoendoscopic and fluorovideoscopic techniques for instance, would be demanded in order to make right therapeutic judgement, speech therapy or surgery.

Conclusion

1. Speech therapy should be tried first prior to surgery for slight velopharyngeal incompetence, whatever the etiology may be. It is effective in some cases.
2. The speech therapy as we employ includes the encouragement of physical and mental development of the child patient and articulation training.
3. The success rate of speech therapy for velopharyngeal incompetence and faulty articulation was higher in SMCP and CVPI group than in repaired CP group.

Summary

Fifty-five patients who had been diagnosed as slight velopharyngeal incompetence due to either repaired cleft palate CP (19 cases), submucous cleft palate SMCP (21) or congenital velopharyngeal incompetence CVPI (15) at our clinic from May 1976 to April 1982 were studied regarding the effect of speech therapy.

They were all first placed under trial speech therapy which consisted of ① encouragement of the physical and mental development, ② articulation training without blowing exercise. Twenty-seven out of the 55 subjects underwent further surgery (mostly pharyngeal flap operation) after speech therapy for over 6 months at our clinic. On the other hand, 14 out of the 55 subjects improved velopharyngeal closure from slight incompetence to competence and corrected their faulty articulations through speech therapy alone. The success rate of speech therapy was higher in SMCP and CVPI than in repaired cleft palate.

We emphasize that those who are judged as having slight velopharyngeal incompetence should first be placed under speech therapy for at least 6 months.

The indication for further surgery are ① over age 5 years, and ② no improvement obtained in slight velopharyngeal incompetence and faulty articulation even by speech therapy for over one year.

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