J. max.-fac. Surg. 12 (1984) 239–246

The Influence of the Age at which the Palate is Closed on Speech in the Adult Cleft Patient

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Accepted for publication 29. 12. 1983

Summary

A follow-up study was done on adult cleft patients with a total unilateral cleft with regard to the influence of the time of closure of the palate on speech. It was established that postponement of surgery of the palate from 3 to 6 years did not influence the ultimate result in respect of speech. One of the interesting findings was that in those patients who were operated on at the age of 3 there were more compensations than in those patients who were operated on at the age of 6.
Pharyngoplasty did produce a satisfactory obturation between nasopharynx and the oral cavity in both age groups, but the ultimate quality of speech was clearly inferior to those patients who were not subjected to pharyngoplasty.

Key-Words

Palatoplasty age – Speech development

Introduction

The age at which the palate should be closed in the cleft patient has already been the subject of a great deal of dispute in the past. The cleft patient confronts us with multiple problems that are so complicated that they have to be approached from several directions. There are three objectives to be attained:

1. Development and growth of the maxillo-facial skeleton should be as normal as possible;
2. Speech should be as normal as possible;
3. Auditory and nasal function should not be impaired.

Knowledge of the fundamentals of growth of the skeleton and of the physiology of speech and hearing make it clear that for these objectives to be accomplished, two opposing conditions have to be met (*Stark,* 1968; *Jolleys*, 1972). On the one hand, it is important for the development and optimal growth of the maxillo-facial skeleton that closure of the palate should be postponed for as long as possible (*Bishara,* 1973; *Schweckendiek,* 1955, 1966, 1978). Non-operation results in almost normal maxillary growth (*Jesus,* 1959; *Imis,* 1962; *van Limborg,* 1966; *Ortiz-Monasterio* et al., 1967; *Pitangui* and *Franco*, 1967). On the other hand, it seems important for the normal development of speech, hearing and nasal function that the palate should be closed at the earliest possible time (*Wardill*, 1937; *Peet*, 1961; *Stark*, 1968; *Evans* and *Renfrew*, 1974). An "intermediate" stance is taken by *Koberg* and *Koblin* (1973) and several other authors. A compromise between the two extremes is to close the soft palate early, and to postpone the closure of the hard palate (*Schweckendiek*, 1951; *Slaughter* and *Pruzansky*, 1954; *Perko*, 1979). With regard to speech *Fara* and *Brousilova* (1969) and *Cosman* and *Falk* (1980) found this method unsatisfactory. In support of a preference for a particular timing for the operation, all kinds of accessory factors may be offered for consideration, such as the psychosocial development, the separation of mother and child during a critical phase of development etc. (*Schaffer* and *Callender*, 1959; *Evans* and *Renfrew*, 1974).
These factors are undoubtedly important, possibly more so than the development of speech, but they are outside the scope of this paper. The purpose of this investigation was to shed some more light on the influence of the age of palatal closure on the ultimate speech proficiency of our patients, considering the many uncertainties, which still exist (*Drexler*, 1968). To this end, two groups of patients with unilateral total cheilognathopalatoschisis were compaired. In one group of patients, the palate had been closed at the age of approximately 3 years (group A), in the other at the age of approximately 6 years (group B).

Surgery

All patients have been operated on by the same person, using the identical technique, the one proposed by *Ganzer* (1920) – *Veau* and *Ruppe* (1922). The procedure is described in another paper in this journal (*Blijdorp* and *Egyedi* – 1984). The hard and soft palate are closed in one stage. In a few patients, a velopharyngoplasty was performed according to the method of *Sanvenero-Rosselli* (1955) as modified by *Tjebbes* (Fig. 1). At this operation, the distal part of the soft palate is opened in the midline. The posterior pharyngeal arches are opened in a longitudinal direction and a cranially pedicled triangular flap, dissected from the posterior pharyngeal wall, is sutured into the defect.
The oral mucosa is lengthened by means of a 'Z'-plasty to cover as much as possible of the wound surface of the transferred flap. The sizes of the remaining openings on either side of the flap are checked by means of a catheter through the nose. Finally, the posterior pharyngeal wall is sutured.

Material

For this study, from over 2500 operated cleft patients, we selected 105 adult patients with unilateral total cheilognathopalatoschisis. In 51 patients the palate had been closed at the age of 2½ – 3½ years (group A) and in 54 patients at the age of 5½ – 6½ years (group B); (Table 1). Patients in whom the timing of closure of the palate had been influenced by recurrent otitis or by speech problems were excluded from the investigation.

Table 1

Group A Number	Mean age at closure	2½–3½ year olds Range	Mean age at follow-up	Range
51	2 years + 11 months	2 years + 6 months 3 years + 6 months	24 years + 9 months	13 –29 years*
Group B Number	**Mean age at closure**	**5½–6½ year olds Range**	**Mean age at follow-up**	**Range**
54	5 years + 11 months	5 years + 6 months 6 years + 6 months	24 years + 4 months	19–29 years

* Only one patient was as young as 13 years, he was more or less fully developed; the next patient in the series was aged 19.

The fact that some of the patients were operated on at approximately 3 years of age and others at the age of approximately 6 years is exclusively the consequence of the number of cleft patients presenting during the periods in question; in all other respects, selection was completely random.

In all patients, the lip was closed at the age of 3 months. A velopharyngoplasty was carried out in 8 patients of group A and in 10 patients of group B. The velopharyngoplasty was carried out only in cases with considerable hypernasality after closure of the palate. Patients who had undergone a velopharyngoplasty have intentionally not been excluded from this study in order also to be able to compare these groups, the more so since the proportions of the two groups were practically identical.

Methods

1. Clinical evaluation of the appearance of the palate and the pharynx.
a. length of the soft palate;
b. mobility of the soft palate;
c. velopharyngoplasty;
d. tonsils.
2. Velum function test (Fig. 2).
a. Mirror examination
In this examination, the patient is asked to make sustained sounds: "aa" (as in are). "oo" (as in who), "ee" (as in see), and "ss". Any nasal escape is detected by means of the mirror held under the nose.
b. Auscultation
While the patient says certain standard phrases, attention is paid to air escaping through the nose, and to nasal sounds.

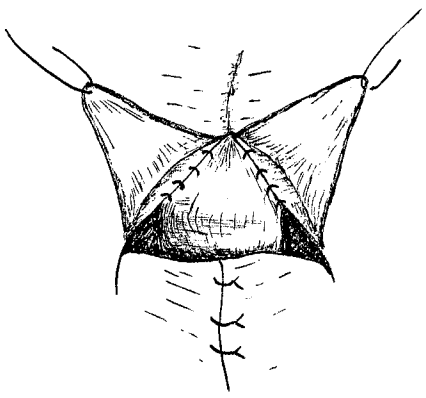

Fig. 1 a After division of the soft palate in the midline and separation of the oral and nasal layers the flap is sutured to the nasal layer and the donor site closed.

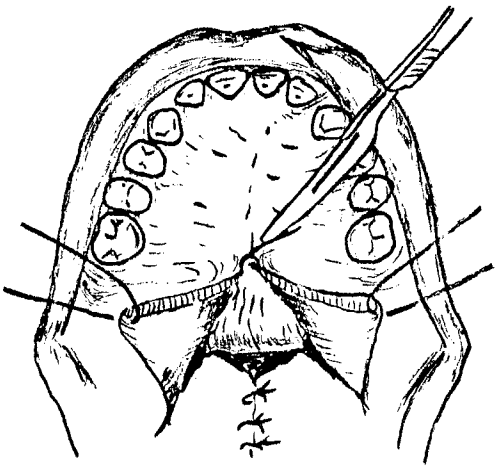

Fig. 1 b Side-cut on left hand side to obtain a Z-configuration of the oral covering of the flap.

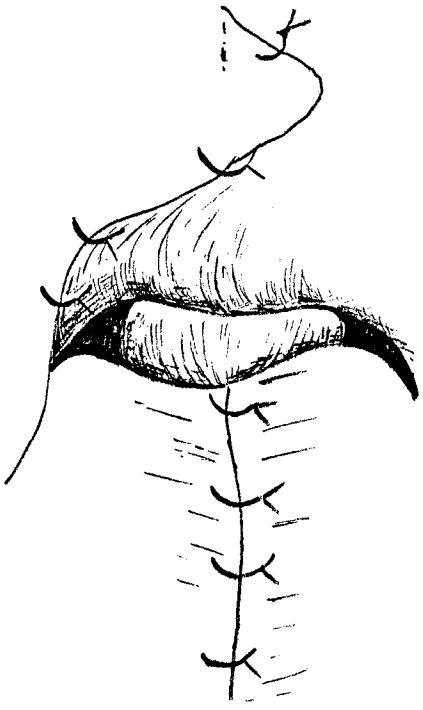

Fig. 1 c Situation after suturing the oral layer.

Fig. 1 Pharyngoplasty with cranial pedicle according to Sanvenero-Rosselli with Z-modification of oral layer according to Tjebbes.

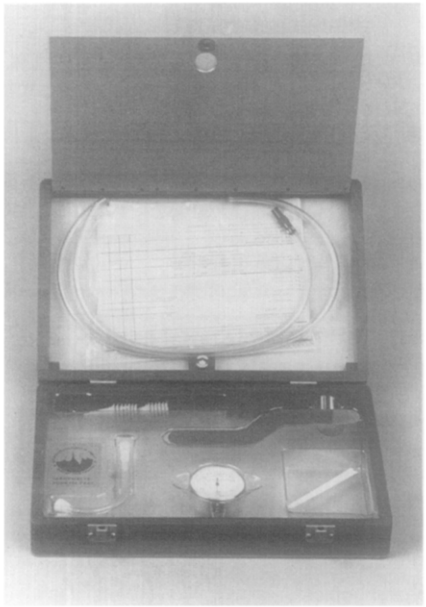

Fig. 2 Velum function test set used in the investigation. The mirror for detection of escaping air, the rubber hose for diagnosis of snoring sounds and the manometer can be seen, as are the mouth pieces.

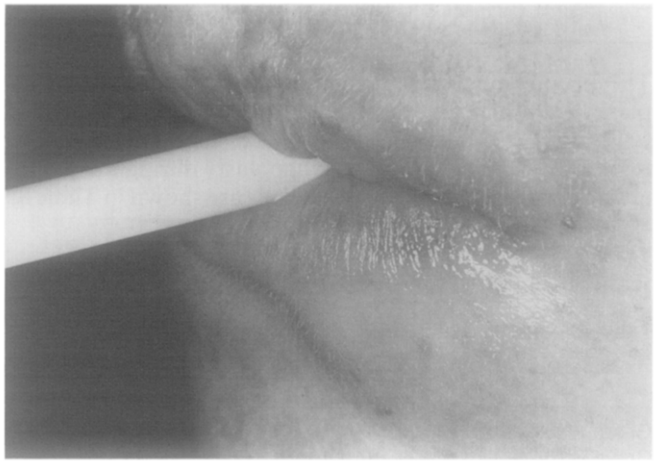

Fig. 3 Patient blowing into mouth piece connected to manometer to measure pressure build-up inside the oral cavity.

c. Blowing test
The pressure in the oral cavity during maximal blowing effort is measured by means of a manometer (Fig. 3).
3. Clinical evaluation of speech.
Speech was evaluated by the examiner (P.B.), who paid attention to:
hypernasality;
hyponasality;
glottal stops;
sigmatism;
grimaces.
If none of these abnormalities was found, speech was classified as good. In the presence of one abnormality, it was classified as reasonable. In the presence of two or three abnormalities, speech was classified as passable, while it was classified as bad whenever all were present and if speech was difficult to understand.
Glottal stops are compensatory mechanisms to pronounce explosives such as b, d, g, k, p and t when the function of the soft palate is inadequate. Grimaces are movements of the alae and other mimic muscles in an attempt to reduce the hypernasality by occluding the nares.
4. Radiological evaluation of the function of the soft palate.
This investigation was done in order to gain an impression of:
a. the anatomical condition of the soft palate
b. the function of the soft palate
A pharyngogram, i.e. a profile X-ray of the skull after introduction of contrast medium into the nose and mouth was made of every patient. These X-rays were made at rest, during articulation and during blowing as advised by *Lubker* and *Maris* (1968).
In this manner, the lifting capacity and the valve function of the soft palate can be visualized, and an impression is gained of the thickness and length of the soft palate (*Skolnick*, 1975).
Contact with the posterior pharyngeal wall was classified as ample if it extended over 2 to 3 mm.
It was classified as minimal when there was contact at one point only. The classification "gap" was used wherever the distance of the posterior border of the palate to the pharyngeal wall was up to 2 mm. A "large gap" exceeded 2 mm.
If the lifting function of the soft palate is adequate, the so-called boot phenomenon occurs, as shown in Fig. 4 a, b, c, Fig. 5 a, b, c, and Fig. 6 a, b, c.
Attention was also given to the occurrence of pharyngeal contraction (Passavant's ridge) which becomes visible especially during the phonation of 'ss' and is due to contraction of the superior pharyngeal musculature.

Results

The appearance of the soft palate and the pharynx

Table 2 The length of the soft palate

	Total	Good	Passable	Poor
group A	51	9 (17.6 %)	37 (72.5 %)	5 (9.8 %)
group B	54	13 (24.1 %)	28 (51.9 %)	13 (24.1 %)

Table 2 shows that the soft palate in patients of group A is significantly longer than in patients of group B (Chi^2 = 9.76; $p = < 0.04$). The significance is even greater because of the inclusion of the patients with a pharyngoplasty.

Table 3 The mobility of the soft palate

	Total	Good	Passable	Poor
Group A	51	21 (41.2 %)	24 (47.1 %)	6 (11.8 %)
Group B	54	10 (18.5 %)	36 (66.7 %)	8 (14.8 %)

In Table 3, it can be seen that the soft palate was significantly more mobile in the patients of group A than in those of group B (Chi^2 = 6.51; $p < 0.04$);

Table 4 Velopharyngoplasty

	Total	velopharyngoplasty	no velopharyngoplasty
Group A	51	8 (15.7 %)	43 (84.3 %)
Group B	54	10 (18.5 %)	44 (81.5 %)

The proportions of patients subjected to velopharyngoplasty are practically the same in the two groups (Chi^2 = 0.01; p= 0.90); clearly, in most cases there have been no reasons to perform a velopharyngoplasty during the period after closure of the palate. The details are shown in Table 4.

Tonsils
A classification of tonsillar size is shown in Table 5.

Table 5 Tonsils

	Total	Large	Normal	Small (absent)
Group A	51	24 (47.1 %)	17 (33.3 %)	10 (19.6 %)
Group B	54	31 (57.4 %)	12 (22.2 %)	11 (20.4 %)

There is no difference statistically (Chi^2 = 1.72, p= 0.42).

Results of the velum function tests
Since the purpose of the velopharyngoplasty is to compensate for inadequate function of the soft palate, the results of the patients who had been subjected to velopharyngoplasty were evaluated separately. Mentioning Chi^2 seemed superfluous.

Mirror examination
Table 6 shows the results of the mirror examination for assessment of nasal escape in patients who had not undergone velopharyngoplasty.

Table 6 Nasal escape in patients without velopharyngoplasty

	Total	"ee"	"oo"	"ss"
Group A	43	32 (74.4 %)	33 (76.6 %)	21 (48.8 %)
Group B	44	34 (77.3 %)	33 (75.0 %)	26 (58.8 %)
	87	66 (75.8 %)	66 (75.8 %)	47 (54.0 %)

The results could hardly have been more similar.
Table 7 lists the results of the speculum examination in patients who had been subjected to velopharyngoplasty.

Table 7 Nasal escape in patients with velopharyngoplasty.

	Total	"ee"	"oo"	"ss"
Group A	8	7 (87.5 %)	7 (87.5 %)	5 (62.5 %)
Group B	10	7 (70.0 %)	6 (60.0 %)	2 (20.0 %)
	18	14 (77.8 %)	13 (72.2 %)	7 (38.9 %)

The results have little relevance with regard to the object of our investigation, but show that the other tables in which the actual palatal surgery is compared are not influenced by the pharyngoplasties in the two groups.

Auscultation

Table 8 Speech test (palatoplasty only)

	Total	"Pete has a stoop"	"These cases give me fits"
Group A	43	28 (65.1 %)	31 (72.1 %)
Group B	44	34 (77.3 %)	34 (77.3 %)
	87	62 (71.3 %)	65 (74,4 %)

Table 8 shows the results of the audible nasal escape during recital of two phrases without nasals by patients not subjected to velopharyngoplasty. The dutch phrases actually used were different, but had similar phoniatric characteristics.

Table 9 shows the results obtained in patients with a velopharyngoplasty (nasal escape).

Table 9 Speech test (pharyngoplasty)

	Total	"Pete has a stoop"	"These cases give me fits"
Group A	8	6 (75.0 %)	6 (75.0 %)
Group B	10	6 (60.6 %)	6 (60.0 %)
	18	12 (66.7 %)	12 (66.7 %)

It can be concluded from these findings that a large proportion of the patients of both groups has a less than optimal function of the soft palate, and that there is hardly any difference between the patients of group A and those of group B.
If we assume that all patients subjected to velopharyngoplasty had a marked nasal escape before that operation, and we thus add the most unfavourable results in Table 8, we find that during recital of the standard phrases, 39 (76.5 %) of the 51 patients of group A would have a nasal escape as against 44 (81.5 %) of those of group B. This implies a slight difference in favour of the former group. Tables 7 and 9 also show that a large proportion of the patients who had undergone velopharyngoplasty nevertheless still displayed nasal escape.
In this respect, however, the results of the patients of group B were better than those of group A.

Blowing test
The mean pressure measured in the oral cavity during maximal effort is listed in Table 10 in cm.Hg. for patients with and without velopharyngoplasty.

Table 10 Blowing test

	Without velopharyngoplasty	With velopharyngoplasty
Group A	18.60 cm.Hg.	21.85 cm.Hg.
Group B	17.00 cm.Hg.	22.50 cm.Hg.

Table 10 shows that of the patients not subjected to velopharyngoplasty, those of group A, on average, were able to build up a higher pressure than those of group B.

The patients who had undergone velopharyngoplasty were naturally able to build up a higher pressure.
There are slight differences, but adding the two groups together shows an almost identical result.

Results of the clinical evaluation of speech.

Table 11 Quality of speech: an over-all evaluation

Group A	Without velopharyngoplasty	With velopharyngoplasty	Total
Good	6 (14.0 %)	0	6 (11.8 %)
Reasonable	23 (53.5 %)	1 (12.5 %)	24 (47.0 %)
Passable	13 (30.2 %)	7 (87.5 %)	20 (39.2 %)
Poor	1 (2.3 %)	0	1 (2.0 %)
Group B	**Without velopharyngoplasty**	**With velopharyngoplasty**	**Total**
Good	2 (4.5 %)	4 (40 %)	6 (11.1 %)
Reasonable	26 (59.1 %)	3 (30 %)	29 (53.7 %)
Passable	14 (31.8 %)	3 (30 %)	17 (31.5 %)
Poor	2 (4.5 %)	0	2 (3.7 %)

Table 11 shows that there is no appreciable difference in the quality of speech between patients of groups A and B ($Chi^2 = 0.96$; $p = 0.81$).
When we consider the results in the patients who had not undergone velopharyngoplasty, we find that they are slightly better in group A. The difference is not statistically significant, however. In both groups we find that the speech of the patients who have been subjected to velopharyngoplasty is significantly worse than of patients not subjected to this operation (group A: $Chi^2 = 9.35$; $p=<0.02$ and group B: $Chi^2 = 10.96$; $p=<0.01$).
Table 12 lists separately the various items considered in the evaluation of speech.

Table 12 Separate speech factors (palatoplasty only)

	Group A	Group B
Hypernasality	38 (74.5 %)	38 (70.4 %)
Glottal stops	12 (23.5 %)	4 (7.4 %)
Grimacing	8 (15.7 %)	8 (14.8 %)

Table 12 shows that there is no difference in regard to hypernasality, but that glottal stops occurred significantly more often in patients of group A than in patients of group B ($Chi^2 = 4.10$; $p = 0.04$).
The results obtained in the patients who had undergone velopharyngoplasty are shown in Table 13.

Table 13 Separate speech factors (pharyngoplasty)

	group A	group B
Hypernasality	7 (87.5 %)	5 (50 %)
Glottal stops	3 (37.5 %)	2 (20 %)
Grimacing	3 (37.5 %)	2 (20 %)

As Table 13 shows, there is a difference between the patients of group A and of group B in all three respects: – hypernasality, glottal stops and grimacing.
In the latter group, all these items occurred less often.

Results of radiological examination of the anatomical conditions

Table 14 shows the results of the radiological determination of the anatomical condition of the soft palate.

Table 14 Radiology of palate

Thickness	Group A	Group B
Normal	21 (50.0 %)	20 (46.5 %)
Moderate	17 (40.5 %)	18 (41.9 %)
Thin	4 (9.5 %)	5 (11.6 %)
Total	42	43

There is no difference statistically ($Chi^2 = 0.15$; $p > 0.90$)

Length	Group A	Group B
Normal	14 (33.3 %)	9 (20.9 %)
Short	24 (57.1 %)	31 (72.1 %)
Very short	4 (9.5 %)	3 (7.0 %)
Total	42	43

There is no difference statistically ($Chi^2 = 2.11$; $p > 0.30$). This table shows that the anatomical proportions of the soft palate were more favourable in patients of group A than in those of group B. These findings are in accordance with the clinical observations mentioned in Table 11. However, there is no difference statistically.

The function of the soft palate
Table 15 shows the lifting capacity of the soft palate, as expressed by the occurrence of the so-called boot phenomenon in patients not subjected to velopharyngoplasty while making the "ss" sound.

Table 15 Boot phenomenon

	Total	Occurrence of the boot phenomenon	No boot phenomenon
Group A	42	32 (76.2 %)	10 (23.8 %)
Group B	43	34 (79.1 %)	9 (20.9 %)
Total	85	66 (77.9 %)	19 (22.4 %)

Table 15 shows that the lifting function was good in the majority of cases and that there was no statistical difference between the two groups examined ($Chi^2 = 0.10$; $p = 0.25$).
The valvular function of the soft palate is shown in table 16 and 17 for patients not subjected to velopharyngoplasty while making two different sounds.

Table 16 Valvular closure during "oo"

	Group A	Group B
Ample	7 (16.7 %)	4 (9.3 %)
Minimal	16 (38.0 %)	18 (41.9 %)
Gap	18 (42.9 %)	18 (41.9 %)
Large gap	1 (2.4 %)	3 (5.8 %)
Total	42	43

Fig. 4 a Position at rest.

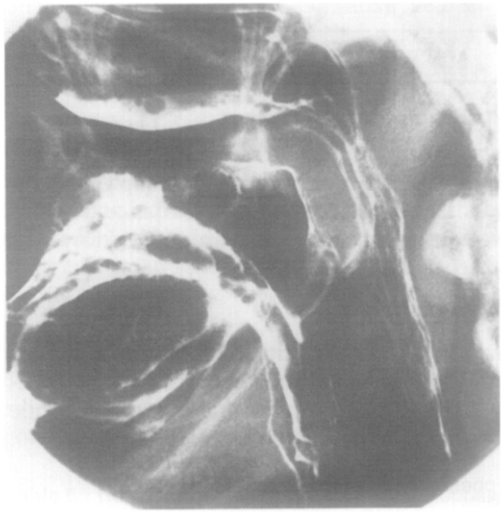

Fig. 4 b Boot phenomenon present on phonation of "ee".

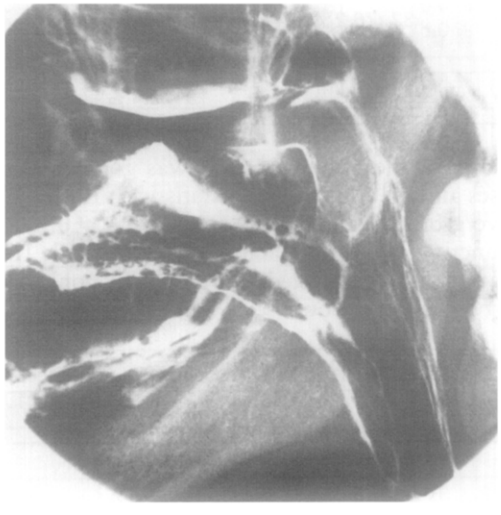

Fig. 4 c Boot phenomenon present on phonation of "sss".

Fig. 4 Pharyngograms of adequate soft palate. Normal thickness and length of the soft palate.

There is no difference statistically ($Chi^2 = 1.92$; $p = 0.59$).

Table 17 Valvular closure during "ss"

	Group A	Group B
Ample	11 (26.2 %)	8 (18.6 %)
Minimal	22 (52.4 %)	24 (55.8 %)
Gap	8 (19.0 %)	8 (18.6 %)
Large gap	1 (2.4 %)	3 (7.0 %)
Total	42	43

Table 17 shows that the valvular function was slightly better in the patients from group A: however, the difference is not statistically significant ($Chi^2 = 1.53$; $p = 0.67$).

Occurrence of a contraction ridge was observed in 30 patients of group A (71.4 %) and in 23 patients of group B (53.5 %) ($Chi^2 = 2.20$; $p = 0.14$). Of the patients who had undergone velopharyngoplasty, 2 of group A (25 %) and 5 of group B (50 %) showed a pedicle with good mobility.

Discussion

Generally speaking, speech in patients of group A does not differ from speech in group B. A curious finding was that in the patients of group A there were more glottal stops and muscular compensations of the M. constrictor pharyngis than in group B. This is a remarkable finding because the patients of group B had a rather prolonged period during speech development in which the palate was still open and therefore they had three more years during which speech was unintelligible than the patients of group A.

As to pharyngoplasty, this investigation was more successfull in the patients of group B, probably because of a more mobile obturation of the nasal cavity. A possible explanation of these rather unexpected results could be, that development of the palatal and pharyngeal musculature was impaired at a later stage than in the other group. Scar tissue, atrophy of muscle tissue following dissection and suturing at the age of 3 years may have produced a functional apparatus inferior to the one where these unfavourable factors became operative at a later stage. Of course this does not imply, that surgery at a much earlier age e.g. during the first year of life would not produce much better results (*Veau* [1931] and several other authors [viz introduction]). With the velar function tests, the patients who were subjected to a pharyngoplasty seem to do remarkably well compared with the other patients. As to the manometric investigation, this group of patients seems to be even better off. Speech, however, was significantly worse. There seems little doubt that this discrepancy is brought about by selection. Only those patients who could not speak properly were subjected to this type of surgery. Well defined criteria as put forward by *Cleveland* and *Falk* (1970) and several other authors were not applied. Therefore we may conclude that pharyngoplasty may improve velar function tests but the effect on speech is limited. Of course in this matter one should also take into account that in both groups of patients pharyngoplasty was carried out at a rather advanced age because of the late closure of the palate. As expected, the speech results in both of our groups A and B compare unfavourably with those obtained by authors who do a pharyngoplasty at the time of primary palate repair

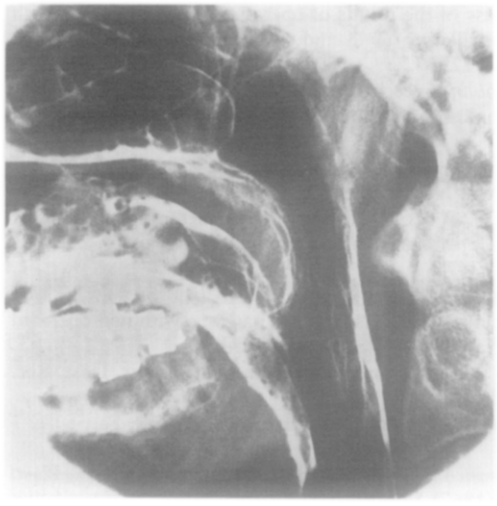

Fig. 5 a Palate at rest.

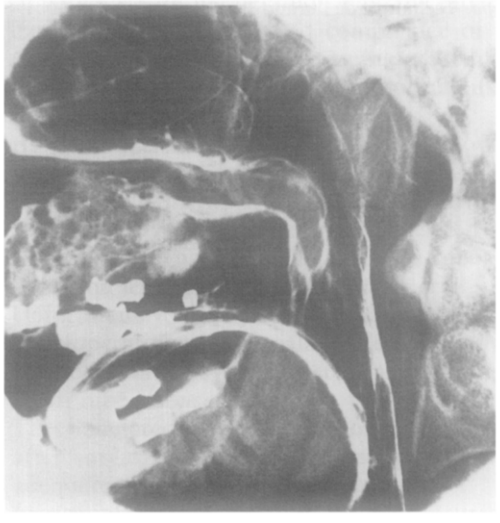

Fig. 5 b Palate on phonation of "eee".

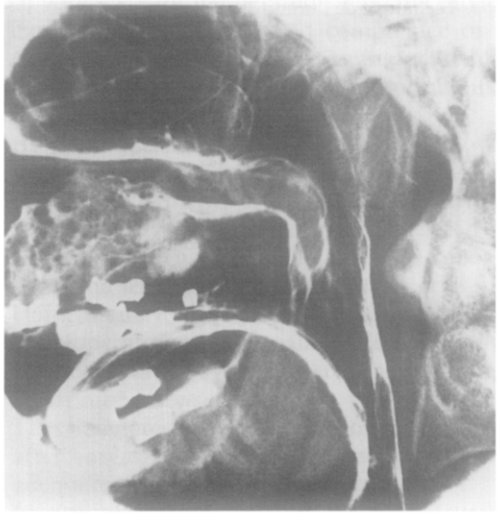

Fig. 5 c Palate on phonation of "sss".
Even with the boot phenomenon present a gap between the palate and the posterior pharyngeal wall can be seen.

Fig. 5 Pharyngograms of inadequate palatal closure.

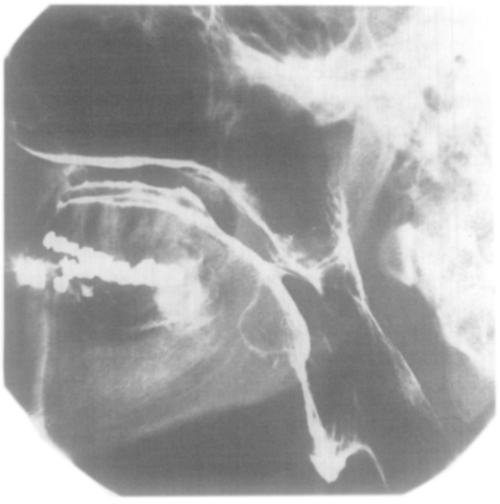

Fig. 6 a Situation at rest.

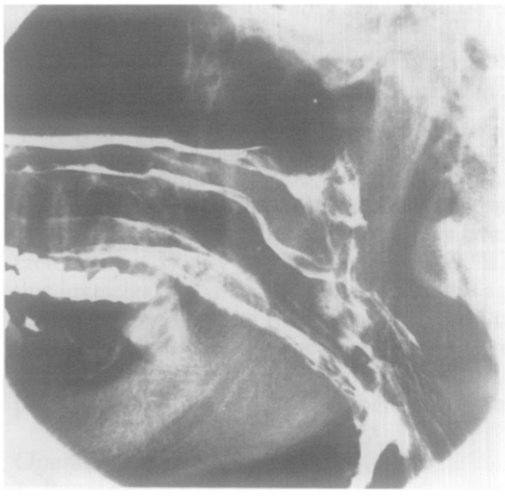

Fig. 6 b Situation on phonation of "ee"

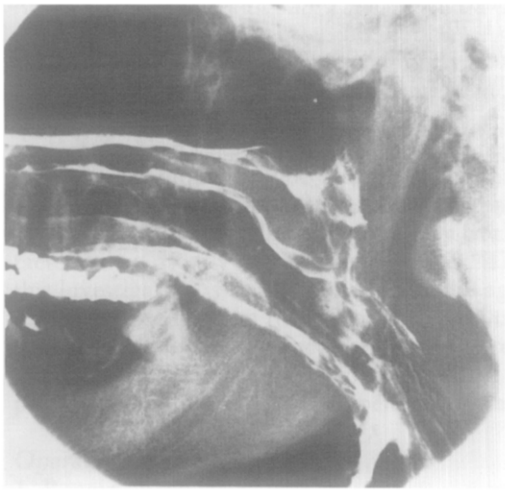

Fig. 6 c Situation on phonation of "sss", a Passavant's ridge can be seen.

Fig. 6 Pharyngograms in patient with pharyngoplasty. In this patient there is adequate mobility of the stalk.

(*Stark* and *de Haan*, 1960; *Fara* et al., 1970; *Bingham* et al., 1972). On the whole, the results of this investigation seem to indicate that poor speech habits at the age of 3 are difficult to correct. Whether with energetic speech therapy (and pharyngoplasty not postponed too long whenever indicated) the results would have been better, cannot be judged, because too little was known about the logopaedic treatment in both groups of patients.

Conclusion

In two otherwise comparable groups of patients it could not be established that the ultimate result in respect of speech is influenced by postponement of palatal closure from the age of 3 to the age of 6. In the two groups examined very little difference was found. Since speech in many patients was unsatisfactory it may be concluded that from this point of view closure or some reliable sort of obturation should be obtained at a much earlier age and orthopaedic considerations should be balanced against this goal.

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